The Palaeontology Newsletter

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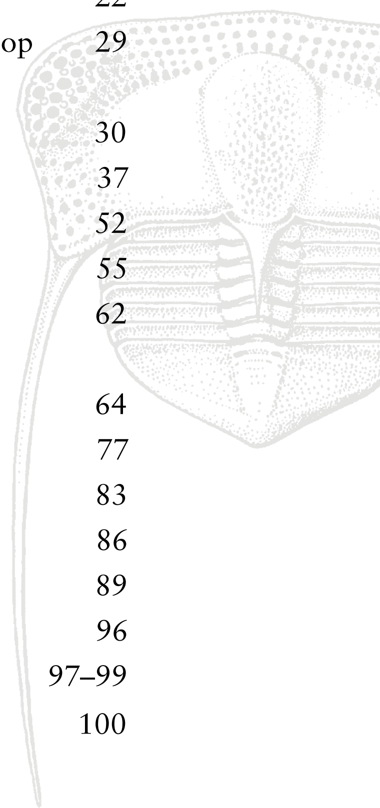
From our correspondents



Reminder: The deadline for copy for Issue no 84 is 4th November 2013.

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Editorial

The ubiquity of digital cameras, especially those incorporated into mobile phones and tablets, has provoked a number of debates. Musicians have complained that people are too busy filming them to fully appreciate live performances. Presenters at conferences worry that their slides, which often discuss pre-publication material, are being disseminated by electronic means as soon as their talk is over. An attitude of ‘pics or it didn’t happen’ is encroaching on life, whether personal or professional.

My own concern with the rise of digital imaging is that as the capability to capture and distribute digital images increases, the observational skills and training to produce drawings and images that communicate scientific information is devalued and diminished. The proverb ‘A picture is worth a thousand words’ should perhaps be modified to ‘A well-composed picture is worth a thousand well-structured words’. We have all seen examples of brilliant slides shown during a lecture that remain with us far longer than the speaker’s words, or figures from a paper that are used again and again in other works because of their clarity and ability to convey information. The key to these successful images is that the person producing them is applying their expert knowledge to draw our attention to the key points or features of a graph or specimen.

In the course of a lecture in 1857 John Ruskin contended that drawing ‘enabled [students] to say and to see what they could not otherwise say or see.’ Much effort is made to improve writing skills, with ever more courses offered by universities to teach scientific writing, but how many courses are available to learn about the drafting and preparation of figures and artwork? Scientific illustration courses seem to be largely confined to schools and colleges of art, which serves to perpetuate the sense that the skills to draw and illustrate are something that only ‘artistic’ people possess. Like any other skill, training and practice can improve our performance. During my stint as Editor on the *Newsletter*, we’ve been fortunate to be able to feature the work of a number of artists that show the range of techniques and uses of art in palaeontology, from reconstructions of extinct animals and their environments to casting dinosaurs as the stars of comics. What unifies the work of the illustrators we’ve featured is their desire to understand the material they are working with, both through their artwork and through their conversations with scientists. Both groups could benefit from more informal contact, and one promising development is the growing involvement of artists in scientific communication projects or as artists-in-residence.

Beyond the ability to produce pleasing images, as scientists we should also reflect on the other skills that the preparation of illustrations fosters: observation, critical comparison and attention to details on the subject of the drawing. This is the skill set of the comparative anatomist, which underpins much palaeontological research, and stresses the role of drawing in helping us to express information about the fossil material we study. Even if we don’t end up producing final products of the same standard as those of people trained as illustrators, by devoting some time to drawing specimens, this can lead to a more reflective study of specimens that can yield new observations and insights that might be missed by the dead eye of the camera lens.

Al McGowan
University of Glasgow
Newsletter Editor
<newsletter@palass.or g>

Association Business

Annual Meeting 2013

Notification is given of the 57th Annual General Meeting

This will be held at the University of Zurich, Switzerland, on 14th December 2013, following the scientific sessions.

AGENDA

1. Apologies for absence
2. Minutes of the 56th AGM, University College Dublin
3. Trustees Annual Report for 2012
4. Accounts and Balance Sheet for 2012
5. Proposed amendments to the Constitution
6. Proposed changes to subscriptions
7. Election of Council and vote of thanks to retiring members
8. Report on Council Awards
9. Annual address

DRAFT AGM MINUTES 2012

Minutes of the Annual General Meeting held on Sunday 18th December 2012 at University College Dublin.

1. **Apologies for absence:** Dr C. Jeffery-Abt, Prof. P.C.J. Donoghue, Dr R. Owens, Mr P. Winrow.
2. **Minutes:** proposed by Prof. M.P. Smith and seconded by Mr D. Ward, the minutes were agreed a correct record by unanimous vote of the meeting.
3. **Trustees Annual Report for 2011:** Proposed by Dr A. McGowan and seconded by Dr C. Klug, the report was agreed by unanimous vote of the meeting.
4. **Accounts and Balance Sheet for 2011:** Proposed by Dr H.A. Armstrong and seconded by Prof. J.W. Cope, the accounts were agreed by unanimous vote of the meeting.
5. **Election of Council and vote of thanks to retiring members**

Prof. J.E. Francis extended a vote of thanks to the following members of Council who were retiring from their positions this year: Prof. J.W. Cope Prof. M.P. Smith. The following members were elected to serve on Council. *President:* Prof. M.J. Benton; *Vice Presidents:* Dr H.A. Armstrong and Dr A.B. Smith; *Treasurer:* Mr P. Winrow; *Secretary:* Prof. R.J. Twitchett; *Chair of Publications Board:* Dr P. Orr; *Editor Trustees:* Prof. P.C.J. Donoghue, Dr H. Armstrong; *Newsletter Editor:* Dr A. McGowan; *Book Review Editor:* Dr C. Jeffrey-Abt; *Newsletter Reporter:* Dr L. Herringshaw; *Internet*

Officer: Dr M. Sutton; *Meetings Coordinator:* Dr T. Vandenbroucke; *Ordinary Members:* Dr C. Klug, Dr R. Owens, Dr P. Upchurch, Dr W. Renema and Mr D. Ward. Dr F. Gill and Dr C. Buttler were co-opted to assist with outreach, and Prof. M.A. Purnell was co-opted to assist with publicity. Dr Klug will organise the annual meeting in 2013 at the University of Zurich, Switzerland.

6. **Association Awards**

The following awards were made: Lapworth Medal to Prof. E.N.K. Clarkson (University of Edinburgh); President's Medal to Dr H. Dowsett (USGS); Hodson Award to Dr J. Vinther (University of Bristol); and the Mary Anning award to A. Rasmussen (Denmark). Under the Small Grants Scheme, the following awards were announced: Sylvester-Bradley Awards to S.M. Ferrari, P. Jardine, V. McCoy, R. Nawrot, M. Smith, and M.L. Raveloson; Callomon Award to Dr J. Hooker; and Whittington Award to J. Clarke. Research Grants were awarded to Dr E. Cadena (North Carolina State University), Dr M.-E. Clémence (Plymouth University), and Prof. M.A. Purnell (University of Leicester). The President's Award was made to N. Longrich (Peabody Museum of Natural History, Yale) and the Council Poster Prize was presented to E. Locatelli (Yale University).

The Annual Address entitled "New views on the origin of our species" was given by Prof. C. Stringer (Natural History Museum, London).

Trustees Annual Report 2012

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 18th December 2011: *President:* Prof. J. E. Francis; *Vice Presidents:* Prof. J. C. W. Cope and Dr H. A. Armstrong; *Treasurer:* Mr P. Winrow; *Secretary:* Dr R. J. Twitchett; *Chair of Publications Board:* Dr P. Orr; *Editor Trustee:* Dr P. C. J. Donoghue; *Book Review Editor:* Dr C. Jeffrey-Abt; *Publicity Officer:* Dr E. Rayfield; *Newsletter Reporter:* Dr L. Herringshaw; *Newsletter Editor:* Dr A. McGowan; *Web Officer:* Dr M. Sutton; *Meetings Coordinator:* Dr T. Vandenbroucke; *Ordinary Members:* Dr C. Klug, Dr R. Owens, Dr W. Renema, Prof. M. P. Smith, Dr P. Upchurch, Mr D. Ward. *The Executive Officer:* Dr T. J. Palmer and *Editor-in-Chief:* Dr S. Stouge continued to serve Council but are not Trustees. Dr C. Buttler, Dr F. Gill and Prof. M. A. Purnell were co-opted onto Council but are not Trustees.

Membership. Membership on 31st December 2012 totalled 1,182 (1,167 at end 2011). Of these, 692 were Ordinary Members, 148 Retired Members, 18 Honorary Members, 268 Student Members and 56 Institutional Members. There were 80 institutional subscribers to *Special Papers in*

Palaeontology. Wiley-Blackwell also separately manage further Institutional subscribers and distribute publications to these Institutional Members on behalf of the Association.

Professional Services. The Association's Bankers are NatWest Bank, 42 High Street, Sheffield S1 1QF. 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, St Helen's, 1 Undershaft, London EC3A 8BB.

Reserves. The Association holds reserves of £709,878 in General Funds, which enable the Association to generate additional revenue through investments, and thus to keep subscriptions to individuals at a low level, whilst still permitting a full programme of meetings to be held, publications 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 £72,337 in Designated Funds which contribute interest towards the funding of the Sylvester-Bradley, Hodson Fund and Jones Fenleigh awards, and which will contribute interest towards the funding of the Callomon and Whittington awards. Funds carried forward to 2013 totalled £782,215.

Finance. Total charitable expenditure, through grants to support research, scientific meetings and workshops in 2012, was £248,423. Governance costs were £15,555. Total resources expended were £294,969. 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*.

Risk. The Association is in a sound financial position. Succession planning for executive officers remains a concern and will be considered as part of the Annual Review of Officers in 2013.

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.

Research Grants. Palaeontological Association Research Grants were awarded to Dr Edwin Cadena (North Carolina State University) "A new fossil turtle from the Early Cretaceous (Barremian–Aptian) of Colombia (South America); revealing the early stages of marine turtle evolution"; Dr Marie-Emilie Clémence (Plymouth University) "The impact of climate change on carbonate production, across the Triassic–Jurassic Boundary"; and Prof. Mark Purnell (University of Leicester) "Microstructures of body parts and homology in non-biomineralised vertebrates".

Grants–in-aid. The Association provided funds to support the following meetings: The evolution of biomineralization (GSA Annual Meeting session T137, Charlotte, NC, USA); Virtual Paleontology: computer-aided analysis of fossil form and function (GSA Annual Meeting session T144, Charlotte, NC, USA); International Palynological Congress (IPC) XIII and International Organization of Palaeobotany Conference (IOPC) IX (Tokyo, Japan); The Anthropocene: Confronting the Prospects of a +4°C World (AGU meeting session, San Francisco, CA, USA).

Small Grants Scheme. The scheme received seventeen applications. Eight were recommended for funding in 2013, totalling £9,973. Sylvester-Bradley Awards were made to Silvia Mariel Ferrari, Phillip Jardine, Victoria McCoy, Rafal Nawrot, Martin Smith and Miky Lova Raveloson. The Callomon Award was made to Jeremy Hooker, and the Whittington Award to John Clarke.

Online activities. The online activities of the Association continue to expand. A grant was provided to support the *Palaeocast* website initiative. The Association continues to host mirror sites for the PaleoDbase, *Palaeontologia Electronica*, the EDNA fossil insect database, the Palaeontographical Society website, and a database of fossils from Kent produced by the Kent RIGS Group.

Public meetings. Four public meetings were held in 2012, and the Association extends its thanks to the organisers and host institutions of these meetings.

56th Annual Meeting. This was held on 16–18 December at University College Dublin. Dr Orr with local support from colleagues and PhD students organised the meeting which included a symposium on “Taphonomy and the fidelity of the fossil record” and comprised a programme of internationally recognised speakers. There were 268 attendees. The Annual Address entitled “New views on the origin of our species” was given by Prof. Chris Stringer (Natural History Museum, London). The President’s Award for best oral presentation from a member under 35 was made to Nicholas Longrich (Peabody Museum of Natural History, Yale). The Council Poster Prize was presented to Emma Locatelli (Yale University). There was no post-conference field trip.

British Science Festival, Palaeontological Association Symposium. This is an annual forum for presentations to the public and general scientists. The Symposium “Our fossil-fuelled future” was organised by Dr L. Herringshaw (University of Durham) and funds were provided in support of four internationally renowned speakers.

Progressive Palaeontology. The annual open meeting for presentations by research students was organised by J. Ortega-Hernandez and a team of eight other colleagues, and was held at the University of Cambridge.

Lyell Meeting. The Lyell Meeting in 2012 was held in London on the topic of “Big Palaeontology”, organised by Dr T. Dunkley-Jones (Imperial College).

Publications. Publication of *Palaeontology* and *Special Papers in Palaeontology* is managed by Wiley Blackwell. Volume 55 of *Palaeontology*, comprising six issues, was published. *Special Papers in Palaeontology* 87, “Tabulate corals from the Givetian and Frasnian of the southern region of the Holy Cross Mountains (Poland),” by M. K. Zapalski; and *Special Papers in Palaeontology* 88, “Smithian (Early Triassic) ammonoids from the Salt Range, Pakistan,” by T. Brühwiler *et al*., and “Middle and late Smithian (Early Triassic) ammonoids from Spiti, India” by T. Brühwiler *et al*., were also published during the year. 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. For the first time, the Association had a stand at the Lyme Regis Fossil Festival, which was staffed by members of Council, the Executive Officer and volunteers.

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. E. N. K. Clarkson (University of Edinburgh). 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 H. Dowsett (USGS). 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 J. Vinther (University of Bristol). The Mary Anning award, for an outstanding contribution by an amateur palaeontologist, was made to Alice Rasmussen (Denmark). Council also awards an undergraduate prize to each university department in which palaeontology is taught beyond Level 1.

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. Francis (Chair) and Dr Twitchett represented the Association. During the year the Association responded to requests for information from HEFCE concerning the Research Excellence Framework.

Forthcoming plans. 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, 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. The Association will continue to recognise the contribution individuals have made to palaeontology and associated sciences through its awards. In 2013, a similar programme of public meetings and publications will be carried out. Funds will be made available to further develop the website aimed at encouraging outreach and to support other outreach initiatives. The Association plans to set up a new undergraduate research bursary scheme. The 57th Annual Meeting will be held at the University of Zurich. Progressive Palaeontology will be held at the University of Leeds. The Association will sponsor a symposium at the British Science Festival, “Bodies of evidence,” and provide travel grants for the Congress of the European Geosciences Union.

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369
STATEMENT OF FINANCIAL ACTIVITIES for the YEAR ENDED 31st DECEMBER 2012

		Note		General Funds	Designated Funds	TOTAL 2012	TOTAL 2011
Incoming Resources							
Generated Funds							
Voluntary income	Subscriptions		58,627			58,627	61,916
	Donations		175		2,566	2,741	1,250
				58,802	2,566	61,368	63,166
Charitable activities							
Sales	Palaeontology		206,951				
	Special Papers		9,573				
	Offprints		90				
	Newsletter		450				
	Field Guides		11,954				
	Distribution		1,032				
				230,050		230,050	228,715
Investment income				14,970	80	15,050	13,323
TOTAL INCOMING RESOURCES				303,822	2,646	306,468	305,204
Resources expended							
Costs of generating funds							
for voluntary income Admin.			27,805				23,640
Investment mgt.	Stockbroker fees		3,186				3,215
				30,991	0	30,991	26,855
Charitable activities							
Publications	Palaeontology		70,730				
	Special Papers		6,247				
	Offprints		1,022				
	Field Guides		16				
	Newsletters		16,046				
	Distribution		2,575				
	Marketing		2,379				
	Editorial costs		59,443				
Total Publications			158,458			158,458	184,026
Scientific Meetings & Costs			6,946			6,946	29,060
Grants and Awards			20,761		11,299	32,060	9,987
Research Grants			16,197			16,197	14,358
Administration of charitable activities			34,756			34,756	29,551
				237,118		248,417	266,982
Governance costs	Examiner's fee		450				
	Trustee expenses	4	8,154				
	Administration		6,951				
				15,555	0	15,555	16,481
TOTAL RESOURCES EXPENDED		2		283,664	11,299	294,963	310,318
NET INCOMING RESOURCES				20,158	-8,653	11,505	-5,114
INVESTMENT GAINS/LOSSES		1.5					
Realised gain			1,298				
Unrealised gain			26,327				
				27,625		27,625	-12,217
DEFICIT/(SURPLUS) FOR THE YEAR				47,783	-8,653	39,130	-17,331
FUNDS BROUGHT FORWARD				662,101	80,990	743,091	760,422
FUNDS CARRIED FORWARD				709,884	72,337	782,221	743,091

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369
BALANCE SHEET as at 31st DECEMBER 2012

	2011					2012
	£		Note			£
		INVESTMENTS				
	520,606	At market value	**1.6**			546,214
		CURRENT ASSETS				
199,212		Cash at Banks		166,901		
111,900		Sundry Debtors	**6**	119,767		
311,112		Total Current Assets			286,668	
		CURRENT LIABILITIES				
23,500		Subscriptions in Advance		19,681		
65,127		Sundry Creditors	**7**	30,980		
88,627		Total Current Liabilities			50,661	
	222,485	NET CURRENT ASSETS				236,007
	743,091	TOTAL ASSETS				782,221
		Represented by:				
	662,101	GENERAL FUNDS				709,884
		DESIGNATED FUNDS	**8**			
17,218		Sylvester Bradley Fund			11,230	
21,914		Jones-Fenleigh Fund			23,286	
11,828		Hodson Fund			10,386	
10,010		Callomon Fund			8,599	
20,020		Whittington Fund			18,836	
	80,990					72,337
	743,091					782,221

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369
DESIGNATED FUNDS for the YEAR ENDED 31st DECEMBER 2012. Note 8 to the Accounts

	Sylvester-Bradley	Jones-Fenleigh	Hodson	Callomon	Whittington	TOTAL 2012	TOTAL 2011
Donations	513	1,949	0	53	53	2,566	1,250
Interest Received	17	22	12	10	20	80	85
TOTAL INCOMING RESOURCES	530	1,970	12	62	72	2,646	1,335
Grants made	6,518	598	1,454	1,473	1,256	11,299	6,896
SURPLUS/(DEFICIT) FOR THE YEAR	-5,988	1,372	-1,442	-1,411	-1,184	-8,652	-5,561
FUNDS BROUGHT FORWARD	17,218	21,914	11,828	10,010	20,020	80,990	86,551
FUNDS CARRIED FORWARD	11,230	23,286	10,386	8,599	18,836	72,337	80,990

Note 9 to the Accounts

Nominal	Holding	Cost (bought pre 2012)	Value end 2011
£18,000	UK 4.75% Stock 07/03/20 GBP 100	£ 18,145.87	£ 22,469.00
£20,000	UK 4.5% Gilt 07/03/19 GBP 0.01	£ 20,092.99	£ 24,370.00
£64,176.46	COIF Charities Fixed Interest Fund	£ 85,000.00	£ 85,669.16
804	Royal Dutch Shell B shares	£ 12,432.00	£ 19,730.00
1,425	BP Ord 25c shares	£ 5,047.35	£ 6,562.00
600	BHP Billiton $0.5 shares	£ 4,341.48	£ 11,265.00
500	BG Group Ordinary 10p shares	£ 3,977.95	£ 6,883.00
1,465	HSBC Holdings Ordinary 0.5 US Dollar shares	£ 4,425.44	£ 7,194.15
360	HSBC Holdings Ordinary 0.5 US Dollar shares	£ 1,087.47	£ 1,767.85
6,800	Lloyds TSB Ordinary 25p shares	£ 10,169.91	£ 1,762.00
1,800	Barclays 25p Ord shares		
875	BAE Systems Ord 2.5 P shares	£ 3,542.00	£ 2,495.00
230	Weir Group 12.5p shares		
1,000	3I Group Ordinary £0.738636 shares	£ 3,058.76	£ 1,810.00
1,150	Tesco Ord GBP 0.05	£ 4,583.22	£ 4,640.00
1,550	Kingfisher Ord GBP 0.157142857	£ 3,554.45	£ 3,886.00
500	IMI Ord 25p shares		
175	Carnival Plc Ord USD 1.66	£ 3,996.49	£ 3,721.00
650	Glaxo Smithkline Ordinary 25p shares	£ 10,232.42	£ 9,565.00
220	Shire Ord 5p shares		
2,499	Bluecrest Allblue Ord Npv GBP shares	£ 3,020.28	£ 4,176.00
550	Amec ord 50P	£ 6,133.62	£ 4,991.00
7,000	Ing Global Real Estate Securities Ord NVP shares	£ 7,084.00	£ 5,705.00
4,175	Vodaphone Group Ord USD 0.11428571	£ 6,034.20	£ 7,469.00
2,150	BT Group Ordinary 5p shares	£ 7,787.53	£ 4,104.00
225	Brit Amer Tobacco Ord GBP 0.25	£ 4,991.81	£ 6,875.00
300	Unilever PLC Ord GBP 0.031111	£ 4,326.21	£ 6,489.00
460	Pearson Ordinary 25p shares	£ 8,069.00	£ 5,566.00
490	Serco Group Ord 2P	£ 3,005.01	£ 2,323.00
700	National Grid Ord GBP 0.113953	£ 3,648.26	£ 4,375.00
420	Experian Ord 10C	£ 3,444.95	£ 3,677.00
670	Blackrock World Mi Ord 5P	£ 4,019.09	£ 4,231.00
315	Standard Chartered Ord USD 0.50	£ 5,514.48	£ 4,438.00
650	RIT Capital Partners Ordinary £1 shares	£ 4,903.90	£ 7,956.00
4,400	TR Property Ord 25p shares		
1,000	Balfour Beatty 50P	£ 2,913.17	£ 2,648.00
20	Schroder Alt Solut Agriculture C GBP Dis Hdg	£ 2,987.22	£ 2,338.00
1,225	Brown Advisory US Equity Value £B		
1,500	British Empire Sec & Gen Trust Ordinary 10p shares	£ 5,005.61	£ 6,211.00
425	Findlay Park Partners US Smaller Companies	£ 6,158.47	£ 12,891.00
2,825	Ishares S&P 500 GBP	£ 20,319.63	£ 23,031.00
900	JPMorgan Am UK Ltd Emerging Markets I Instl	£ 5,043.10	£ 4,649.00
8,000	Bny Mellon Glb Fds Erg Mkts Debt Loc Crr C	£ 10,776.59	£ 9,957.00
425	Fidelity EUR Value Ordinary 25P shares	£ 4,059.07	£ 4,263.00
3,900	Edinburgh Dragon Trust Ordinary £0.20 shares	£ 4,478.10	£ 8,463.00
160	GLG Japan Corealpha Equity IT Acc	£ 11,330.79	£ 10,569.00
5,200	Scottish Widows Property Trust B	£ 4,669.49	£ 4,673.00
26	Veritas Asset Mgmt Veritas Asian A GBP	£ 8,182.27	£ 6,663.00
1,320	Goldman Sachs Fund US Equity I GBP Inc Nav	£ 14,640.81	£ 14,045.00
65	Roche Hldgs Ag Genusscheine Nvp	£ 7,226.55	£ 7,119.00
6,600	Henderson Gbl Invs European Special Sits I Inc	£ 7,037.91	£ 6,917.00
55	Shd Umbrella Funds Paragon Capp App Ire B	£ 9,894.52	£ 9,510.00
1,283.80	COIF Charities Investment Fund Acc Units	£ 75,000.00	£ 100,494.71
	Total	£ 465,393.44	£ 520,605.87

Investment Portfolio 2012

Proceeds (sold in 2012)	Cost (bought in 2012)	Gain realised during 2012	Value end 2012	Gain unrealised during 2012
			£ 22,498.00	£ 29.00
			£ 24,352.00	£ (18.00)
			£ 86,477.78	£ 808.62
			£ 17,487.00	£ (2,243.00)
			£ 6,053.00	£ (509.00)
			£ 12,777.00	£ 1,512.00
			£ 5,063.00	£ (1,820.00)
			£ 9,477.00	£ 2,282.85
£ 1,981.56		£ 213.71		
£ 2,075.99		£ 313.99		
	£ 4,034.84		£ 4,723.00	£ 688.16
£ 2,506.19		£ 11.19		
	£ 5,064.75		£ 4,322.00	£ (742.75)
			£ 2,172.00	£ 362.00
			£ 3,864.00	£ (776.00)
			£ 4,404.00	£ 518.00
	£ 4,905.57		£ 5,485.00	£ 579.43
			£ 4,127.00	£ 406.00
			£ 8,678.00	£ (887.00)
	£ 4,986.29		£ 4,151.00	£ (835.29)
			£ 4,251.00	£ 75.00
			£ 5,517.00	£ 526.00
£ 7,071.61		£ 1,366.61		
			£ 6,448.00	£ (1,021.00)
			£ 4,969.00	£ 865.00
			£ 7,022.00	£ 147.00
			£ 7,098.00	£ 609.00
			£ 5,465.00	£ (101.00)
			£ 2,622.00	£ 299.00
			£ 4,921.00	£ 546.00
			£ 4,116.00	£ 439.00
			£ 3,930.00	£ (301.00)
£ 3,722.08		£ (715.92)		
			£ 7,352.00	£ (604.00)
	£ 7,560.85		£ 7,612.00	£ 51.15
			£ 2,737.00	£ 89.00
£ 2,298.88		£ (39.12)		
	£ 14,789.62		£ 14,945.00	£ 155.38
			£ 7,110.00	£ 899.00
			£ 14,336.00	£ 1,445.00
			£ 24,263.00	£ 1,232.00
			£ 5,257.00	£ 608.00
			£ 10,434.00	£ 477.00
			£ 5,470.00	£ 1,207.00
			£ 10,452.00	£ 1,989.00
			£ 10,629.00	£ 60.00
			£ 4,451.00	£ (222.00)
			£ 7,671.00	£ 1,008.00
£ 14,606.59		£ 561.59		
			£ 8,040.00	£ 921.00
			£ 8,210.00	£ 1,293.00
£ 9,397.00		£ (113.00)		
			£ 114,775.57	£ 14,280.86
£ 43,659.90	£ 41,341.92	£ 1,599.05	£ 546,214.35	£ 26,327.41

Notes to the Financial Statements for the year ended 31st December 2012

1. Accounting Policies

The principal accounting policies adopted in the preparation 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 2011 and cover all the charity's operations, all of which are continuing.

The effect of events relating to the year ended 2012 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 2012 and the results for 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 Coumcil 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.
- Callomon Fund: Grants made to permit palaeontological research with a fieldwork element.
- Whittington Fund: Grants made to permit palaeontological research with an element of study in museum collections.

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 both of investents and foreign cash balances.

1.6 SCHEDULE OF INVESTMENTS (per analysis sheet)

2. Analysis of Financial Resources Expended

	Staff costs	Other costs	Total 2012	Total 2011
	£	£	£	£
Generating Funds	18,520	12,471	30,991	26,855
Charitable activities	62,354	186,063	248,417	266,982
Governance	4,630	10,925	15,555	16,481
	85,504	209,459	294,963	310,318

3. Staff Costs

	Salary	National Insurance	Pension Contributions	Total 2012	Total 2011
	£	£	£	£	£
Publications: 1 employee (2011 – 1)	32,918	0	6,069	38,987	39,125
Administration: 1 employee (2011 – 1)	32,167	3,420	10,713	46,300	42,648
	65,085	3,420	16,782	85,287	81,773

4. Trustees Remuneration and Expenses

Members of Council neither received nor waived any emoluments during the year (2011 – nil).

The total travelling expenses reimbursed to 19 Members of Council was £8,154 (2011 – £10,086).

5. Costs of Independent Examiner

	2012 (£)	2011 (£)
Examination of the accounts	450	400
Accountancy and payroll services	1,450	1,450
	1,900	1,850

6. Debtors

	2012 (£)	2011 (£)
Accrued income – receivable within one year	119,767	111,900

7. Creditors – falling due within one year

	2012 (£)	2011 (£)
Social Services costs	3,196	3,303
Accrued expenditure	27,784	61,824
	30,980	65,127

8. Designated Funds

(See page 9.)

9. Schedule of Investments

(See pages 10–11.)

Independent Examiner's Report
on the Accounts of The Palaeontological Association
for the year ended 31st December 2012

Respective responsibilities of trustees and examiner

The charity's trustees are responsible for the preparation of the accounts. The charity's trustees consider that an audit is not required for this year under section 144 of the Charities Act 2011 (the Charities Act) and that an independent examination is needed.

It is my responsibility to:

- examine the accounts under section 145 of the Charities Act,
- follow the procedures laid down in the general Directions given by the Charity Commissioners (under section 145(5)(b) of the Charities Act, and
- to 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 no opinion is given as to whether the accounts present a "true and fair" view and the report is limited to those matters set out in the statement below.

Independent examiner's statement

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

(1) which gives me reasonable cause to believe that in any material respect the requirements:

to keep accounting records in accordance with section 130 of the Charities Act;

to prepare accounts which accord with the accounting records and comply with the accounting requirements of the Charities Act

have not been met; or

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

Dated: 25th April 2013

G R Powell F.C.A.

Nether House, Nether Green,
Great Bowden,
Market Harborough
Leicestershire
LE16 7HF

Proposed changes to the Constitution

Council is recommending certain changes to the Constitution, and members will be asked to approve these at the AGM. The proposed changes are:

1. To modify the list of officers of the Association in line with changes that have been made to streamline the structure of the Publications Board and the Editorial Board of *Palaeontology*. A new, paid Publications Officer has been appointed and the duties and responsibilities of the 'Editor-in-Chief' have been substantially revised. The duties and responsibilities of the 'Chair of the Publications Board' are now included within those of the new 'Editor-in-Chief' and it is proposed to modify the wording of the Constitution to reflect this.
2. In order to maintain flexibility within Council, it is proposed to modify the permitted duration of maximum service as an Officer of the Association.

The wordings of the existing and proposed new Constitutions are given below:

Existing Constitution

1. *Name:* The name of the Association shall be '*The Palaeontological Association*'.
2. *Nature of the Association.* The Palaeontological Association is a Charity registered in England, Charity Number 276369. Its Governing Instrument is the Constitution adopted on 27 February 1957, amended on subsequent occasions as recorded in the Council Minutes. Trustees (Council Members) are elected by vote of the Membership at the Annual General Meeting. The contact address of the Association is that of The Executive Officer.
3. *Aims:* 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.
4. *Membership:* Ordinary, Student, Retired and Honorary members shall be considered full members of the Association and eligible to take part in the government of the Association, but Institutional Members shall not be eligible to take part in the government of the Association.
5. *Subscriptions:* The annual subscriptions for individuals shall be determined by the members in General Meeting. The annual subscriptions for institutions shall be determined by Council.
6. The business of the Association shall be undertaken by a Council and by committees of the Council. The Council shall consist of a maximum of twenty members. The Officers shall consist of a President, and, at least, two Vice-Presidents, a Treasurer, a Secretary, a Chair of the Publications Board and such other Officers as the Council may from time to time determine. At any meetings of the Council six members shall form a quorum which shall always include the President, or a Vice-President or the Secretary. The committees of the Council may co-opt members of the Association as non-voting committee members. Committees of Council shall be open to all members of Council.

7. Periods of service for Officers shall be flexible but should normally not exceed two years for President and Vice-Presidents, and five years for Secretary, Editors, and Treasurer. Total consecutive service as an Officer (excluding service as President) shall not exceed ten years. Other members of the Council shall be elected for a period of three years. All members of Council are Trustees of the Association in accordance with charity law.
8. Elections shall be held annually to fill vacancies on Council. The results of elections shall be announced at the Annual General Meeting. If nominations exceed vacancies a ballot shall be conducted at the meeting and provision shall be made for a postal ballot for members unable to attend the meeting. Nominations should be received by the Secretary not later than the Wednesday of the first full week in October preceding the Annual General Meeting.
9. The Annual General Meeting shall be held within 12 months of the end of the Association year. Other meetings shall be held as determined by Council.
10. The annual report and accounts of the Association shall be made up to 31st December in each year and shall be examined in accordance with the requirements of the relevant Charity Acts. Examined accounts and the annual report shall be submitted to the Annual General Meeting.
11. No member is entitled to any distinct or separate share in the property or effects of the Association, and in the event of a dissolution of the Association such property or effects shall be disposed of by gift to one or more other charitable Societies or Associations which have for their objects the furtherance of palaeontology or its allied sciences, as shall be decided by a vote of a meeting called for the purpose.
12. No alteration of these rules shall be made except by a majority vote at a meeting of the Association held after one month notice of the proposed alterations has been given by the Secretary to the Ordinary, Student and Retired Members.
13. Council may, as resources allow, employ the services of one or more paid officers, to be known as Executive Officers, to carry out a proportion of the tasks involved in the running of the Association. Paid officers will normally attend meetings of Council but shall not be entitled to vote and will not be Trustees. The appointments of all paid officers will be reviewed on an annual basis.

Proposed New Constitution (changes in bold)

1. *Name:* The name of the Association shall be '*The Palaeontological Association*'.
2. *Nature of the Association.* The Palaeontological Association is a Charity registered in England, Charity Number 276369. Its Governing Instrument is the Constitution adopted on 27 February 1957, amended on subsequent occasions as recorded in the Council Minutes. Trustees (Council Members) are elected by vote of the Membership at the Annual General Meeting. The contact address of the Association is that of The Executive Officer.
3. *Aims:* 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.
4. *Membership:* Ordinary, Student, Retired and Honorary members shall be considered full members of the Association and eligible to take part in the government of the Association,

but Institutional Members shall not be eligible to take part in the government of the Association.

5. *Subscriptions:* The annual subscriptions for individuals shall be determined by the members in General Meeting. The annual subscriptions for institutions shall be determined by Council.
6. The business of the Association shall be undertaken by a Council and by committees of the Council. The Council shall consist of a maximum of twenty members. The Officers shall consist of a President, and, at least, two Vice-Presidents, a Treasurer, a Secretary, **an Editor-in-Chief** and such other Officers as the Council may from time to time determine. At any meetings of the Council six members shall form a quorum which shall always include the President, or a Vice-President or the Secretary. The committees of the Council may co-opt members of the Association as non-voting committee members. Committees of Council shall be open to all members of Council.
7. Periods of service for Officers shall be flexible but should normally not exceed two years for President and Vice-Presidents, and five years for Secretary, Editors, and Treasurer. Total consecutive service as an Officer (excluding service as President) **should normally** not exceed ten years. Other members of the Council shall be elected for a period of three years. All members of Council are Trustees of the Association in accordance with charity law.
8. Elections shall be held annually to fill vacancies on Council. The results of elections shall be announced at the Annual General Meeting. If nominations exceed vacancies a ballot shall be conducted at the meeting and provision shall be made for a postal ballot for members unable to attend the meeting. Nominations should be received by the Secretary not later than the Wednesday of the first full week in October preceding the Annual General Meeting.
9. The Annual General Meeting shall be held within 12 months of the end of the Association year. Other meetings shall be held as determined by Council.
10. The annual report and accounts of the Association shall be made up to 31st December in each year and shall be examined in accordance with the requirements of the relevant Charity Acts. Examined accounts and the annual report shall be submitted to the Annual General Meeting.
11. No member is entitled to any distinct or separate share in the property or effects of the Association, and in the event of a dissolution of the Association such property or effects shall be disposed of by gift to one or more other charitable Societies or Associations which have for their objects the furtherance of palaeontology or its allied sciences, as shall be decided by a vote of a meeting called for the purpose.
12. No alteration of these rules shall be made except by a majority vote at a meeting of the Association held after one month notice of the proposed alterations has been given by the Secretary to the Ordinary, Student and Retired Members.
13. Council may, as resources allow, employ the services of one or more paid officers, to be known as Executive Officers, to carry out a proportion of the tasks involved in the running of the Association. Paid officers will normally attend meetings of Council but shall not be entitled to vote and will not be Trustees. The appointments of all paid officers will be reviewed on an annual basis.

Proposed changes to Subscriptions

Council is recommending changes to the subscriptions, detailed below, and members will be asked to approve these at the AGM. The proposed changes follow Council's consideration of the distribution costs of paper copies of *Palaeontology*, and a desire that members should pay less for online-only subscriptions to *Palaeontology*.

Membership Categories

All members receive *Palaeontology* and the *Newsletter*.

Ordinary Member – The principal category.

Retired Member – Retired members are over 60 and not in full-time employment. Currently their subscription is defined as being half that of Ordinary Members.

Student Member – Student members are registered members of a school, college, or university. Study towards a formal educational qualification is their full-time or principal occupation.

Undergraduate Member – These are recipients of the Association's Undergraduate Prize for best performance in palaeontology by a penultimate year undergraduate from an eligible university department. Their membership is free, lasts for two years, and is not affected by these proposals.

Honorary Member – These are individuals who have been significant benefactors and/or supporters of the Association. Their membership is free and is not affected by these proposals.

Current and proposed changes to subscriptions:

	Subscription (£)	
Membership Category	Current	Proposed
Ordinary Member; online access to *Palaeontology* only	36.00	30.00
Ordinary Member; print and online access to *Palaeontology*	36.00	45.00
Retired Member; online access to *Palaeontology* only	18.00	15.00
Retired Member; print and online access to *Palaeontology*	18.00	36.00
Student Member (UK); online access to *Palaeontology* only	10.00	15.00
Student Member (UK); print and online access to *Palaeontology*	10.00	36.00
Student Member (overseas); online access to *Palaeontology* only	15.00	15.00
Student Member (overseas); print and online access to *Palaeontology*	15.00	36.00

Nominations for Council

At the AGM in December 2013, the following vacancies will occur on Council:

- President elect
- Vice-President
- Editor-in-Chief
- two Editor Trustees
- Internet Officer
- Publicity Officer
- Outreach Officer
- Education Officer
- three 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 from <**secretary@palass.org**>.

The closing date for nominations is **9th October 2013**. They should be sent to the Secretary: Prof. Richard J. Twitchett, School of Geography, Earth and Environmental Sciences, Plymouth University, Plymouth, PL4 8AA; email: <**secretary@palass.org**>.

Council's nominations are as follows:

President elect:	Prof. David A. Harper
Vice President:	Dr Mark Sutton
Editor-in-Chief:	Dr Andrew B. Smith
Editor Trustees:	Prof. Charles H. Wellman Dr Marcello Ruta
Internet Officer:	Mr Alan Spencer
Publicity Officer:	Dr Liam Herringshaw
Outreach Officer:	Dr Fiona Gill
Education Officer:	Dr Caroline Buttler

Grants in Aid

Grants-in-Aid: Meeting support

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 using the online application form. Such requests will be considered by Council at the March and October Council Meetings each year. Completed requests should be made at least six months in advance of the event in question. The next two deadlines are **25th September 2013** and **1st March 2014**. Enquiries may be made to <**secretary@palass.org**>.

Grants-in-Aid: Workshops and short courses

The Palaeontological Association is happy to receive applications from the organisers of workshops and short courses 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 (see <**www.palass.org**>). Such requests will be considered by Council at the March and October Council Meetings each year. Completed requests should be made at least six months in advance of the event in question. The next two deadlines are **25th September 2013** and **1st March 2014**. Enquiries may be made to <**secretary@palass.org**>.

Awards and Prizes

Nominations are now being sought for the Hodson Fund, Mary Anning Award and to the Small Grants Scheme.

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. Nominations must be 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

This 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.

Palaeontological Association Small Grants Scheme

The Association now offers three small grant awards to fund palaeontological research, travel and fieldwork:

Sylvester-Bradley Award. Multiple awards up to £1,500 for palaeontological research.

Callomon Award. An award up to £1,500 for a project which is normally field-based.

Whittington Award. An award up to £1,500 for a project which is normally based on museum collections.

1. There will be one application form and Council will decide on the allocation of the awards based upon the nature of the project made in the application.
2. Before applying applicants should first read the *Terms and Conditions* at <**http://www.palass.org/modules.php?name=palaeo&sec=geninfo&page=76**>, which leads to the online application form.
3. Awards are open to all members of the Association and will be announced at the AGM.
4. Applications are to be submitted electronically through the website, and will comprise a CV, an account of project aims, objectives and expected outcomes (5,000 characters maximum and including references where appropriate), and a breakdown of the proposed expenditure.
5. Each application should be accompanied by an e-mailed reference (to <**palass@palass.org**>), to cover the project and a personal reference for the applicant. Applicants are responsible for ensuring that this reference is sent by the deadline.
6. The application should include a summary (of up to 1,500 characters) suitable for the non-specialist which will be published in the *Palaeontology Newsletter* when the award is made.
7. The final project report will be published in the *Palaeontology Newsletter* and successful applicants 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 should be sent to the Secretary (e-mail <**secretary@palass.org**>) by **1st September**. The websites will be judged by Council members.

ASSOCIATION MEETINGS

57th Annual Meeting of the Palaeontological Association
University of Zurich, Switzerland *13 – 16 December 2013*

Please address all queries to <**annualmeeting@palass.or g**>.

The 57th Annual Meeting of the Palaeontological Association will be held at the University of Zurich, Switzerland, organised by Christian Klug, Heike Goetzmann and colleagues from the Palaeontological Institute and Museum.

Maps

Four maps have been prepared to assist delegates in navigation in Zurich. A map is available for each of the following categories: hotels; directions; pubs/bars; conference dinner. The maps can be downloaded as jpg files from the Annual Meeting website.

Oral contributors

All speakers (apart from the symposium speakers) have been allocated 15 minutes. You should therefore prepare a 12 minute talk to allow time for questions and switching between presenters. We are using a limited number of parallel sessions in adjacent theatres so this is especially important. A single A/V projector linked to two screens (*i.e.* displaying the same image) is available; the system is both Mac- and PC-based and PowerPoint is installed. We will try to accommodate anyone who requires other platforms/hardware, provided they bring these with them. Your presentation should be submitted and checked the day before it is scheduled. If this is not possible, then please contact me.

Poster contributors

Poster boards are *c.* 2m tall and 1m wide; they will not be supplied with power sockets. Each will accommodate an A0-sized poster presented in PORTRAIT format. The board will *not* be suitable for posters of this size in landscape format.

Should I bring materials to fix the poster to the board?
You can, but you don't have to.

May I ship my poster to you in advance to avoid baggage charges?
Of course: ship it to me (allowing time for Christmas post) at Christian Klug, Paläontologisches Institut und Museum, Karl Schmid-Strasse 4, CH-8006 Zürich. E-mail me at <**annualmeeting@palass.or g**> to advise that you have done so. You can collect your poster upon arrival. (You may wish to bring the poster on a USB stick in case it is lost or damaged in the post, but we do not have access to an A0-printer here, so you would have to go to a shop nearby to get it printed in the worst case.)

Friday 13th: Symposium and Icebreaker reception

The meeting will begin on Friday afternoon with the Symposium followed by the icebreaker reception.

Please note that this scheduling is different from previous years.

The **Symposium** is on ‘Fossilised ontogenies and evolution’.

1.45–2.00pm	Welcome
2.00–2.30pm	Prof. Hans Kerp, Patricia Kearney & Hagen Hass (Universitaet Muenster): “Reproduction and early development of two plants from the Early Devonian Rhynie chert”
2.30–3.00pm	Dr Alex Nuetzel (Bayerische Staatssammlung fuer Palaeontologie und Geologie Munich): “Larval ecology in fossil gastropods”
3.00–3.30pm	Prof. Nigel Hughes (University of California Riverside): “Trilobites – evodevo on a roll”
3.30–4.00pm	Coffee break
4.00–4.30pm	Dr Zerina Johanson (Natural History Museum London) & Kate Trinajstic (Curtin University): “Fossilized ontogenies: Gogo placoderms reveal embryonic development in 370 million year old early vertebrates”
4.30–5.00pm	Dr. Rainer Schoch (Staatliches Museum fuer Naturkunde Stuttgart): “Life histories of early tetrapods: a diversity of ontogenies”
5.00–5.30pm	Prof. Jukka Jernvall (University of Helsinki): “Gradualism, punctuated equilibria, and missing links in developing teeth”
7.00–8.30pm	**Annual Address:** Prof. Michael Coates (Dept of Organismal Biology and Anatomy, University of Chicago): “Sharks and the deep origin of modern jawed vertebrates”

We are extremely grateful to the Palaeontological Association for their sponsorship of the Symposium and the Annual Address.

9.00–11.30pm	The **icebreaker reception** will be held at the Zoological Museum.

Many thanks to the city of Zurich for sponsoring this event!

11.30–???!!	There are many pubs and bars in Zurich, several open beyond midnight. See the pub/bar map for areas with many bars (Langstrasse, Niederdorf, Kreis 5).

Saturday 14th to Sunday 15th: Conference, and Association AGM

The Conference itself will commence on Saturday 14th December with a full day of talks and posters and the Association AGM. The lectures will be mainly in the large lecture hall **KOL2-F-180**, which is suspended above the Zoological Museum (see directions map), and parallel sessions might be held in the afternoons in lecture hall **KOL-F-118 E 5029**. In the evening there will be the Annual Dinner. After the Dinner, everybody is free to go to bed or find a pub or bar (see pub map).

Sunday 15th December will comprise a dedicated poster session and talks. The time allocated to each talk will be 15 minutes; we will try to avoid parallel sessions, however they will be organised for part of each day if really required to accommodate as many speakers as possible.

Monday 16th: Fieldtrips

Field trip A (Dinosaur museum Aathal): £40.00

[without lunch]

We will take public transport (included) from the main station of Zurich to the village of Aaathal. After a ten-minute walk we will be at the Museum. We will be guided either by the director Dr H.C. Hans-Jakob Siber or by the vice-director Dr Thomas Bolliger. The Sauriermuseum Aathal was founded by Dr Hans-Jakob Siber and has become world-renowned for its world-class dinosaur skeletons, which were excavated by Siber's team. Lunch will be either at the Italian restaurant next door or in the Museum. The tour will end around 3pm (back in Zurich around 3.30pm), making it possible – for those who wish to travel home the same day – to catch a late flight.

Fieldtrip B (Ticino, Monte San Giorgio, Museum Meride): £110.00

[containing one night in a hotel (shared rooms) from Sunday to Monday, breakfast, museum fee, transport; dinner + lunch will have to be paid individually]

Directly after the last talk, we will take three VW-buses to Ticino. We will have lunch directly south of the St. Gotthard-tunnel and will arrive at our hotel around 10pm. On Monday, Dr Heinz Furrer (Curator of the Palaeontological Museum of the University of Zurich) will guide us to two localities in the Monte San Giorgio area (it might be cold, but usually there is not a lot of snow) and we will visit the new and excellent museum in Meride, which exhibits fossils from the Triassic of Monte San Giorgio as well as spectacular models of the animals of Monte San Giorgio made by Beat Scheffold (Collection assistant, producer of palaeontological reconstructions). We will head back to Zurich around 3pm and will be at Zurich around 7pm (the time of arrival might vary significantly depending on weather conditions and traffic).

The number of participants is limited to 24.

Registration and booking

Registration, abstract submission and booking (including payment by credit card) commenced on Monday 1st July 2013.

Abstract submission closes at midnight on Monday 9th September 2013; abstracts submitted after this date will not be considered.

Registration after Friday 21st September 2013 will incur an additional administration charge of €30.00 (approximately £25.00, US$38.00).

The final deadline for registration is Friday 15th November 2013.

Registrations and bookings will be taken on a strictly first-come-first-served basis. No refunds will be available after the final deadline.

Registration, abstract submission, booking and payment (by credit card) will be through online forms available on the Palaeontological Association website (<**http://www.palass.org/**>). Please note that all these transactions will be in sterling (£:GBP). Accommodation must be booked separately (see below).

The cost of registration is the same as last year. Early registration is €110.00 (approximately £90.00, US$140.00) for ordinary and retired members; €75.00 (approximately £60.00, US$95.00) for students; and €145.00 (approximately £120.00, US$185.00) for non-members. People who register early will obtain an original **Mammut** backpack with the meeting logo stitched onto it.

Registration costs include sandwich lunches on Saturday and Sunday, the reception on Friday evening, full registration package and tea/coffee breaks.

The Annual Dinner event costs €60.00 (approximately £50.00; US$75.00). It will be held in the Uto Kulm Restaurant on the Uetliberg (<**http://www.utokulm.ch/en/restaurant /**>), a mountain next to Zurich (see conference dinner map). The evening's festivities will include a drinks reception, a salad buffet and a classical Swiss cheese fondue. To get to the restaurant, we will guide you to the train and will travel to the highest mountain of Zurich, the Üetliberg (870 m). From the train station, it will still be a short walk of 500 m (60 m in altitude). The last train from the mountain is at 0.03am, so the restaurant closes around 11.45pm.

If you are not able to walk a short distance, please contact <**annualmeeting@palass.or g**> to arrange a shuttle.

Venue and travel

The Conference will take place at the Universitaet Zentrum (see directions map), University of Zurich, which is a ten-minute walk uphill from the main station (HB = Hauptbahnhof). Accommodation we have reserved is nearby, so no further public transport will be needed to get to the lecture halls from your hotel (only if you stay in places further away, obviously). However we will use public transport to get to the Conference dinner. Tickets will be provided and we will guide you there in small groups.

Getting to Zurich

For those who wish to avoid flying, Zurich can be reached by combining rail (*e.g.* via Paris, TGV usually takes about 4–5 hours to Zurich) or bus links, which might be more or less cheap but obviously time consuming. For the majority, flying will be the best option.

Plane

Zurich is served by Zurich Airport Kloten (ZRH), which is located north of Zurich City Centre. There are currently direct air links (including EasyJet from London) into Zurich from a large number of airports globally, and, in particular, from Britain, continental Europe and North America. Early booking is recommended if you want to get a good bargain. It is usually worthwhile consulting search engines such as, *e.g.*,<**http://www.jetcost.co.uk /**> or <**http://www.ebookers.com /**>, which search several providers and airlines.

Another option is flying to Basel/Mulhouse airport. From there, a bus takes you to the main station in Basel city. There are fast trains to Zurich, which take about one hour. So in total, the journey Basel airport – Zurich would take about 1h 30min.

Transferring from the airport

There are frequent connecting "S-Bahn" (city trains) and regular trains from the airport to the city centre (main station = Hauptbahnhof). You can use all of those where Zurich HB is indicated (some are faster, some slower) with the same ticket from the vending machine in the airport (around £2 to £3; you can pay in Euros, Swiss Francs, Maestro, Postbank card, *etc.*). The transfer takes 10 to 15 minutes.

Getting to the Universitaet Zentrum-building (University of Zurich)
Once you've reached the main station (Zurich HB), leave the building towards the River Limmat. Be careful, because there is also the River Sihl, which is also close to the train station (see directions map). You can always ask because most of the locals speak English well and are very helpful. Cross the Limmat and continue to a large roundabout with a bus stop and a tram stop ('Central'). From there, you can:

- walk up the stairs: <**http://www.plaene.uzh.ch/KO2#ankermap**>
- take tram 6 or 10 to the stop ETH/Universitaetsspital then follow the directions map; you can find a map of all connections within the city with this link: <**http://www.zvv.ch/opencms/export/sites/default/common-images/content-image-gallery/linien-zonen-pdfs/Liniennetzplan_Stadt_Zuerich_2012.pdf**>
- take the cable car (Polybahn; see directions map). The entrance is next door to Starbucks at Central (across the river from the main station). It costs 1 CHF (it is included when you have a valid ticket for Zone 110); there is a vending machine at the entry of the Polybahn. It is a short romantic ride, which takes you to the Polyterrasse, which is a large terrace providing a nice view over the town. Cross the terrace and turn left into the Karl Schmid-Strasse. The entrance is between the two fishponds.

As always, we will put up signs to guide you, once you are close to the lecture halls.

Train
Zurich is served by one main railway station: Zurich HB (main station = Hauptbahnhof). There are TGVs from Brussels and Paris, ICEs from Frankfurt, Stuttgart and Berlin, and the Cisalpino from Milano. They are all rather comfortable and fast. Make sure to check whether you need reservations or not.

Local public transport: Tram and bus
Public transport is excellently organised in Switzerland and the costs are reasonable. In Zurich, there is a tram stop or a bus stop roughly every 300 m. You can get short-distance tickets ('Kurzstrecke'; only valid to the destinations listed on the vending machine), one-hour tickets (in Zurich for Zone 110, which is the majority of the city) and 24-hour tickets for Zone 110. Zurich is not a very big town, so many places can easily be reached on foot. Bear in mind, however, that there are many hills and walking through Zurich might involve climbing many stairs.

Taxi
There are usually abundant taxis in operation in the city centre at any given time. Zurich taxis are among the most expensive taxis in the world, so I recommend using them only if you are rich or lack another choice. It is possible to hail a taxi from the street, but convenient taxi ranks in the city centre are located on the Hauptbahnhof and around other bigger train or tram stations. You may also call one at +41 (0) 44 4444444 or +41 (0) 43 4555885 or +41 (0) 44 4504242.

Accommodation

Rooms in a variety of hotels, hostels and guest-houses at a range of prices are available in Zurich city centre and can be reserved through the usual channels. In addition, we have organised discount rates at some hotels close to University.

Accommodation must be booked separately. Bookings can be made individually (for students: why not try couch-surfing?) or via the following link (for hotels where we made reservations and where we obtained a cheaper rate, BOOK EARLY: these rates are available only until **6th November**):

<**http://www.zuerich.com/en/kongresslandingpages/kongress31.html**>

Zürich Tourismus, Hotelreservation
Im Hauptbahnhof
Postfach
CH-8021 Zürich
Tel.: +41 44 215 40 40
Fax: +41 44 215 40 44
E-Mail: <**hotel@zuerich.com**>

A credit card number is required at the time of booking as a guarantee for your room.

These are the included hotels (see Hotels map):

Hotel St. Georges, Weberstrasse 11, 8004 Zürich,
single room 129.50 CHF **double** room 166 CHF

Hotel Limmathof, Limmatquai 142, 8001 Zürich,
single room 145 CHF **double** room 178 CHF

Hotel Scheuble, Mühlegasse 17, 8001 Zürich,
single room 150 CHF

Hotel Astor, Weinbergstrasse 44, 8006 Zürich,
single room 155 CHF **double** room 185 CHF

City Hotel, Löwenstrasse 34, 8021 Zürich,
single room 165 CHF **double** room 230 CHF

Comfort Hotel Royal, Leonhardstrasse 6, 8001 Zürich,
single room 175 CHF

Hotel Alexander, Niederdorfstrasse 40, 8001 Zürich,
single room 180 CHF **double** room 240 CHF

Hotel Adler, Rosengasse 10, 8001 Zürich,
single room 195 CHF **double** room 275 CHF

Rütli, Sorell Hotel, Zähringerstrasse 43, 8001 Zürich,
single room 200 CHF **double** room 230 CHF

Leonardo Boutique Hotel Rigihof, Universitätstrasse 101, 8006 Zürich,
single room 300 CHF **double** room 310 CHF

Think about sharing a room to save costs, if necessary!

The hotel costs are not so different from British towns. Nevertheless, we are still working on an option to offer cheaper fares to PhD and other students (see also below).

PhD and Masters students might prefer to stay at the Youth Hostel:

Jugendherberge Zürich, Mutschellenstrasse 114, 8038 Zürich
Tel: +41 43 399 78 00,
E-mail: <**zuerich@youthhostel.ch**>
Web: <**http://www.youthhostel.ch/zuerich**>

There are several other hotels (some indicated on the Hotels map), which are at a reasonable distance and *not* in this list (Hotel Sunnehus, Design Hotel Plattenhof, Hotel Foyer Hottingen).

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 Zurich 2013 meeting, grants of less than £100 (or the € equivalent) will be available to student presenters who are travelling from outside Europe. The actual amount available will depend on the number of applicants and the distance travelled. Payment of these awards is given as a disbursement at the Meeting, not as an advance payment. Students interested in applying for a PalAss travel grant should contact the Executive Officer, Dr Tim Palmer (e-mail <**palass@palass.org**>) once the organisers have confirmed that their presentation is accepted, and before **1st December 2013**. Entitle the e-mail "Travel Grant Request". No awards can be made to those who have not followed this procedure.

Any increase in the granted amount depends on the amount of money that will come in from sponsors.

Why not make a stay of it?

Switzerland at any time of the year is an excellent destination for a short break; why not come a few days early and see what the country has to offer? Alternatively, if anyone travelling with you is not enthralled by the idea of three days at a PalAss Conference there is plenty to do.

<**http://www.myswitzerland.com/en/home.html**>

<**http://www.zuerich.com/en/Visitor.html**>

We look forward to seeing you in Zurich in December!

Introduction to Research Methods in Quantitative Palaeobiology

School of Earth Sciences, University of Bristol
Wills Memorial Building
Queen's Road
Bristol BS8 1RJ
19–21st November 2013

Building on the success of the 2011 workshop, we are pleased to offer this three-day workshop to provide training in a number of areas of numerical palaeobiology.

We will give training in data entry and extraction from the PaleoDB, use of the built-in tools in the PaleoDB for analyses and producing palaeogeographic plots.

The course will include sessions on the use of the R statistical language and PAST for analyzing data extracted from the PaleoDB and for palaeobiogeographic analyses.

We expect to be able to offer around 25 places and will consider applications from anyone committed to quantitative work in palaeobiology. We thank the Palaeontological Association for financial support and in-kind support from the University of Bristol.

For further details and application forms
Contact Al McGowan
(Alistair.McGowan@glasgow.ac.uk)

Song of ages

The devil has all the best tunes, it's said. One is tempted to agree, thinking, say, of Don Giovanni's wickedly persuasive serenade to that otherwise level-headed and resourceful servant girl, Zerlina. He might even – with a little help from Mozart – have added her to his then total of one thousand and three conquests on Spanish soil[1] (Leporello, pers. comm.) had not Donna Elvira burst upon the scene like an avenging angel. She had heard *that* siren song before.

It's an old song, of course. If we allow it as a phenomenon of melody, rhythm and seductive intent rather than of any particular species, then it began about fifty million years ago, in the early Cenozoic. That is when the songbirds – properly avian ones – first appeared on Earth. Their motives would not have been greatly dissimilar to the Don's.

How do we *know*? For melodies do not linger in the fossil world. Each song dies within seconds of leaving the throat that produced it – or at least it did until Thomas Edison produced his marvellous invention of the gramophone, allowing humans to add the miracle of sonofossilization to their growing range of novel contributions to the stratigraphic record. Why, then, cannot we include a warbling *Archaeopteryx*, or even singing (non-avian) dinosaur, in allowable reconstructions of the past?

There are real constraints on the music of time. I had been quite unaware of just how far one can go in reconstructing the soundworld – the real, evidence-based soundworld – of deep prehistory, until stumbling across Phil Senter's marvellous review of the kind of sounds that animals would have made – and listened to – in the Palaeozoic and Mesozoic eras. It is, first of all, a *long* review of what he calls palaeobioacoustics – 33 pages in all, and packed with detail. This presumably explains why he didn't delve (much) into the Cenozoic[2]: one would have needed a fork-lift truck to carry such a tome home, and a sabbatical dedicated to reading it.

The case of birdsong constrained and mute dinosaurs, for instance. It's all down to functional morphology – and, in the former, also the framing of definitions of birdsong that one may regard as anything between pragmatic and outrageous. Take the morphology, first. Birds (perhaps including dinosaurs too, though I'm a little hazy on this) have a syrinx – a set of cartilaginous rings at the base of the trachea, with membranous folds that can vibrate to produce sound. To make it work properly, though, it needs an air sac that derives from the equivalent of the shoulder blade, and that leaves a distinctive opening upon the bone of the upper arm. That may seem a strange way to make a bird sing, but that's Mother Nature for you – quirky as you please, as if she wanted the Earth's first song to be a comedy number.

Now this particular structure is fossilizeable. It turns up in a bird clade called the Ornithoraces, which (as far as I can divine, before sinking into the quicksands of cladistic classification systems) includes modern birds and a Cretaceous group called the Enantiornithes. Analogous, but unrelated, structures are present in pterosaurs. But not in dinosaurs. So the terrible lizards of

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[1] I was surprised to find that the opera is set in a Spanish mansion, despite those Italianate names.

[2] With occasional asides, with the temptation to cite the songbirds thankfully unresisted.

Hollywood epics, short of a functioning syrinx, could not have roared. That doesn't mean, as Senter notes, that they were simply dumb monsters. They could have hissed, snapped their jaws, ground their teeth, stamped their feet, rattled their scales or otherwise produced sounds befitting the most villainous of B-movie hoodlums. This is, after all, eloquent in its own way, even if they were fated never to be able to enjoy the pleasures of an evening at the karaoke machine[3].

Once a creature has the equipment, though – does it necessarily give it the song? Well, as every aspiring bathtime tenor or coloratura soprano will know, singing isn't that simple. And in transferring this distinction to the animal world, this is where one has to be very careful with words. Or, if you like, one has to imbue them with the kind of enforced precision that can only be supplied by a sackful of weasels. What then, is a song? It is not any old birdcall, in the same way that the average Eurovision Song Contest entry cannot be said to be music. Birdsong, in the opinion of the authorities cited by Senter, is only produced by songbirds (the Passeriformes, to give them their official title), the doves (Columbiformes), or by tinamous birds (the Tinamiformes). Only they, it seems, produce sounds mellifluous enough to be called song. Everything else is called, well, a call. And given that birds of those groups do not have a Mesozoic record, songs were invented in the Cenozoic. QED.

I did, as you recall, warn about the potentially outrageous element of this line of inquiry. The modernists out there will be fuming that the rustic but deeply meaningful vocal ostinati of birds of other feather have been summarily excluded from the musical fold, while others of a more conservative persuasion might be darkly muttering that the cooing of those blasted doves is well within Eurovision territory. And all the while, way back, the more sensitive Velociraptors might have been composing fugues in their heads while lacking the means to bring their sublime creations before the rapt attention of their peers. No wonder they were so bad-tempered.

Now, so far we have – as so often – been devoting ourselves to the dinosaur/bird combine, and therefore giving these most hyped of creatures yet more publicity[4]. Senter, now, shows far more dignified impartiality, and an impressive range of inquiry. Leaving aside the question of musicality, and considering simply the production and detection of communicative sound, then this phenomenon goes back – clearly goes back – way before the dinosaurs.

The invertebrates here take pride of place, by sheer weight of numbers. Arthropods, now, have hard outer carapaces that, with a little bit of design modification, can be rubbed together to produce a range of sounds. Stridulation, it's called. Spiders, beetles, crickets, bugs[5], grasshoppers and others can, left to themselves, produce a nigh-well deafening stridulatory cacophony in the average meadow. These are the sounds of love and war: of mating calls, or of warnings to a potential predator that unpleasant chemicals, say, may follow any closer approach.

How much of their musical instrumentation is fossilizeable? Well, not as much as one might like, it seems, given the vagaries of preservation. But the Orthoptera – crickets, grasshoppers and such – have tell-tale patterns of wing veins that betray the noise-makers. These creatures are known from the Carboniferous, but the early models were silent. The stridulatory structures appear in the Late Triassic, with Ensiferans (not quite crickets) getting in on the act first, followed in the

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[3] For one hundred million years. The level of deprivation is beyond measure.

[4] Impossible to resist, though.

[5] True bugs, that is – not just any old bugs.

Cretaceous by true crickets and mole crickets, and then in the Cenozoic by grasshoppers and katydids. It was a slow crescendo in the evolving meadows of the world.

Cockroaches and their like (the Blattaria), too, have their share of auditory eloquence, though Senter somewhat mysteriously says that this is accomplished by 'a variety of means'. The noisiest of the roaches are, delightfully and perhaps not coincidentally[6], in the family Blaberidae. This mischief would not have gone unnoticed by the world's most famous cockroach, Archy, citizen of New York, poet, wit, philosopher and sympathetic observer of both human and insect society[7].

It was Archy's peculiar and improvised means of sound production that first drew him to the attention of his amanuensis, Don Marquis, who explained it in the preface to his (Archy's that is) literary collection[8]. Waking in the middle of the night to the sound of successive taps coming from his desk, he went to see what was going on. He saw a cockroach, laboriously climbing to a shelf above the desk, then launching itself, headfirst, at the typewriter beneath, to strike one of the keys beneath, with an audible click, and print out one letter. The dazed roach picked itself up, climbed once more to the shelf, to launch itself at another key. And repeated this until the small hours, until it had painstakingly completed the night's narrative. Then, it finally crawled away, exhausted.

Impressed by the insect's determination, Don Marquis made sure that there was always paper in the machine so that the self-expression found permanent record. He could do nothing about certain practical problems, given the technology of the day. The key shift on the typewriter was beyond the poor roach's abilities, and so the poems (vers libre, if you are curious about the style) are all in lower case.

Space does not allow a full exposition of all of Archy's *oeuvre*. A good deal is given to the recording of the somewhat scandalous adventures of a local cat[9], Mehitabel, whose morals sometimes descended below the very highest levels, and whose personal circumstances saw many ups and downs, but whose spirits remained undimmed – a morale maintained because she averred herself a reincarnation of Cleopatra. *Noblesse oblige*, naturally, with such a pedigree. There are rueful observations, too, on the prejudices of humans – particularly on their cavalier and thoughtless use of insecticides, and the many little tragedies that this can lead to. Archy considered himself a reincarnation also, of a minor poet, and commented on Shakespeare's circle, offering illuminating insights on that literary *milieu*. The Bard, for instance, was avowedly lowbrow. Eyewitness accounts like this are *so* valuable. Without them one can be quite perplexed by the conflicting accounts of historical episodes.

Perhaps it is time for us to return, hastily if a little reluctantly, to Phil Senter's more sober palaeobioacoustical catalogue of fossilized hums, squeaks, rattles, whistles and songs. Noises on the world's stage, of course, extend underwater, and have long done so. Indeed the underwater animal soundworld must predate that of the land by a hundred million years of so, as the first terrestrial organisms quoted as potential noise-emitters are the myriapods and arachnids recovered from that most remarkable of individual strata, the Ludlow Bone Bed, in

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[6] One is always hopeful that humorous word associations slip under the guard of the guardians of taxonomic respectability.

[7] The sympathies mainly lay with the insects, of course.

[8] *Archy and Mehitabel*. I have the old Faber edition, and would not part with it for anything.

[9] Or perhaps only scandalous to those inexperienced in the ways of cats.

which swept-in remains of Late Silurian terrestrial ecosystems form rare but eloquent grace-notes to the current-winnowed masses of early fishbones, eurypterid armour and other sundry arthropodic debris[10].

This delicacy of inference applies to the earliest animal sounds that might have been produced. Who, or what, might have been responsible for the first animal noises of all? The Ediacaran biota, clinging to those endless expanses of late Precambrian microbial mats, must have been silent, like the Doshuanto embryos. The latest Precambrian shelly fossils? Senter is silent on these, but notes that the earliest animal sounds were likely accidental, the footsteps (as it were) of early Cambrian arthropods as they began their long walk across the world's sea floors. Tapdancing, thus, as prelude to the song? It would make sense for accidental percussion to happen, to become noticed and reacted to, and to develop into a signal.

Thereafter, the seas would have become ever noisier. There would have been the crackling of sea urchins and barnacles, the former by moving their spines and the latter by scraping their appendages against their shells; the snapping of mussels, as they broke their byssal threads during locomotion; the popping noises made by swimming cephalopods, as they expelled water past their flapping mantle lips; the stridulations of sundry crabs and lobsters and shrimps, with the spiny lobsters of the Palinuridae being notable for rubbing an antenna-born 'plectrum' against a hard structure beside the eye, rather as a violinist passing a bow across violin strings.

Then, of course, came the fish. As in much else, they were a little slow with things. Lampreys and hagfish seem to have been deaf as well as dumb, while cartilaginous fish today are mostly silent with the odd exception of the cownose ray, that clicks when touched by humans. The cownose ray family (the Myalobatidae) goes back to the Cretaceous. Humans, of course, don't, despite the best efforts of Hollywood directors to convince us otherwise. Lungfish, when they breathe air, can make a bit of a racket, though this is noted as more a character defect than an attempt at communication.

Bony fish are noisier, and emit a variety of squeaks, grunts, yelps, thumps, moans and groans[11], for the usual purposes of love and hate. A vibrating swim-bladder is the usual means of sound production, but teeth can be audibly ground too, tendons can be snapped, or pectoral girdles vibrated. The geological record of the noise-makers goes back to the Late Jurassic in one case (the tarpons) but mostly to the Late Cretaceous (sturgeons, catfishes, cod and such); hence, fishy noises in the sea are mostly a Cenozoic phenomenon.

Were the Mesozoic oceans necessarily quiet, though, given that larger beasts then swam? Senter is silent as to what noises the marine reptiles may or may not have made, but observes that ichthyosaurs and plesiosaurs did not seem to have much of an ability to hear (lacking traces of a tympanum, which I guess is more or less an eardrum). Mosasaurs, though, did have a tympanum, moreover one that was ossified so that it would not rupture under the increased pressure in deep water. Their skull, too, was designed to be able to transmit sound to the middle ear. These predators clearly could sense the Late Cretaceous marine soundscape, but we remain none the wiser as to what they listened out for.

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[10] It is something of a long shot, this, the logic being that myriapods and arachnids today can produce sounds, and so therefore might have these most ancient of representatives.

[11] These are the descriptions provided by Senter, and not my own elaborations, in case you wondered.

The novel noisiness of the Cenozoic seas is augmented, of course, by the advent of marine mammals, most famously the whales. Their songs of the seas, in their truest sense, though, are a Cenozoic invention. An early singer of the line was disinterred by fossil-hunter, publicist, impresario and determinedly careless taxonomist Albert Koch, amid the Alabama slave plantations in 1845. Koch, fresh from success – financial as well as public in exhibiting a beast he had given the wonderful name of *Missourium theristrocaulodon*[12] – was looking for another monster to amaze the sensation-hungry public with. In Alabama he found one: a skeleton over a hundred feet long, with satisfyingly ferocious teeth, to which he added a few imaginative additional touches, such as paddles made from carefully-arranged ammonites[13]. He called it *Hydrarchos*, though the bits of it that were more or less genuine were of a creature that had already been called *Basilosaurus*.

What was the basic, unimproved creature, though? Marine reptile or mammal? It had the shape of the former and double-rooted (and ferocious-looking) teeth like the latter. There was much perplexity in the circles then concerned with such matters, until an accident decided the issue. Part of the side of the skull was being handed round during discussions on this mysterious creature when – calamity! – it dropped on to the floor and shattered. Then – serendipity! – the gathered fragments revealed the structure of an inner ear. A mammalian inner ear. This was no ichthyosaur-relative. It was a whale.

So those (mostly) gentle leviathans of today's oceans had a fossil record, extending back, eventually, it was found, into early Tertiary times. From where did they spring, these water-borne mammals? Darwin, as perplexed by this as anybody, had opined an ancestor something like a bear, splashing around in coastal marshes until deeper water beckoned. In fact, the ancestor turned out to be more like a wolf (in shape, rather than affiliation), once the missing links become no longer, well, quite so missing. That fitted the ferocious teeth of Koch's hundred-foot monster, and perhaps – just perhaps – a howling, carried into the deep and transformed into song.

For the whale-songs, most beautifully of the humpback whale, were – once discovered – one of the minor sensations of the days of my youth. When did the whales start singing? Senter is silent on the subject – understandably, given his temporal brief. But from the nature of those predator-ancestors, and from that serendipitously broken earbone, they might have been trying underwater communication from early on. The Cenozoic seas likely echoed to ever more elaborate vocalizations. It's rather a beautiful thought – just in case any Hollywood producers with a spare hundred-million dollar budget happen to be reading.

It's harder for the whales now – for the few that remain, that is, in the oceans. The film script to be written now is of gritty urban-style reality, with soundtrack to match. Water is a good medium for long-distance communication, because it transmits sound so well. It is also, therefore, prone to being made noisy. These days, that means mostly from human sources.

The sound pollution of the oceans, and the effect that this might have on marine mammals, occasionally gets into the news. It's usually the dramatic and potentially deafening (indeed potentially lethal) noises that attract the attention: military sonar, for instance, and the undersea air guns that are used in marine geophysical surveys. But the main problem is simply the noise

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[12] It was a mastodon. Quite a nice one, mind.

[13] Koch could make Phileas Taylor Barnum look like the epitome of scrupulous honesty: the whole story is in Switek's (2011) fine set of explorations of the prehistoric boneyard.

of shipping: there are now more and bigger ships plying the seas than ever before. The noise from their engines and propellers is mostly low frequency (between 10 Hz and I kHz), which happens to be pretty well that used by both the large baleen whales and fish (dolphins, porpoises and toothed whales, operating at higher frequencies, can be regarded as luckier in this respect). Over much of the oceans, the big whales used to be able to communicate over distances of tens of kilometres. That communication bubble has now mostly shrunk to a radius of a kilometre or two (Malakoff 2010). Indeed, some whales are now singing an octave higher in response, and I'm intrigued whether that counts as a cultural response or represents true genetic evolution driven by extreme selection pressure.

Human-style noise pollution is just another of those wholly new phenomena of our current extraordinary time. There is another change, though, associated with our activities that might – just perhaps – have prehistoric, eminently geological counterparts. One thing I had not realized until recently: that the ability of seawater to transmit sound is strongly influenced by what might seem relatively minor aspects of its chemistry.

Specifically, as the pH of the ocean drops, it becomes more transparent to low-frequency noise, so sound can carry further. The mechanics of this are chemically byzantine. A key influence on sound waves in water is the negatively charged borate ion, $(BOH)^{-}_{4}$, which happens to be just the right size to be squashed by the sound waves, in this way soaking up their energy. As the seas become more acid, the charged borate ions are converted into an uncharged form $B(OH)_3$, which is smaller and not so squashable. As this happens, the sound waves pass through the water more easily. With a drop of 0.3 of a pH unit (likely the state by mid-century: we're a third of the way there already) low-frequency sound can travel about 70% farther. For any remaining whales, that might be a mixed blessing: their songs will carry further, but the ship noise will seem louder too.

The acoustic properties of the ocean must have changed in the past, too, because humanity's experimental release of carbon has geological analogues, albeit ones not carried out at quite such a furious pace. The best-known of these are the Paleocene–Eocene Thermal Maximum (PETM), 55 million years ago, and the Toarcian event in the depths of the Jurassic, over 180 million years ago, though other such 'hyperthermals' are being turned up. In the PETM, at least, there is clear evidence of a rapid drop in pH. The evidence, indeed, couldn't be clearer, consisting of a widely dissolved ocean floor, as its calcium carbonate was pressed into service to neutralize the extra acidity.

So the ocean, must have been a place where it was not simply more difficult to make (or keep) a calcium carbonate shell, but one where sound carried with greater reach and clarity than previously. Did any of the then ocean fauna take advantage of these suddenly more acute acoustics? Or did they even notice? This is all conjecture, and probably entirely untestable to boot, but underlines the fact that present and past environments are quirky and multi-dimensional well beyond our current powers of analysis.

Other abrupt changes in ocean chemistry have occurred, and I've often wondered about just what kind of cascade of non-intuitive effects these would have generated. There are the changes in oxygen content, of course, such as the repeated switches between oxygenated and anoxic sea floors of early Palaeozoic times (with the Toarcian being a brief reprise of those ancient, oxygen-starved days).

There is also, more simply, just the saltiness of the sea. Early geologists used to try to work out the age of the Earth by how long it would take the oceans to acquire their freight of salt, washed in from the land. They hadn't taken into account those enormous, capricious regulators of global salinity, the formation in the geological blink of an eye of the rare, spectacular 'salt giant' deposits. Take the Messinian event, for instance, when, between 6 and 5 million years ago, the Straits of Gibralter rose tectonically and the Mediterranean, largely cut off from the Atlantic, became a desert. Then, up to two miles thickness of salt began to accumulate in that million-year span on its suddenly[14] baking and inhospitable floor. This, I have read somewhere, would have lowered global salinity by as much as 5%, from just a minor accident of local tectonics. Given how fussy many marine creatures are about the amount of salt they like to have in the water they live in, I wonder what the wider repercussions of the Messinian event might have been.

Given the quirkiness of ocean sound propagation, might the world ocean then have become a noisier or a quieter place? I haven't the foggiest notion of whether it did or not, but perhaps somebody should find out. Now that palaeobioacoustics has become a discipline within our venerable science, one should take a deep breath and begin to sing the praises of hypohaloaqueopaleobioacoustics. Now *that* would have a fine rhythm to it.

Jan Zalasiewicz

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[14] With only the Nile otherwise as a significant source of water, it probably didn't take much more than a thousand years to dry up.

PalaeoMath 101
Semilandmarks and Surfaces

We've spent a considerable time talking about semilandmarks, but that's because—as I hope you'll agree by now—they are by far the most intuitive and useful of morphometric objects. Landmarks arguably do have more biological information content, at least in a theoretical sense. However in many, if not most, practical contexts you're simply not going to have the information you need to specify the location of a sufficient number of true landmarks to, or be able to locate these landmarks in places that, enable you to test the hypotheses you're interested in across all specimens in your sample. In such all-too-common cases, the ability to employ sets of semilandmarks as descriptors of morphological variation can make the difference between being able to apply a quantitative approach to morphological analysis or being forced to rely on qualitative, observation-based assessments. In the last two essays of this series we're going to push semilandmarks to the very limits of their utility. This will allow me to end this column, in a curious manner, back where I started it ten years ago with a consideration of what it means to 'observe' morphology and how we might use mathematical tools to inform, supplement, and extend our qualitative observations.

You also might have wondered why I've spent so much time on two-dimensional (2D; x,y) morphometric analysis when, increasingly, three-dimensional (3D; x,y,z) analyses are becoming the standard. There are several reasons. Historically the methods and procedures—even shape theory—were worked out for the 2D case first. The methods I've described to this point have been discussed in the context in which they were first presented to the scientific community. Granted, in many cases extension of these procedures to the third dimension required few, if any, modifications. Nevertheless, morphometrics has been developed and pursued in the context of 2D representations of form far longer than in the context of 3D data and, at the moment, 2D morphometric investigations outnumber 3D investigations by a considerable margin. Of course, this dimensional priority pertains only to the data we collect from organismal bodies. Morphometric data analysts have utilized higher dimensional representations of form/shape similarity/difference for a very long time, even though this distinction often seems to be forgotten (or ignored) in many published technical reports.

This historical focus on 2D data did not derive from any failure to appreciate the 3D character of organismal morphology. Despite the fact that quantitative morphologists have almost always described and discussed their results as if the 2D (apparent) representation of 3D forms was a matter of so little consequence it was scarcely worth mentioning, most experienced practitioners of the morphometric arts were acutely aware of the limitations imposed on their investigations by representing 3D objects with 2D data. Our collective silence on this topic was more one of embarrassment than evasion. The simple fact was that all but a very few of us did not have access to 3D digitizers and 3D data processing software throughout the 1980s and 1990s. This began to change in the late 1990s with the advent of reasonably low cost, 3D physical, acoustic, and (finally) optical digitizers. Now, the situation has changed to such an extent that PhD student visitors to The Natural History Museum (London) often turn up carrying large cases containing an amazing variety of 3D digitizers that they have the inestimable pleasure of lugging across Europe —sometimes across the world—on their 'museum visitation' data-collection trips.

Once these 3D digitizers had appeared on the market, or more to the point, in the hands of morphometricians, it was not long before 3D landmark and (even) 3D outline analyses began to be published. In most cases the procedures involved in the analysis of landmark and outline configurations were able to be extended to encompass the 3D case rather easily. Nevertheless, while this proved both a welcome and easily achieved technical advance that unquestionably enhanced the appropriateness and sensitivity of the hypotheses tests to which these new 3D data were applied, by themselves these extensions did not achieve what many of us really wanted; a morphometric method that was capable of accurately representing and analyzing 3D surfaces.

The problem with surfaces is obvious once you stop and think about it. Surfaces contain a wealth of morphological detail that systematists and taxonomists make use of routinely. But they often don't exhibit many landmarks or outlines. For example, take these three fossil representatives of the bivalve genus *Astarte* collected from the Red Crag Formation in the UK.

Figure 1. Three Pleistocene fossil bivalve species from the Red Crag Formation, Essex, UK.

In plan view each shell has at least one obvious landmark (the tip of the beak) and each has an outline. But the most important feature(s) distinguishing these species from one another is the character of the valve surface. *Astarte mutabilis* is characterized by a somewhat smooth but irregularly spaced series of annular growth rings set on a highly vaulted surface. *Astarte obliquata* displays a much lower valve vault on which a more regular series of fine annular growth rings are set, each with distinctly and regularly rounded ridges and furrows. And *Astarte omalii* is characterised by a valve vault that is even more pronounced than that of *A. mutabilis*, but whose surface is typified by a prominent smooth and coarsely undulating annular ornament. Qualitative descriptions like these are fine for explaining how someone might separate these three specimens by observational criteria alone. But how can we use morphometrics to characterize these surfaces so that we might introduce a degree of quantitative rigour to the morphological analysis of these surfaces?

Clearly, landmarks are out as a reasonable quantitative form-description strategy. These forms could be represented by outlines. If we wanted to test some hypothesis that was captured adequately by the outline (*e.g.*, shape of the valve opening) outlines would be just the ticket. But as a proxy for the general character of morphological similarity and difference the outline is only one bit of a much larger puzzle; and with regard to these particular shells, a pretty nondescript bit at that. The outlines of *A. mutabilis* and *A. omalii* are broadly similar to each other and differ from *A. obliquata*. However, from the standpoint of the valve morphology enclosed by their outlines, these three species could hardly be more different. Therefore, using differences between the form or shape of these shells' outlines as an index of general form/shape similarity would result in a badly biased representation of their true similarity. If we opted instead for making inter-specimen comparisons based on landmarks this bias grows even worse!

There is a wealth of morphological information encoded in the surfaces of these bivalve shells. Qualitative taxonomists have access to this information and use it as a matter of course to make distinctions between these species. But very little of this information is such that it can be represented by a small set of landmark point positions or strings of outline semilandmarks. What to do?

The first step in solving this problem is to decide what is needed. If we could represent the surfaces of these valves in a manner consistent with the use of geometric morphometrics, what would that look like? As the *sine qua non* of geometric morphometric analysis is the mathematical point, if we could scatter mathematical points over the surfaces of these valves, and then match them in some way across the different specimens in the sample, we'd be able to create a valid index of form/shape similarity and difference using the standard geometric morphometric toolbox. Let's try that.

With the advent of those digitizers I was talking about, scattering mathematical points across the surfaces of the values is easier than you might think. Figure 2 shows the results of fairly low-resolution 3D scans of the *Astarte* specimens shown in Figure 1. These point clouds are formed out of 5,528, 6,571 and 5,614 points for *A. mutabilis*, *A. obliquata* and *A. omalii* respectively.

Figure 2. Digitized points of the surface of the three Astarte *specimens.*

As you can see, the point spacing achieved by these low-resolution scans is more than sufficient to represent the gross morphology of the valve surfaces as well as a considerable amount of surface detail. Unfortunately, these point clouds cannot be compared in the manner sets of landmarks and strings of semilandmarks can. First, different specimens are represented by different numbers of points. Second, individual points in each point-cloud dataset have no necessary geometric or biological correspondence to points at the same position in the sequences of other point-cloud datasets. As a consequence, even if we could constrain each point-cloud dataset to contain the same number of points—a task that can be accomplished easily in software—this lack of geometric or biological correspondence would still prevent us from using the raw point-cloud coordinates as meaningful morphological descriptors from the standpoint of quantitative form/shape comparison.

In addition there is an information redundancy issue in these data. Even at these rather modest levels of spatial resolution there is a considerable amount of geometric autocorrelation in the datafiles representing these valve surfaces. The values of neighbouring points tend to be very similar so do not contribute much new information either to the representation of individual forms/shapes or to their comparison with one another. Ideally we'd like to reduce this redundancy prior to analysis in order to increase analytic efficiency by reducing extraneous computational overhead.

Somehow we need to use these data as the basis for the specification of a surface point-sampling scheme that will deliver sequences of (semilandmark) points that bear a consistent geometric correspondence both to one another and to the underlying morphology. There are a number of ways to approach this problem. One of the most straightforward and flexible is a sampling technique I call eigensurface analysis.

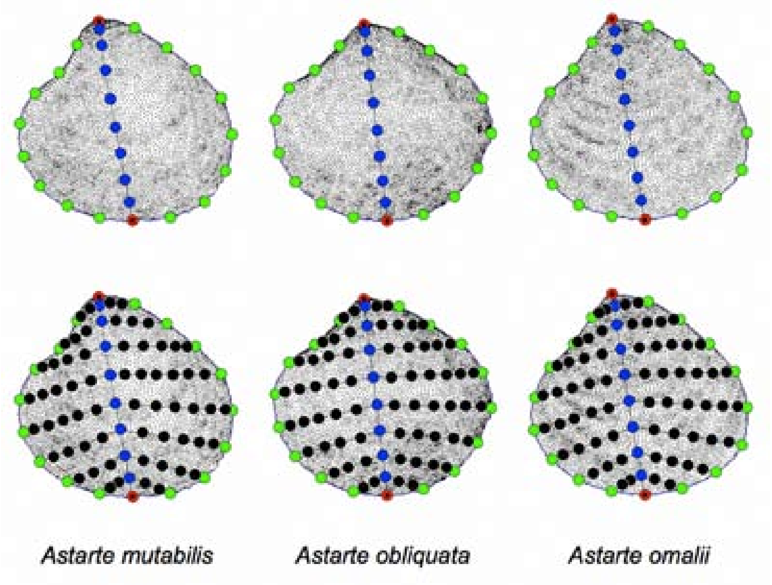

Figure 3. Steps in sampling surface morphology using the eigensurface procedure as applied to the three Astarte *specimens. The red symbols mark positions of the landmarks used to orient the semilandmark sampling grid, green symbols the outline semilandmarks, blue the midline semilandmarks, and black the 'rib' semilandmarks that join the midline to the outline segments. These are 10-grids in which each half outline and the midline is represented by 10 semilandmarks. Spatial resolution of the sampling network is controlled by increasing or decreasing the number of equally spaced semilandmark points used to represent these dimensions of specimen form. See text for further discussion.*

The eigensurface sampling procedure is illustrated in Figure 3. It's essentially an extension of extended eigenshape analysis (see MacLeod 1999, 2012). Sampling for eigensurface analysis begins with specification of the surface's outline, which is done in the normal way; with the outline starting at a landmark point (in this case the maximum of curvature represented by the valve's beak, marked in Figure 3 by a red symbol) and represented as an ordered set of semilandmark coordinates. Each specimen's outline can be represented by the same number of semilandmark points or by different numbers, so long as this number is large enough to accurately represent the form of the outline.

The next step is to select a second landmark that also lies on the form's outline. This will be used to specify the position of a midline across the surface. In Figure 3 the second landmark is placed at the ventral margin of the valve midway between the two adductor muscle scars (second red symbol located along the lower margin of the drawings comprizing Fig. 3). Obviously, using a constructed point in this manner is a very approximate way of defining the second landmark. It would have been better to have used a more objectively defined and reproducibly located true landmark to tie the path of the midline chord to a well-defined location. But, for these bivalve specimens no more suitable landmark was available. Nevertheless, this marginal midpoint between the two adductor muscles has the highly desirable property of subdividing the valve into two subequal halves and the adductor muscles on which this point's definition is based are unquestionably homologous (in both the mathematical and biological senses of that term) structures. Once these points have been located, sampling of the surface can begin.

Sampling of the specimen's surface is achieved by using the midline landmarks to subdivide the outline into two segments in the manner of extended eigenshape analysis and interpolating a fixed number of equally spaced semilandmarks along each half-outline segment (the green symbols in Fig. 3). All calculations used in carrying out this interpolation are done using 3D coordinates. As the number of interpolated points chosen for this step effectively sets the resolution of the surface sampling system, this number should be chosen with care, though strategies do exist that will allow the shape complexity of the sample to determine the number of points used to represent the set of surfaces (see MacLeod 1999, 2008, 2012). Next, a chord is drawn that joins the midline landmarks. This chord is projected onto the surface of the specimen (as defined by the point-cloud data), and the same number of equally spaced 3D semilandmarks used to represent the outline half-segments is used (via interpolation) to represent its path across the specimen's surface (the blue symbols in Fig. 3).

Finally, chords are drawn between each midline semilandmark and the corresponding outline semilandmarks on either side. These chords are projected onto the surface of the specimen and represented via 3D interpolation as a set of equally spaced semilandmarks. For descriptive convenience I'll refer to the chords joining the midline to the outline as 'rib' chords. Since the lengths and shapes of these rib chords will vary across the specimen's surface, a fixed geometric fidelity index is used to determine how many equally spaced semilandmarks are necessary to represent this chord's form to a given tolerance criterion (usually 95% of uninterpolated chord 3D length, the black symbols in Fig. 3). Once a preliminary interpolation along each rib has been achieved for each specimen, the number of semilandmarks used to represent each corresponding rib chord in each specimen can be compared across all specimens in the sample, and the maximum value used to reinterpolate the geometric representation of that rib. This operation ensures that a minimum standard amount of representational detail is provided in a consistent manner across all specimens in the sample, and that all corresponding ribs across all specimens in the sample are represented by the same number of outline semilandmarks.

The eigensurface sampling procedure results in the creation of a network of semilandmark points that will adapt itself to the 3D form of any shape that is represented by a 3D surface, irrespective of the complexity of that surface, so long as the surface is single valued for all rib chords. To facilitate achievement of a maximally informative fit of the semilandmark system to the underlying form of the specimen, the midline chord can be straight (see Fig. 3) or curved. The only requirement that needs to be respected in deciding on the form of the midline chord is that its path must be able to be specified precisely for each specimen in the sample and it must result in a rib chord network that is single valued for each specimen in the sample. Additionally all surfaces represented by this procedure must be continuous—possess no holes or other missing data.[1] Surfaces that fail to meet these criteria can be accommodated in an eigensurface analysis by subdividing them at landmarks into regions, calculating an eigensurface-based network of semilandmark points for each region, and then combining the regional semilandmark networks into a single synthetic dataset for analysis. Similarly, the surfaces of complete, continuous 3D forms can be represented by using the outline to subdivide the form into 'upper' and 'lower' halves, using the same set of landmarks and same set of outline data to orient the sampling grid for each half, and combining the two halves into a single synthetic dataset prior to analysis. Note that, if either of these composite form-representation strategies is attempted, care must be taken to eliminate any redundant landmark or outline semilandmark points from the dataset during assembly of the composite data.

As mentioned above, the spatial resolution of an eigensurface sampling network is set by the initial decision of the number of outline and midline semilandmarks to use to represent the form. A lower number (*e.g.*, 10, 20) will sample these surfaces' gross form, result in the specification of a smaller number of 3D coordinates to submit for analysis, and result in quicker analyses. Higher numbers (*e.g.*, 40, 50) will sample fine details of the surface, result in specification of larger numbers of 3D semilandmarks for analysis, and result in slower, more computation intensive analyses. Of course, the size of the dataset resulting from any particular outline sampling resolution will also be controlled by the geometric complexity of the set of surfaces under investigation as the bulk of the specified semilandmark data comes from the rib semilandmarks.

Table 1. *Astarte* dataset sizes specified under different eigensurface sampling schemes

Grid Resolution	No. of Semilandmarks	No. of Data Analysis Variables
10-Grid	88	264
15-Grid	207	621
25-Grid	493	1,479
50-Grid	2,011	6,033

Table 1 provides indicative data for the sizes of the semilandmark datasets that result from different sampling resolutions as applied to 3D scans of the three specimens shown in figures 1 and 2. As can be seen from this table the relation between grid resolution and sampling dataset size is decidedly non-linear. Accordingly, care should be taken in determining how much resolution is necessary to solve the problem, or test the hypothesis, you're interested in. As with all data analysis problems, not only is it inefficient to collect more data than you need, in many

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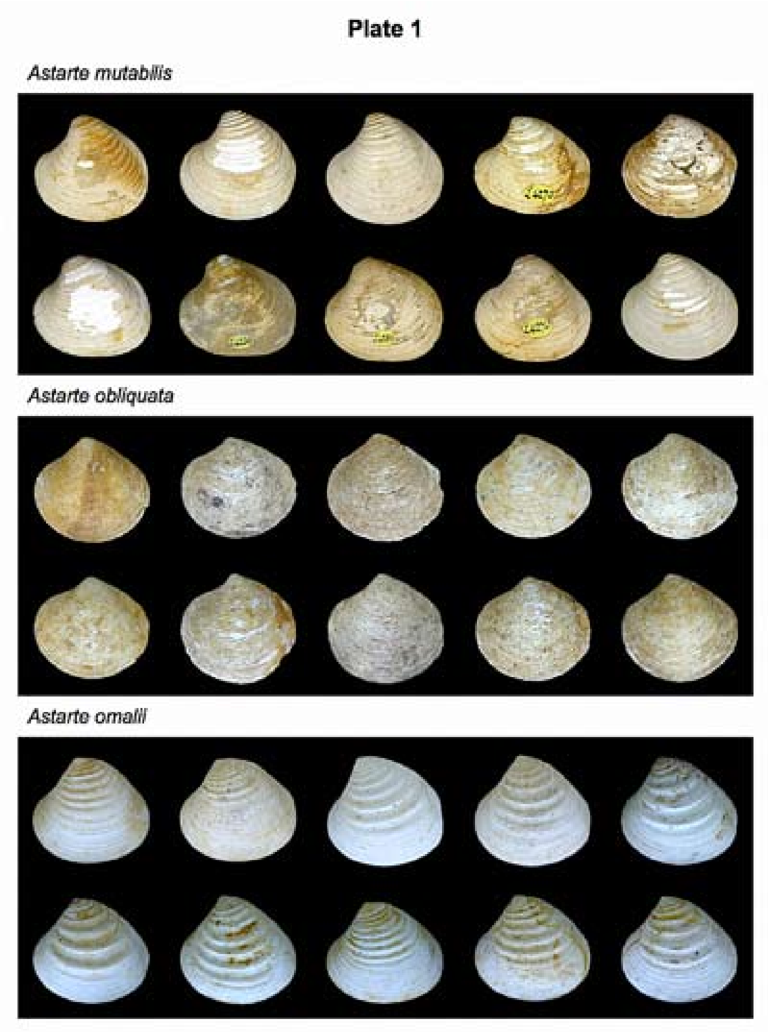
[1] Small holes in the specimen's surface (*e.g.*, entry of exit points for nerve chords in vertebrate crania) can be ignored.

cases doing so introduces other issues into the analytic design (*e.g.*, the need for large sample sizes, see discussion of the *Curse of Dimensionality* in MacLeod 2007). These issues should be avoided if possible. At the very least large datasets will cause the programs that implement generalised least-squares (GLS) Procrustes superposition or principal components analysis (PCA) to take an extraordinarily long time to complete their calculations and may well exceed the design limits either of the software or of the computer used to run the software.

Once the eigensurface sampling procedure has produced a set of topologically comparable sets of semilandmark data points that quantify geometric variation along the surface of a set of forms, these 3D coordinate data may be submitted to any of the various procedures that make up the geometric morphometric toolkit. Generally speaking this will entail registering these data and transforming them into the Procrustes shape space using GLS Procrustes superposition (Rohlf and Slice 1990; MacLeod 2009a) and using Procrustes PCA (also called relative warps analysis, see MacLeod 2010a) to assess the major trends in shape variation, inspect the ordination of surface shapes in a shape-variance optimised coordinate system, and/or reduce the dimensionality of the data via projection of the shape-coordinate data onto a series of shape variance-optimised, orthogonal, latent vectors (= eigenvectors) as a pre-processing step for additional analyses. One of the most common of these additional analyses will be assessment of the differences between groups in a group-optimized discriminant space using canonical variates analysis (CVA, see Campbell and Atchley 1981; MacLeod 2007). Fortunately, all the shape modelling procedures I've discussed in previous essays (see MacLeod 2009b, 2010b) can be used to represent the results of these procedures in a graphical form that greatly enhances our ability to interpret the results and communicate our interpretations to generalized audiences.

In order to illustrate the power of the eigensurface technique I've chosen to reanalyze part of the *Astarte* dataset I used originally to describe it (MacLeod 2008). Plate 1 (over the page) illustrates the first ten specimens for each of the species-specific datasets.



For the purposes of this example the right valves of these specimens were 3D scanned using The Natural History Museum's Konica-Minolta VIVID 910 laser scanner and the resulting scans processed such that each specimen was represented by 5,000–7,000 x,y,z coordinate points. A 15-grid eigensurface sampling resolution was chosen to represent the gross morphology of these species' valves, and the sampling procedure outlined above applied to each specimen in the dataset. This sampling procedure resulted in the specification of 207 interpolated semilandmark points for each specimen in the sample with each point bearing a consistent topological relation to every other point across all of the sampled specimens. Since each semilandmark point exists in 3D space, this procedure resulted in the creation of a dataset in which 621 variables were employed in describing the surface morphology of each specimen. These data were aligned using the GLS Procrustes procedure which normalized each specimen's location and size, and rigidly rotated the semilandmark point set about its centroid to a position in which the sum of squared deviations of each point, relative to the mean shape of the dataset as a whole, was minimized.

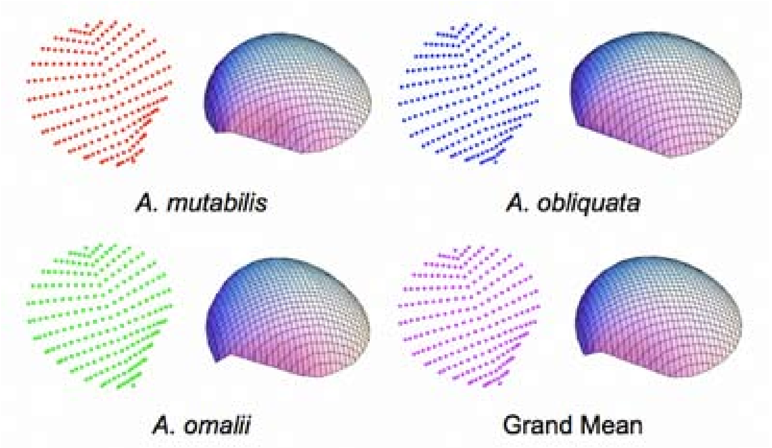


Figure 4. Mean shapes for each of the species-specific datasets and the grand mean for the pooled dataset as a whole. The grand mean controls placement of the tangent plane onto which specimen surface shape configurations are projected in subsequent Procrustes PCA analysis.

Figure 4 summarizes the form of the mean shapes of each species, and the grand mean shape, for both the coordinate data and the surface models created from the coordinate data. Obviously the 15-grid level of resolution captures aspects of the valve vault, escutcheon and beak morphology primarily. While this sampling scheme does not exhaust all the morphological variation available in these shells, inspection of the species-specific mean shapes resulting from its application indicates that this level of spatial sampling resolution does capture distinctions between the species. Let's see if we can use these distinctions to develop a morphometric procedure for testing the degree of shape distinction that characterizes the shells of these species and (perhaps) for allocating unknown *Astarte* shells to the correct taxonomic group.

The first step toward realizing this goal is to use the Procrustes PCA method to summarize the major aspects of shape variation existing in these data and reduce its dimensionality. Of these two, reduction of the system's dimensionality is the more important goal for our analysis since the number of variables used to characterize our surfaces is so large (621) and our sample size so small (30). Characterization of the primary modes of variation in these data is a by-product of this dimensionality reduction step. Nonetheless, from systematic and evolutionary points of view it's an interesting by-product.

Table 2. Eigenvalues obtained from the Procrustes PCA decomposition of the pooled *Astarte* shape covariance matrix

No.	Eigenvalues	% Variation	Cum. % Variation	No.	Eigenvalues	% Variation	Cum. % Variation
1	0.000924	36.830	36.830	15	0.000014	0.553	96.735
2	0.000508	20.246	57.076	16	0.000012	0.463	97.198
3	0.000315	12.540	69.616	17	0.000010	0.418	97.615
4	0.000176	7.031	76.647	18	0.000009	0.358	97.973
5	0.000135	5.384	82.031	19	0.000009	0.348	98.321
6	0.000092	3.670	85.702	20	0.000007	0.291	98.612
7	0.000054	2.151	87.853	21	0.000006	0.257	98.869
8	0.000049	1.943	89.796	22	0.000005	0.203	99.072
9	0.000045	1.809	91.606	23	0.000005	0.179	99.251
10	0.000031	1.249	92.855	24	0.000004	0.160	99.412
11	0.000027	1.093	93.948	25	0.000004	0.150	99.562
12	0.000023	0.918	94.866	26	0.000003	0.134	99.696
13	0.000017	0.690	95.557	27	0.000003	0.118	99.814
14	0.000016	0.625	96.182	28	0.000003	0.105	100.000

Eigenanalytic decomposition of the shape covariance matrix calculated from the pooled sample yields 28 positive eigenvalues (Table 2). Of these, 13 eigenvectors are required to capture 95 percent of the observed surface shape variation. This is impressive dimensionality reduction (97.8 percent) and pulls the number of variables necessary for the subsequent discriminant analysis back into the range of appropriateness given our sample size. A question might be raised concerning stability of eigenvectors calculated in such a high-dimensional space using so few data. But all we're interested in at the moment is whether we can devise a discriminant space that separates these specimens from each other. In this sense we're using Procrustes PCA as a data-transformation procedure to pack the surface variation signal recorded by these semilandmark data into the smallest number of variables possible and, at the same time, ensure those variables' independence from one another.

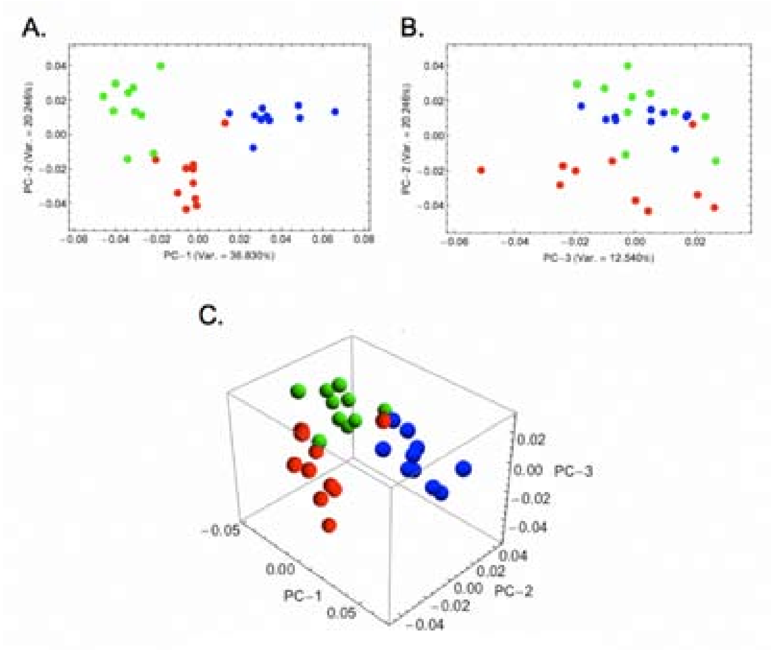


Figure 5. Ordination of Astarte *surface shapes along the first three Procrustes PCA axes. Red symbols,* A. mutabilis*; Blue symbols* A. obliquata*; Green symbols* A. omalii*.*
A. The PC-1 – PC-2 subspace. B. The PC-3 – PC-2 subspace. C. The PC-1 – PC-2 – PC-3 subspace.

While we're not really that interested in the ordination of valve surfaces in the Procrustes PCA shape space *per se*, inspecting them is instructive (Fig. 5). Despite the fact that PC-1 – PC-2 subspace represents only slightly more than 50 percent of the observed shape variation, the distribution of valve surface geometries in this space suggests that these species are distinct from one another in terms of those aspects of valve-surface variation captured by the 15-grid eigensurface sampling scheme. This ordination also suggests that species-specific differences in valve surface shape are largely responsible for the variation observed in the sample as a whole. Finally, there is a suggestion here that all three species are subequally distinct from each other with regard to valve vaulting, beak morphology and escutcheon shape.

Many analysts would end their investigation here as a reasonable distinction between species was achieved in the PCA space. However, doing this would be tantamount to throwing away just under half the information on surface shape variation captured by the eigensurface measurement network and could result in an erroneous interpretation of the true level of distinction between these species that has been captured by these data. Remember, while it's an easy matter to portray the ordinations of groups in the low dimensional PCA subspaces, these subspaces are neither optimized to distinguish between-groups variation, nor to present a complete picture of shape similarity relations, *even within the PCA space*. Rather such subspaces portray primary directions of variation within the pooled dataset and only represent the subset of biologically interesting patterns that happen to be aligned with the dimensions plotted.

To create an accurate picture of group distinction we'll need to run the projected positions of our *Astarte* surface shapes on all 13 of the Procrustes PCA axes that, together, account for 95 percent of observed shape variation into a CVA. This results in the specification of two discriminant axes since we're trying to discriminate between three groups. More importantly though, the CVA technique will use all information residing on all 13 Procrustes PCA axes in its calculations, not just the first two or three that might be inspected as an intermediate step in data analysis. This is more information than we could reasonably hope to assimilate by looking at a series of scatterplots of shape distributions in 2D or 3D Procrustes PCA subspaces (*e.g.*, Fig. 5) and should, at least in theory, result in an improved ordination. Since we're only dealing with three groups, our CVA result will also have the convenient property of allowing us to portray all the information relevant to group discrimination that was picked up by our 15-grid eigensurface sampling scheme in a single 2D scatterplot (Fig. 6).

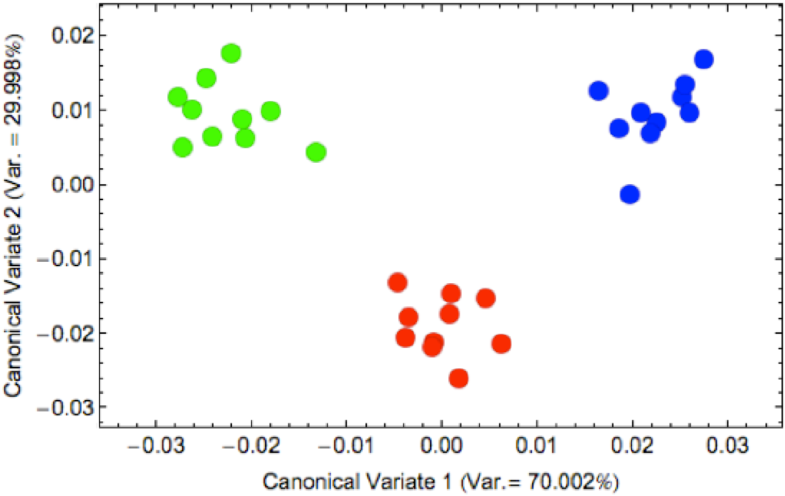


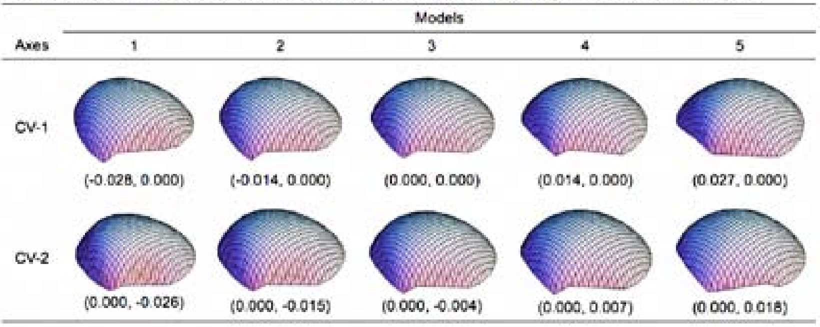
Figure 6. Ordination of the Procrustes PCA score data in the group difference-optimized canonical variates space. Symbols as in Fig. 5.

There really is no comparison between figures 5 and 6 in terms of the degree to which group distinctiveness is represented. Use of a method that's designed to optimize the linear ordination space for group-differences, plus the addition of information from the 'minor' Procrustes PCA axes, has made a considerable difference. Through the application of a data analysis procedure capable of summarizing all the relevant valve surface shape information to optimize between-group differences we can (now) see that the specimens comprizing this sample are entirely distinct from one another in terms of their valve surface morphology, even in the gross manner captured by the 15-grid sampling scheme. Indeed, there's a greater amount of between-groups distinction present on this plot than appears to be present in Plate 1. How can this be?

In Plate 1 we see the specimens comprizing our sample in their full glory, not only exhibiting the characteristics of their species, but also the iron stains, gouges, dings, scratches, that all fossils are heir to; even the occasional museum label. Many of these imperfections are substantial and would have been captured on the original 3D laser scans. However, the eigensurface interpolation procedure minimizes their effect by being blind to any that don't affect the geometry of the surface morphology and by being effectively blind to those whose spatial dimensions fall below the resolution of the sampling grid. Moreover, the influence of any imperfections present in the grid data are minimized during the data analysis phase of the eigensurface procedure because these will tend to be aspects of shape variation peculiar to individual specimens, and so (most likely) located on the higher Procrustes PCA (= eigenvector) axes. Note that most of these axes were not carried forward and allowed to participate in the CVA. In effect, the eigensurface procedure tunes itself to emphasize the signals associated with the geometric regularities of morpho-group membership while rejecting the noise that characterizes individual specimens. This fine level of partitioning of the pattern of the morphological variation into generalized signal and idiosyncratic noise components is very difficult to achieve via simple qualitative inspection of specimen morphologies, in no small measure because the human visual system has been honed and refined over many millions of years to be drawn to the odd, the idiosyncratic, and the seemingly out of place (Broadbent 1958; Triesman 1982; Bertenfall 1992). In this sense eigensurface analysis—and other methods like it—not only extend the capabilities of the human visual system for assessing patterns within morphological data, it can be argued they represent substantial improvements on the human system.[2]

So, what do these *Astarte* discriminant axes 'look like' in terms of patterns of morphological variation? Table 3 illustrates the geometric character of the two *Astarte* discriminant axes using a series of theoretical surface shape configurations residing at equally spaced positions along each axis. These models were calculated using the method described in MacLeod (2009b).

Table 3. Along-axis 3D shape models illustrating patterns of morphological change along the two Astarte discriminant axes. Numbers in parentheses are coordinate positions of the modeled morphologies in the CVA space (Fig. 6).



	Models				
Axes	1	2	3	4	5
CV-1	(-0.028, 0.000)	(-0.014, 0.000)	(0.000, 0.000)	(0.014, 0.000)	(0.027, 0.000)
CV-2	(0.000, -0.026)	(0.000, -0.015)	(0.000, -0.004)	(0.000, 0.007)	(0.000, 0.018)

Inspection of Table 3 shows that CV-1 captures the surface shape distinction between rather narrow forms characterized by (1) a high valve vault that verges strongly toward the beak; (2) a prominent, sharply pointed and asymmetrical beak; and (3) a long escutcheon oriented to form a decidedly shallow angle with the main portion of the valve periphery (low scores on CV-1), and broad forms characterized by (1) a low valve vault with a more equilateral vault curve; (2) a small, pointed and more symmetrical beak; and (3) a long escutcheon set at a much higher angle with regard to the valve periphery (high scores along CV-1). These models are consistent

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[2] See MacLeod *et al.* (2010) and Culverhouse *et al.* (in press) for more extended discussions of the limitations of human visual systems in the context of taxonomic analysis.

with the main taxonomic distinction shown along CV-1 which contrasts *A. omalii* (low scores) and *A. obliquata* (high scores). Similarly, CV-2 captures the distinction between forms with (1) a relatively high, equilaterally curved valve vault; (2) a small, pointed, asymmetrical beak; and (3) a relatively short escutcheon that meets the valve periphery at a relatively high angle (low scores on CV-2), with forms characterized by (1) a low, equilaterally curved valve vault; (2) a small, pointed, symmetrical beak; and (3) a relatively long escutcheon that meets the valve periphery at a relatively low angle (high scores on CV-2). These models are consistent with the main taxonomic distinction shown by the scatter of shapes along CV-2 which contrasts *A. mutabilis* (low scores) and *A. omalii – A. obliquata* (high scores). In interpreting these modelling results it should be noted that the CV-2 models calculated for the higher values along this axis fall midway between the shape fields occupied by *A. omalii* and *A. obliquata*. Consequently these models reflect aspects of both species' characteristic morphology, but correspond to no valve shapes that exist in the demonstration dataset.

The eigensurface technique is only one of a number of emerging morphometric methods that are now being developed to analyse 3D surfaces in the context of the geometric morphometric paradigm (see also Gunz *et al.* 2005; Polly 2008). These procedures promise to extend the morphometric toolkit into the realm where image processing and analysis passes into virtual reality and computer vision. More pragmatically, their use has demonstrated that a previously unsuspected wealth of phylogenetic, taxonomic, functional, ecological, environmental and even behavioral information resides in the surface features of bones, shells and other structures, both living and fossil, as well as providing a means to analyse and extract that information from biological structures (*e.g.*, Sievwright and MacLeod 2012). Indeed, application of this data sampling/analysis strategy even transcends biology itself (*e.g.*, MacLeod *et al.* 2013) or, perhaps more properly, demonstrates that morphological data are ubiquitous across the biological *and* physical sciences while providing new tools that all scientists can use in a flexible and informative manner to probe, characterize, and discover the geometric patterns residing in natural phenomena.

Software for carrying out an eigensurface analysis is available as a set of *Mathematica*™ notebooks from myself. I'd like to acknowledge Jonathan Krieger for his work in helping to develop the algorithms on which the current implementation of eigensurface analysis is based.

Norman MacLeod
The Natural History Museum
<N.MacLeod@nhm.ac.u k>

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Don't forget the *PalaeoMath 101* web page, at:

<**http://www.palass.org/modules.php?name=palaeo_math&page= 1**>

Art of Ancient Life
(the arts and endeavours of a pencil pusher)

Most people find god, I found Peter Trusler – well (at that time) two illustrations created by him, and those two images set me on an eventful course that was to change my life.

Nine to five was no longer for me. Contracts such as illustrating power tools for Black and Decker were not my work focus any more. I gave up my job! I set about reading every book on prehistory that I could lay my hands on and started to paint – **Art of Ancient Life** was conceived as a business.

That was 20 years ago and I am still enjoying this curious journey; a journey, in fact, that I believe I am only really beginning now. It has taken me to some interesting places and also injected major confusion through my developed accent over the years. When asked where I come from, I find it easier to cite the Jurassic as one of my favourite ports of call, rather than explain that I have lived in England, Scotland and Australia in equal measure. Certainly, I feel most at home when I give my heart over to wander and explore the floodplains of the Jurassic – and 'home is where the heart is' after all. For the past few years, however, it has settled in the Early Cretaceous, somewhere between the Otways and Strzeleckis, in Melbourne; an excellent place to be if you have palaeontological inclinations and friends like Tom and Pat Rich.

Back here in Blighty, however, the bedrock is a bit more ancient (at least in my local vicinity) and, with dinosaurs being a bit thin on the ground, I supplement my artistic endeavours with teaching, as well as indulging my archaeological, musical and literary pursuits.

I believe it's quite rare to hear of someone saying they like the British weather, particularly up here in Scotland, but after a decade or more of sun and sand, I find the misty Scottish mornings inspire the atmosphere I aim for in my illustrations.

I have been constantly developing my art and creating images depicting prehistoric life over the past two decades – juggling my passion to produce high quality studies, based on all things ancient and extinct, with the ever present desire to put food on the table. And it would appear that I have done something right if you consider my waistline in this scenario! However, in a world increasingly dominated by computers, sophisticated software and complex programs, this becomes an ever-increasing challenge for an artist who sticks to his brushes.

With this in mind, I continually develop skills and techniques, finding new methods to gain the results I set out to achieve. All part of the journey of course – and I can honestly say that I am happier than I have ever been with the work I am producing right now.

With dinosaurs featuring so strongly throughout my work, I find I am constantly asked (particularly when I am teaching) what my favourite dinosaur is. There could be a few contenders, but the fact is, I don't really have a favourite, not really. If it's extinct, be it a salamander or a sabre tooth, I am hooked. And, being really honest here, my absolute passion is for plant life. My down-trodden dinosaurs constantly have to settle for second place beyond a barrage of flora.

As I hope is evident in my works, I am not one who subscribes to the idea of a cosmic gardener who comes around every so often and cleans things up. I know only too well from my own gardening experiences that the longer I leave things the worse they get, and it is this steady decline into chaos that excites me most. The way plants grow, the shapes they create, the way they break, the way they bend and twist and the decay that befalls them – this is what keeps me drawing.

John Sibbick once paid me a wonderful compliment when he commented that my paintings most certainly don't look like the Garden of Eden, and I can shamefully say that, back in Melbourne, I even allowed a whole fernery of *Dicksonia*, *Cyathea* and *Blechnum* to shrivel up just so that I could observe their death throws. Therein lay my interest, obsession and addiction for vegetative intricacies that for half a lifetime I have spent exploring.

I began my career as an archaeological illustrator, depicting ancient human habitation, and one of the first things I learned was the value of context, without which finds have little meaning. The same thing applies to palaeontological remains. Having grown up in an era of illustrated dinosaurs being confined to swamps and deserts, with the obligatory monkey puzzle tree tucked in for good measure, I have sought in my own way to address that balance, with an ever-growing emphasis on recreating well-researched and informed depictions of prehistoric plants and environments. I hope this is evident in my pictures.

My journey continues!

Jon Hoad
Art of Ancient Life: Palaeontological Reconstruction.
Australian Citizenship: Distinguished Talent.

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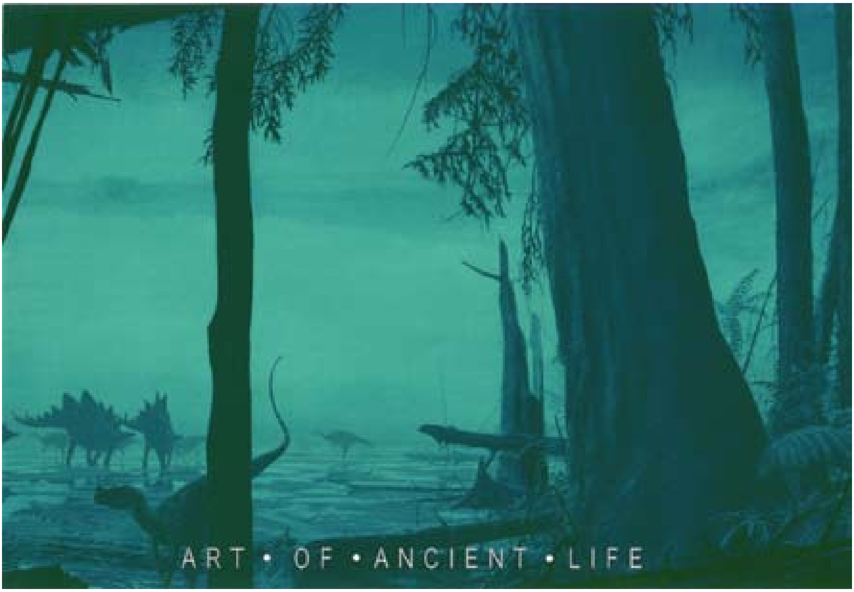

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>>***Future*** Meetings of Other Bodies

11th INTECOL Congress, Ecology: Into the next 100 years

London *18 – 23 August 2013*

The '11th INTECOL Congress, Ecology: Into the next 100 years' will be held in London as part of the centenary celebrations of the British Ecological Society. The theme of the Congress is advancing ecology and making it count, and will present world class ecological science that will truly move the science forward.

Activities will include a symposium on 'Process-based approaches in macroecology', an international macroecology social, and a workshop with Thiago Rangel.

Further information is available on the INTECOL 2013 website at <**http://intecol2013.org** />.

The 61st SVPCA, the 22nd SPPC, jointly meeting with the GCG

National Museums Scotland and University of Edinburgh *27 – 31 August 2013*

The 61st Symposium of Vertebrate Palaeontology and Comparative Anatomy (SVPCA) and the 22nd Symposium of Palaeontological Preparation and Conservation (SPPC) will be holding this joint meeting with the Geological Curators' Group (GCG).

This year the meeting will include a symposium celebrating the life and contribution to vertebrate palaeontology of Stan Wood. The meeting will be followed by a field trip to important Palaeozoic fossiliferous sites in the Scottish Borders.

Platform and poster presentations on all aspects of vertebrate palaeontology are invited for SVPCA, and on all aspects of geological and palaeontological preparation, conservation and curation for the combined SPPC/GCG meeting. Further details for both meetings will be available in the first circular, which will be circulated in March. If you are interested in attending either of these meetings and would like to be included on the mailing list, please contact Stig Walsh (e-mail <**s.walsh@nms.ac.u k**>) for SVPCA or Vicen Carrió (e-mail <**v.carrio@nms.ac.u k**>) for SPPC/GCG.

Organisers: Nick Fraser, Stephen Brusatte, Stig Walsh and Vicen Carrió.

International Summer School "Methods of Palaeoenvironmental Researches"

Moscow, Russia *11 – 14 September 2013*

The international scientific community is invited to an International Summer School on 'Methods of palaeoenvironmental researches' in order to discuss the latest developments in pollen analysis and data interpretation. Further information will be available at <**http://pollendata.org** />.

2nd International Joint Congress APL E-APLF on “Pollen Diversity and Function in a Changing Environment”

Madrid, Spain *17 – 20 September 2013*

The Spanish and French Palynological Societies, APLE and APLF, will join for their next Symposium in Madrid on 17–20 September 2013. Under the general title of 'Pollen Diversity and Function in a Changing Environment' and organized by CSIC and Complutense University palynologists, the two societies will meet to present and discuss their recent findings on relevant palynological topics.

Further information is available at <**http://pollen2013.com** />. The deadline for abstracts is 19th April 2013.

17th Evolutionary Biology Meeting at Marseilles

Marseilles, France *17 – 20 September 2013*

The Evolutionary Biology Meeting at Marseilles is an annual congress, which has gathered high-level experts in evolutionary biology since its creation in 1997.

The following subjects will be discussed: Evolutionary biology concepts and modelisations for biological annotation; Biodiversity and Systematics; Comparative genomics and post-genomics (at all taxonomic levels); Functional phylogeny; Environment and biological evolution; Origin of Life and exobiology; Non-adaptative versus adaptative evolution; The «minor» phyla: their usefulness in evolutionary biology knowledge.

Further information is available on the conference website at <**http://sites.univ-provence.fr/evol-cgr** />.

Celebrating Dinosaur Island: Jehol-Wealden International Conference

University of Southampton, UK *20 – 21 September 2013*

The Isle of Wight (Dinosaur Island) and China are key areas for Cretaceous fossils, especially dinosaurs. Chinese and UK dinosaur palaeontologists will discuss their research at the National Oceanography Centre, Southampton. Visit key dinosaur sites on the Isle of Wight and network with tourism and business leaders.

Two-day conference hosted by the University of Southampton Confucius Institute and Ocean and Earth Sciences with support from the National Oceanography Centre, Southampton, the Isle of Wight Visitor Attraction Association and Dinosaur Isle Museum, Sandown. Talks (15 minutes) and posters are solicited for Friday 20th September, then the conference moves to the Isle of Wight.

Registration is £100 to include coffee breaks, lunches, evening receptions, the conference dinner and all transport to and on the Isle of Wight.

For further information and booking details e-mail <**gareth.dyke@soton.ac.uk**> or visit:
<**http://www.southampton.ac.uk/multidisciplinary/news/events/2013/09/20_dinosaur_island.page**>
<**http://www.dinosaurisle.com/newhomepage.aspx**>
<**http://isleofwightvaa.com/**>.

46th Palynological Society Annual Meeting

San Francisco, USA *20 – 24 October 2013*

The 46th AASP-TPS (AASP: The Palynological Society) Annual Meeting will be a joint meeting with DINO 10, Canadian Association of Palynologists, and the North American Micropaleontology Section of SEPM (NAMS).

The meeting will be held in the heart of San Francisco at the Hotel Whitcomb, which has been chosen for its location, its historic elegance, its proximity to everything San Franciscan, and its excellent conference facilities. A large block of rooms has been reserved at the conference hotel for delegates. Field trips will include a pre-meeting field-trip to Napa Valley, Muir Woods, Golden Gate Bridge, *etc.*, and a post-meeting field-trip to either Sierra Nevada or Santa Cruz.

San Francisco (SF) is located on beautiful San Francisco Bay in coastal central California on the west coast of the United States. SF is a tourist destination recognized worldwide with such major attractions as the Golden Gate Bridge, Alcatraz Island, cable cars, beautiful beaches, redwood forests, Napa Valley wine country, *etc.* These popular features should help attract palynologists and their families from around the world to visit and maybe spend a few extra days vacationing in the Bay Area. To take advantage of the excellent weather during early Fall, the meeting is scheduled for 20–24 October 2013 – 30 years to the week after the 16th annual meeting held in SF in 1983.

Further information will be available in due course on the Palynological Society website at <**http://www.palynology.org/**>, or contact Lanny Fisk (e-mail <**Lanny@PaleoResource.com**>.

GEOS 2013

Phuket, Thailand *28 – 29 October 2013*

As the only life-bearing planet, Earth provides resources and the exact conditions to make life possible. However, with the advent of technology and industrialization, the Earth's resources are being pushed to the brink of depletion. Non-sustainable industrial practices are not only endangering the supply of the Earth's natural resources, but are also putting burden on life itself by bringing about pollution and climate change.

A major role of earth science scholars is to examine the delicate balance between the Earth's resources and the growing demands of industrialization. Through research and development, earth scientists have the power to preserve the planet's different resource domains by providing expert opinion and information about the forces which make life possible on Earth.

For further information and registration details visit the conference website at <**http://www.geoearth.org/index.html**>.

10th North American Paleontological Convention

Gainesville, Florida *February 2014*

The meeting will be hosted by the Florida Museum of Natural History (University of Florida) from 15th to 18th February (Saturday to Tuesday). Pre-conference and post-conference field-trips are tentatively planned for 13–14 and 19–20 February.

Check the Paleontological Society website at <**http://www.paleosoc.org /**> for updates.

Lyell Meeting 2014. Deep sea chemosynthetic ecosystems: from modern exploration to the geological and fossil record

Geological Society of London, Burlington House, London *12 March 2014*

The Annual Lyell Meeting for 2014 is being organized by Dr Silvia Danise (Plymouth) and Dr Crispin Little (Leeds). More details will be available shortly.

Mid-Mesozoic: The Age of Dinosaurs in transition

Fruita, Colorado & Green River, Utah *, USA* *30 April – 5 May 2014*

The Morrison Formation is world famous for its Upper Jurassic dinosaur fossils and is one of the most extensively studied dinosaur-bearing units in the world. It is exceptionally well-exposed across the Colorado Plateau and preserves at least two dinosaur faunas. In contrast the overlying Lower Cretaceous Cedar Mountain Formation spans roughly 35 million years, in comparison to the Morrison Formation's seven million years. The Cedar Mountain is approximately half the stratigraphic thickness, but represents about five times as much in geologic time, in comparison to the two closely related faunas in the Morrison; the Cedar Mountain preserves at least six different distinct faunas.

Colorado Plateau's Morrison–Cedar Mountain Formations are contributing critical information about an important period of time in the history of terrestrial life in the Northern Hemisphere. The density of biostratigraphic, chronostratigraphic and palaeoclimatic data make the Colorado Plateau a standard on which to resolve the geological and palaeobiological history of the mid-Mesozoic in the northern hemisphere.

This field conference has been structured to minimize the participant's cost ($230.00 US). It consists of four day-long field trips to visit pivotal sections and localities, with an optional pre-meeting trip to Dinosaur National Monument ($50.00 US). Additionally, there are two days for conference talks and posters of international scope.

Check the conference website at <**http://www.utahpaleo.org/mid-mesozoic-conference.htm l**>.

Fossil Fishes and Fakes:
The Sir Arthur Smith Woodward 150th Anniversary Symposium
Natural History Museum, London *21 May 2014*

Smith Woodward built his scientific reputation on detailed and meticulous studies of fossil fish, many of which helped to form the foundations of current research on numerous fish groups. However, he also contributed to our knowledge of other extinct animals and regional geology, and he endured some notoriety for his involvement in the Piltdown Man hoax. Almost no attempt has been made to assess Smith Woodward's wider impact on palaeontology. This one-day symposium aims to rectify this omission, with invited speakers who will present papers on Smith Woodward's life and career, his varied scientific outputs, and his involvement in Piltdown.

To pre-register and receive further information please e-mail the Meeting Coordinator at <**ASW150@nhm.ac.uk**>.

Commission Internationale de la Microflore du Paléozoïque International (CIMP)
Ghent-Liège, Belgium *6 – 11 July 2014*

This meeting will include general CIMP sessions, chitinozoan workshops and a field-trip between Ghent and Liège. For more information please contact <**p.steemans@ulg.ac.be**>.

9th European Palaeobotany-Palynology Conference
Padua, Italy *26 – 31 August 2014*

The Italian group of palaeobotanists and palynologists is very glad to be able to invite all of you to Padova in 2014 for the next EPPC. Padua (Padova in Italian) is a picturesque, historic city in Northern Italy (about 40 km west of Venice), with a dense network of arcaded streets, large communal "piazza" (squares), and many bridges crossing the various branches of the Bacchiglione.

All scientific sessions will be held at the new Department of Geoscience, and the famous Botanical Garden and Museum of Geology and Palaeontology will be involved in this conference. Field-trips are planned in the fascinating landscapes of the Dolomites, Sardinia, Emilia-Romagna, Latium and Tuscany.

For further information contact the conference secretary (e-mail <**Evelyn.Kustatscher@naturmuseum.it**>) or look for updates on the conference website at <**http://www.geoscienze.unipd.it/9th-european-palaeobotany-palynology-conference/**>.

9th International Congress "Cephalopods – Present and Past" (ISCPP 9) and the 5th International Coleoid Symposium

University of Zurich, Switzerland *4 – 14 September 2014*

This series of cephalopod meetings was launched in the seventies in York. Thereafter, they were held every three or four years in various cities including Tübingen, Granada, Vienna, Fayetteville, Sapporo and Dijon. It is the only occasion in which cephalopod workers meet from around the world. There are normally three to four days of scientific presentations. The interesting and important aspect of this meeting is that both biologists and palaeontologists meet, although there traditionally have been slightly more palaeontologists. This might change at the 2014 meeting, however, since it will host the International Coleoid Symposium for the first time.

Traditionally, two field-trips are offered in association with the meeting. On this occasion, trips are planned to the Fossillagerstätten of southern Germany, and fossil localities yielding cephalopod fossils in Switzerland, each of which will last a couple of days. Details of these field-trips will be announced in due course.

For further information please visit the conference website at <**http://www.pim.uzh.ch/symposia/ISCPP9/index.php**>.

6th International Symposium on Lithographic Limestone and Plattenkalk

Museo del Desierto, Saltillo, Mexico *15 – 19 September 2014*

The Museo del Desierto invites you to the 6th International Symposium on Lithographic Limestones and Plattenkalk. This multidisciplinary meeting is planned to address aspects of the study of lithographic limestones and plattenkalk deposits across all disciplines, from palaeontology (taxonomy, palaeoecology, taphonomy), to geology (stratigraphy, sedimentology, palaeoenvironments), and also mineralogy and petrology of Plattenkalk deposits and related Fossil-Lagerstätten. The meeting is organized in collaboration with the Institute of Earth Sciences of the University of Heidelberg, Germany. We plan field-trips to the famous plattenkalk deposits of Vallecillo and Cuatro Cienegas.

Please consider submitting manuscripts for the LAK conference proceedings. These are planned to be published in the *Revista Mexicana de Ciencias Geologicas*, which is indexed in several citation indices, including the Science Citation Index. Impact Factor (2010) is 1.136. The *Revista* is an open-access journal.

Please visit the conference website at <**http://isllpsaltillo.uni-hd.de/**> for updates.

4th International Palaeontological Congress (IPC 2014) to include the 47th AASP-TPS (AASP – The Palynological Society) Annual Meeting

Centro Científico Tecnológico, Mendoza, Argentina *28 September – 3 October 2014*

Local organizers are planning a comprehensive congress with an intellectually motivating scientific programme. The Congress will create opportunities for participants to present and share experiences, explore new directions and debate topics among specialists from across the globe. The meeting will include the 47th AASP-TPS Annual Meeting.

A varied array of meeting styles with a combination of keynote lectures, special symposia on leading issues, interactive workshops, technical sessions, and short courses promises to hold sessions of interest to all palaeontologists.

Delegates will have the opportunity to enjoy a wide range of conference excursions to rich and well-known Argentinean palaeontological sites involving a combination of scientific and touristic attractions. The schedule of field trips covers superbly exposed sedimentary successions, representing a great diversity of marine and continental palaeoenvironments, and encompasses nearly the whole stratigraphic record.

Organizers for the 47th AASP-TPS Annual Meeting are now calling for Symposium topics. If you have any great ideas for palynology-related symposia, please feel free to contact Thomas Demchuk by e-mail to <**tdemchuk@swbell.net**>.

Please see the conference website at <**http://www.ipc4mendoza2014.org.ar/**> for further details. Abstract deadline: March 2014.

14th International Palynological Congress and the 10th International Organization of Palaeobotanists Congress (IPC XIV/ IOPC X 2016)

Salvador, Brazil *Late September – early October 2016*

Local organizers are planning the Congress to occur after the Olympics in Brazil. Further details will follow in due course.

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

——OBITUARY——

Alice Rasmussen
1923 – 2013

Alice Rasmussen was an incredibly dedicated amateur geologist who achieved international fame.

Throughout her life, Alice Rasmussen had a passion for fossils, but only after she retired from her career as a horticulturalist was she really able to dedicate herself to her hobby. Together with her husband and four children, she amassed an impressive collection of fossils mostly from Faxe Quarry and Stevns Cliff. Not only full of impressive specimens, her collection was very well documented, with Latin names and the precise locations of the finds.

For more than twenty years Alice Rasmussen was a beloved guide for schoolchildren and tourists visiting Faxe Kalkbrud, and with her boundless enthusiasm she opened the eyes of everybody to the incredible prehistoric world recorded by fossils in the quarry. For this work, the city council of Faxe awarded Alice Rasmussen the Culture prize in 1998.

When the building of the new exhibition at Geomuseum Faxe became a reality in 2008, Alice took a very active role and donated several of her finest and scientifically most important specimens from Faxe quarry to the new exhibition, ensuring the present high quality of the exhibition.

In December 2012, Alice was awarded the Palaeontological Association's Mary Anning Award, for her enormous contribution to science. At first she was reluctant to receive the prize as she said with her usual modesty, "I have just been doing my hobby", but she quickly realized how great an honour it was and there is no doubt that receiving the prize in Dublin was one of her proudest moments.

After she passed away in March 2013, her family informed us that her wish was that her collection, which is in excess of 3,000 specimens, was to be donated to Geomuseum Faxe, to ensure it would be used for the public good.

Alice was an inspiration to us all, and she will be sorely missed, but her legacy lives on as her collection is being incorporated in the exhibition of Geomuseum Faxe.

Jesper Milàn, Tove Damholt & Bodil W. Lauridsen

Meeting REPORTS

7th World Congress of Herpetology

University of British Columbia, Vancouver, Canada *8 – 14 August 2012*

The World Congress of Herpetologists (WCH) is a meeting that features research on amphibians and (non-avian) reptiles. It takes place every three or four years and has previously been held in Canterbury (UK), Adelaide (Australia), Prague (Czech Republic), Bentota (Sri Lanka), Stellenbosch (South Africa) and Manaus (Brazil).

The seventh meeting was the first to take place in North America and was hosted by the University of British Columbia, Vancouver (Canada). To maximise the profile of the meeting it enveloped the annual meeting(s) of the Society for the Study of Amphibians and Reptiles (SSAR), the American Society of Ichthyologists and Herpetologists (ASIH), the American Elasmobranch Society (AES), and Herpetologists League (HL). Therefore, fish were also on the menu. Many of the talks focused on the behaviour, physiology and conservation of modern taxa, but morphology, evolution, palaeontology and perspective from deep time were also important facets of the meeting.

The first day of the conference was set aside for committee meetings and the arrival and registration of delegates and guests. The evening Travelogue presentation was given by **Harry W. Greene**, whose talk entitled "Natural History, Aesthetics and Conservation" featuring mainly snakes and frogs was wonderfully delivered and highly enjoyable.

Thursday started with a welcome from the organisers, the WCH secretary general, and the Vice Provost of the University of British Columbia. The inaugural plenary speaker was the dynamic and engaging **Tyrone Hayes** who drew our attention to the devastating effects of the herbicide atrazine on amphibians and the environment in general. The Robert H. Gibbs, Jr Memorial Award was presented to **Lance Grande** for "an outstanding body of published work in systematic ichthyology" that includes many impressive papers on fossil fish (*e.g.* Grande and Eastman, 1986; Grande and Bemis, 1991). This was followed by the past-president address by **Michael Douglas** and a moving eulogy to recently deceased ichthyologist Joseph S. Nelson delivered by Joe's wife. The second plenary speaker of the morning was **Karen Warkentin**, who spoke about environmentally cued hatching of frog embryos. The 'Reptile Pal[a]eontology' session began with **Stephanie Drumheller** discussing bite marks in modern and fossil crocodylians. **Nicholas Longrich** followed with a talk on *Coniophis*, an early terrestrial snake from the Late Cretaceous of North America. **Jacques Gauthier** conveyed results from the seven-year-long "deep scaly project" which surveyed lepidosaur skull anatomy using high resolution Computed Tomography scans (hrCT) (see <**http://www.digimorph.org/**>). **Mark Hutchinson** presented a detailed re-evaluation of *Bharatagama,* a fossil lepidosaur from the Early Jurassic of India previously problematic for molecular clock analyses. The day ended with the welcome reception, which was an outside BBQ accompanied by croquet in fine weather.

Friday morning began with a plenary talk by **Lara Ferry** on the public perception of "shark people". This was followed by a plenary talk from **Susan Evans** on the fossil record and early evolution of lepidosaurs (lizards, snakes and tuatara). She stressed the importance of fossil taxa for understanding the evolution of skull structure in the group. The remainder of the day included talks on a variety of topics interspersed with social coffee breaks in the sun (or was it the other way around?). One of the stand-out talks was that by **Dean Adams** who compared the evolutionary rates of morphological features that are related to ecology in *Plethodon* salamanders. **Sean Harrington** examined the ossification sequence of skeletal elements in modern amphibians to reconstruct ancestral sequences. **Christy Hipsley** presented on Cenozoic climate change and lacertid lizard evolution. After a dedicated poster session (Figure 1) the day concluded with the feature speaker **Richard J. Wassersug**, who discussed the differences between fish and tadpole body shape and their relationship to locomotion.

Figure 1. Juan Daza and Susan Evans at a poster session.

Saturday morning's plenary speaker was **Laurie J. Vitt**, who lamented the de-emphasis of natural history in university classes today. Saturday also saw the beginning of one of the conference symposia, entitled 'Insights from the Fossil Record' (Figure 2), organised by **Jim Gardner** of the Royal Tyrrell Museum. Jim initiated the symposium with a talk about work carried out with David DeMar on the Mesozoic and early Cenozoic lissamphibian assemblages of western North America and their associated sampling biases. He was followed by **Pavel Skutschas** who reviewed the numerous Mesozoic lissamphibian localities of Middle Asia and Siberia. **Jason Anderson** described how hrCT was providing new data for tackling the problem of lissamphibian origins and in particular the phylogenetic position of caecilians. **Yuan Wang** spoke about his research with Susan Evans and Liping Dong on the beautiful lissamphibian and squamate fossils from the world famous Jehol biota of China. This material has provided a wealth of information on the palaeoecology, reproductive biology, and morphological diversity of groups whose fossil records are generally regarded as frustratingly poor. The final speaker of the morning, **Walter Joyce**, talked about turtles. Although their exact origins remain unresolved, fossils have contributed greatly to our understanding of their early biogeography, palaeoecology, and anatomical evolution.

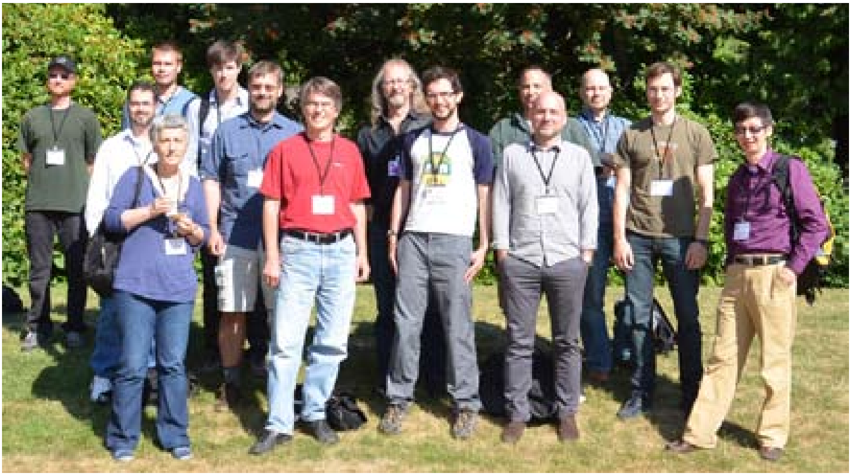

Figure 2. Contributors to the 'Insights from the Fossil Record' Symposium:
Back row: Dave Demar, Pavel Skutschas, Krister Smith.
Middle Row: Randall Nydam, Jim Gardner, Michael Caldwell, Christopher Brochu, Walter Joyce.
Front Row: Susan Evans, Jason Anderson, Marc Jones, Johannes Müller, Alessandro Palci, Yuan Wang.
(Absent from the photo is Juan Daza.) Photo supplied by Liping Dong.

After lunch **Christopher Brochu** spoke about the importance of including fossils in both phylogenetic and biogeographic analyses. He argued that the persistent mistaken perception of modern crocodylians as ancient unchanged beasts was unfortunately a persistent barrier to this practice. On a more positive note Chris also promised that the evolutionary relationships of the false gavial (*Tomistoma*) are close to being finally resolved. **Marc Jones** asserted that although the New Zealand tuatara (*Sphenodon*) has no close living relatives it does not represent the "primitive condition" for lepidosaurs as shown by its fossil relatives (Rhynchocephalia). Both talks were followed by an extended discussion on why the phrase "living fossil" should be avoided and how even using "basal" to describe extant taxa can lead to prejudice and circular reasoning when interpreting character polarity. After coffee, **Susan Evans** presented a talk on the fossil record of squamates and the problems of reading the record literally. **Randall Nydam** provided a comprehensive review of North American microsites charting the changes in Jurassic and Cretaceous squamate faunas. In the concurrent 'ASIH Stoye Award' session **Tyler Lyson** spoke about the evolution and development of the turtle shell. The poster session at the end of the day provided further opportunity to discuss all things herpetological. Two posters by **Mariana Morando** on lizard phylogenetics caught the eye because of their classic card and glue construction.

Sunday's plenary speaker was **Mark-Oliver Rödel** who spoke about the diversity, threats and future of modern West African amphibians. He discussed how the centres of major frog diversity in Western Africa seem to correspond to previous hypotheses made by botanists on the location of Pleistocene refugia. The 'Insights from the Fossil Record Symposium' recommenced with **Krister Smith**. He discussed how the squamate fossil record might provide an important tool for investigating Cenozoic climate change, and showed that even fossils known only from isolated elements could contribute to a total evidence approach. **Juan Daza** presented work carried out with Aaron Bauer and Eric Snively on the contribution of fossils to gekkotan phylogeny. He also explained why geckos preserved in Miocene amber from Hispaniola encompass greater diversity than previously supposed. After coffee, **Johannes Müller** described his work with Christy Hipsley on the origins of amphisbaenians (worm lizards). Analyses with both genes and fossils, not least *Cryptolacerta* from the Eocene Messel Pit of Germany, indicate a position close to Lacertidae (the group that contains the common lizard and sand lizards found in the UK). The final speaker at the symposium was **Michael Caldwell**, with co-authors Alessandro Palci and Randall Nydam, who gave a chronological account of the still contentious debate on snake origins that has been raging since Cope and Nopsca and the key role of fossils.

In the concurrent session on 'Caecilian Biology', **Hilary Maddin** presented results of a survey of braincase structure in modern caecilians and its implications for *Eocaecilia* from the Early Jurassic of North America. The skulls and digging movements of these long-bodied amphibians were covered by **Anthony Herrel**, **Thomas Kleinteich**, and **Emma Sherratt**. **Hendrik Müller** gave an excellent overview of caecilian reproductive strategies and suggested it is now time to stop referring to caecilians as being "poorly known". The 'Reptile Speciation & Phylogeography' session included a talk by **Michelle Lawing** on the palaeophylogeography of recent turtles and its relationship to climate. In the Amphibian 'Systematics & Phylogenetics' session **Robert Pyron** gave a talk on Lissamphibia divergence times and fossil calibrations. The final poster session of the conference provided one last time to survey the research on show. This included a great poster by **Virginia Noble** on tadpoles.

On Monday, the final plenary speaker was **Kelly Zamudio** who spoke about diversification and conservation of reptiles and amphibians. The 'Reptile Morphology' session included four talks of note for vertebrate palaeontologists: **Jennifer Nestler** used geometrics to examine the taxonomy of *Crocodylus*, **Samatha Payne** on tail regeneration in geckos, **Derek Larson** compared tooth variation in *Varanus* (monitor lizards), and **Tristan Stayton** spoke on the material properties of turtle shell bone. In the 'Lizard Evolution' session **Emma Sherratt** used limb proportions from modern *Anolis* lizards to infer the ecomorphology of fossil relatives trapped in Miocene amber and imaged with hrCT. In the symposium on 'Biogeography of African Amphibians and Reptiles' there were several notable talks: *Miguel Vences* gave an overview of the faunal history of Madagascar, **Edward Stanley** talked about cordylid lizards, and **Chris Sidor** talked about the biogeographic patterns of early tetrapods from the Permian and Triassic of Africa. The 'Caudal Autotomy' session included talks on the phenomenon of tail self-amputation in lizards by **Peter Zani**, **Mathew Vikaryous**, and **Anthony Russell**. The conference drew to a close with a banquet held in the Museum of Anthropology (Figures 3 and 4) where it was announced that Hangzhou, China was the location where the next meeting would take place some time in August 2016.

The last day was kept free for exploring Vancouver; visiting the Pacific Museum of the Earth, the Beatty Biodiversity Museum, the Museum of Anthropology, or Vancouver Aquarium; joining one of the many whale-watching tours; or simply chilling out.

The Congress was a great success, with 1,700 delegates from 48 different countries, over 1,000 talks, and more than 400 posters. There were 25 symposia, with, at times, up to 15 [sic] parallel sessions! Although the diversity of topics covered was almost overwhelming (note we've not even mentioned the sessions on 'invasive species', 'habitat fragmentation', 'reptile thermal ecology' and 'deep water chondrichthyans') this meeting represents a valuable forum for the communication between

*Figure 3. Delegates at the Museum of Anthropology (<***http://www.moa.ubc.ca/***>) walking past the Haida Big Houses and totem poles on their way to the conference banquet.*

specialists who focus on fossils with those who work on living herps. The importance of this communication is likely to increase in the midst of pending climate change and acceleration of current herp extinctions. To find more details of this meeting and the future meeting in China visit the website: <**http://www.worldcongressofherpetology.org/**>

Figure 4. An extant frog found outside during the conference banquet.

Marianne R. Pearson
UCL, University College London, London
<marianne.pearson@ucl.ac.uk>

Marc E. H. Jones
UCL, University College London, London
<marc.jones@ucl.ac.uk>

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Lyell Meeting 2013
Geological Society, Burlington House, London *13 March 2013*

The focus was The Cambrian Explosion: understanding Earth systems at the origin of modern ecosystems. The meeting brought together palaeobiologists, ichnologists, geneticists, geochemists and stratigraphers to re-assess the complex, non-uniformitarian processes that operated in ecosystems before, during and after the Cambrian Explosion.

The meeting's first talk was given by **Kevin J. Peterson** (Dartmouth College, Hanover) who revisited the question of whether the Cambrian Explosion was an explosion of animals or of fossils. Kevin presented his research on using microRNA to explore why the fossil record doesn't fully support the molecular clock evidence of an extended, although cryptic, Precambrian history of animals. The microRNA data suggest that the last common ancestor of simple bilaterians should have been large enough to leave some form of trace fossil in the Precambrian, thus posing the important question of why the geological and genetic records differ. Following on from this, **Peter Holland** (University of Oxford) discussed his work on the developmental and genetic changes that occurred within animals, asking when the Cambrian Explosion occurred, phylogenetically. He explained that there is a core set of genes responsible for building the body plan of the vast clade Bilateria. He suggested that the evolution of these genes was likely to have had a major impact on animal diversity, but noted that we must be careful of using trees of genes to predict evolutionary timings. The final talk of the first session focused on a more chemical and environmental approach to the problem. **Robert Gaines** (speaker) and Shanan Peters (University of Wisconsin-Madison) highlighted the importance of the Great Unconformity during the Late Neoproterozoic and Early Phanerozoic in increasing chemical weathering of continental crust, thus affecting the ionic composition of the seawater prior to and during the Cambrian period. The carbon cycle indicates very dynamic flux at that time, with preservation of organic carbon by carpets of carbonate on the seafloor.

The second session was kicked off by **Howard Armstrong** of Durham University. Using evidence from the depositional environments of the Sirius Passet lagerstätte, he proposed that glacio-eustasy was a factor responsible for terminating the Early Cambrian radiation, with glacial, 1.2 Ma obliquity cycles correlating with the occurrence of lagerstätten. Thence to another lagerstätte, and the exceptional preservation in the Emu Bay Shale in Australia. **Greg Edgecombe** gave an insight into the environment and ecological conditions represented in the formation, explaining that they display a range of taphonomic modes that rarely occur in the better-known Burgess Shale, including more phosphatisation and pyritization, and the exceptional preservation of eyes. To complete the session, **Dave Harper** (Durham University) then provided an insight into the Sirius Passet, perhaps the most remote and most poorly known of the Cambrian Lagerstätten. Recent expeditions led by Dave have allowed for the development of new insights into the environmental setting of the region. A focus on understanding the taphonomic pathways, including mouldic preservation, films and silicified gut contents, is something of great importance, but why are the lagerstätte so localized?

After a short – and snowy! – break for lunch we then moved on to the third session, with **Duncan Murdock** (University of Bristol) as the first speaker. Duncan debated the origin of mineralised skeletons and the controversy around the nature of the Cambrian Explosion, and whether this biomineralisation was the result of convergent evolution among phyla. Molluscs appear to have evolved nacre-depositing mechanisms separately, but are they derived from a similar, homologous gene?

Trace fossils are also abundant in the Cambrian and **Gabriela Mangano** (University of Saskatchewan) talked us through their importance in deciphering ecology at a macroevolutionary scale, with particular reference to the Burgess Shale ichnofaunas. Ediacaran ichnology is 'quite boring', but by Stage 2 of the Cambrian burrows had attained depths of 1m. Leading smoothly on from this, **Duncan McIlroy** (Memorial University of Newfoundland) assessed the importance of ichnofaunas and discussed the possible role of bioturbating organisms in fuelling the Cambrian Explosion. He discussed the linkages between bioturbation and nutrient cycles and described the first burrowing organisms as 'ecosystem engineers', transforming the two-dimensional floor of the Precambrian to the three-dimensional Phanerozoic type environments we see today. He suggested that many of the more complex, early Cambrian ichnotaxa were not those of filter-feeders but sulphur- or carbon-miners.

The fourth and final session began with **Nick Butterfield** (University of Cambridge). Nick illustrated the importance of the evolution of cephalized bilaterians in the mid–late Ediacaran, thus in turn causing feedbacks to early food webs and impacting on ecosystem function. Of particular importance was the rise of predators, Nick argued. They would have completely changed the dynamics of the food webs and caused an exponential rise to the Phanerozoic biosphere, *i.e.* the Cambrian Explosion. In the closing address, **Martin Brasier** of the University of Oxford summarised the history of different proposed explanations for the missing Precambrian record of animals over the last *c.*150 years, going back to the writings of Darwin, Lyell, Sollas and Daly. Martin rounded off the day by highlighting the importance of appreciating the significantly different functional biology preceding the Ediacaran to that which became commonplace in the Cambrian, suggesting pithily that – when it came to the explosion – it was 'the anus what done it'. However, we have to appreciate not only the small-scale changes but also the changes that took place on a global scale, as the Cambrian Explosion is not simply a diversification of animals but also a stepwise increase in the dimension of the whole biosphere.

In closing, **Paul Smith** led an open floor discussion in which delegates were able to ask speakers more detailed questions and also an opportunity for other ideas and hypotheses to be voiced. Even after all these years, the Cambrian Explosion remains a controversial subject.

Katie M. Strang
University of Durham

2013 Lyme Regis Fossil Festival: 'Coastal Treasures'

Lyme Regis, Dorset, UK *3 – 5 May 2013*

After an enjoyable and successful first foray last year, the Association sent another crack team of fossilists to the 2013 Lyme Regis Fossil Festival (<**http://www.fossilfestival.com/**>), held over the first weekend in May. The Festival has been running since 2005 and has now become one of the biggest events of its kind in the UK.

To palaeontologists, Lyme Regis perhaps needs no introduction, but there are plenty of visitors who aren't so familiar with its fossils or indeed with the subject in general. The Fossil Festival aims to catch their attention. Each year, a giant marquee is plonked down on the pebbly beach, and hordes of fossil-loving organizations – us, the Natural History Museum, the Jurassic Coast World Heritage

Site, the Geological Society, the British Geological Survey and the British Antarctic Survey, to name but a few – move in, offering a wide array of palaeontological activities.

Elsewhere in the town, guided walks, talks, and public performances bring fossils to the masses. This year, the old town mill malthouse was transformed into the departure lounge for Jurassic Airlines, whilst Horace the Travelling Pliosaur Cinema provided the unusual sight of "a 35-foot sea-lizard with a walk-in cinematic belly." There were even two Mary Anning impersonators.

PalAss offered up the same themed show as last year – "What's In A Name?" – exploring how fossils get named and what the names mean, but we added a few extra diversions to woo the punters. Foremost among these was artist James McKay (<**http://www.jamesmckay.info/**>), who kindly volunteered to join us for the weekend and paint palaeontological pictures. He was to prove to be a quite fantastic acquisition.

Accommodating ourselves in a Lyme townhouse, we began our event on Friday morning, running a series of short classes for primary schools. Half-a-dozen groups came to us during the day, and most were very excited to be able to handle and interrogate some fossils.

They knew the names of many taxa (or had some good guesses), but less surprisingly they didn't generally know what the names meant. After we'd explained that the 'tri-' of trilobites and *Triceratops* had the same origin, a small boy looked at *Phacops* and asked "Is that like Black Ops?"

Lentil-eyed arthropods engaging in covert warfare seemed unlikely, but then the evolution of eyes is often described as an arms race, so perhaps he was onto something.

The vast majority of children were engaged and well-behaved, enjoying the chance to find out what palaeontologists do: inspecting microfossils under a microscope, puzzling over different hand specimens, and trying to think what name they would give a fossil. The story of Daisy Morris's Isle of Wight dragon (<**http://www.bbc.co.uk/news/uk-england-hampshire-21850080**>) helped convince a few of them that they really could discover something new and amazing in the south of England and have it named in their honour.

We undoubtedly piqued their interest – when the Festival opened up to the public for the weekend there were plenty of return visitors. By far the biggest attraction though was our artist James. He'd not been able to come to the school day, but he'd created a set of mix-and-match picture cards explaining the names of different animal features. The children used the cards to build (and name) their own fantastical fossils.

Come Saturday morning, James set up his paints at the end of one of our tables and invited people to come over and have him bring their creations to life. The quality of his artworks was so high that many assumed he must be charging a decent fee for each commission. When they found out he was doing it free and for fun, the general response was of pure astonishment.

The stall soon attracted a decent queue and if you think the computer-addled youth of today have no patience you've not seen children waiting to have James paint them a picture. Many stood for more than half-an-hour holding their chosen cards, then another half-hour as James painted their creature into life. There were a few too many boys going for the Deino-spino-suchus combo for my liking, but there was no shortage of imagination either.

Having a captive audience was great for the rest of us, as we got a lot more time to talk about fossils. We explained the variety of activities palaeontologists take part in, the fossils that we'd named (or had named after us), and hopefully enthused plenty of people in the diverse joys of our subject.

Its diversity was increased when James conjured up an amazing ankylosaur out of Babybel wax one evening. He hoped to get it scanned and 3D-printed by the British Geological Survey's GB/3D fossils project (<**http://www.bgs.ac.uk/collections/jiscGB3DTypeFossils.html**>), but though they were keen, the bouncy floorboards of the marquee precluded it.

Outside the marquee, stone balancing, fossil-hunting tours and a soapbox Darwin kept the public entertained. In the Lyme Regis Museum, a fabulous new ichthyosaur was unveiled, whilst one of the delicatessens was stocking ammonitic cheese. Everything you could need, really.

On the Sunday, we decided to embrace a new form of outreach and took some of our fossils out onto the streets to meet the public. A replica sea scorpion caught plenty of people's attention, though I'm sorry to say it also sent one small dog into paroxysms of consternation.

We didn't keep count of visitors over the weekend, but the British Antarctic Survey estimated they had 1,500 people on each day and we must have had similar numbers. The public appetite for ancient life seemed to be encouragingly huge; one visitor emailed us afterwards to say "a massive thank-you to your team … My son was captivated."

I can only second that: thanks to everyone who volunteered to help out and make it a thoroughly enjoyable Festival. We shall certainly be returning for 2014, when the theme is Citizen Science. We're also in discussions about helping to establish a sister project in northern England, so watch this space…

Liam Herringshaw
Durham University
*(<***reporter@palass.org***>)*

A selection of photos can be found at
<**http://www.flickr.com/photos/liamherringshaw/sets/72157633436116436/**>

Progressive Palaeontology @ Leeds 2013

University of Leeds, UK *22 – 24 May 2013*

"It was an unusual conference." After last year's wonderful meeting the pressure was on to do *Progressive Palaeontology* justice, as an informal but professional display of the superb work of early-career palaeontologists. Informal the icebreaker certainly was, with kegs of local ale, wine, fresh food and homemade cakes before heading to a local pub for nightcaps and chat.

Bright and early, the delegates were greeted by Professor **Jane Francis** who regaled us with memories of the very first ProgPal meeting back in 1984, and reflected on how it has grown and evolved ever since. The message that palaeontology was still as exciting and diverse as that first meeting, was a hugely encouraging way to start what was to be a fantastic day of talks. Under the watchful gaze of the Palaeocast's Internet stream, **Robert Lemanis** (Ruhr-Universität Bochum) began the 'Reconstructing Life Habits' session with an ammonite project addressing the way CT data is processed. Next up the delegates played 'guess the skull' **as Laura McLennan** (Leicester) talked about tooth microwear to determine diet, as an alternative to potentially misleading gross morphology. As twitter started to rumble with feedback, **Jon Tennant** (Imperial College London) described how geometric analysis can be used to quantify bluntness of ruminant rostra, before **David Button** of Bristol finished the session describing niches occupied by sauropod dinosaurs and the feeding mechanics of these impressive creatures.

Freshly brewed (and not forgetting, post-icebreaker), the coffee was consumed with great enthusiasm by our more delicate-looking delegates as the first poster session began. The quality was excellent, and a hugely impressive body of work examining everything from foraminifera to fishes ensured plenty of lively discussion between talks.

The second session focused on the study and reconstruction of palaeoclimate and palaeoenvironments. **Alexandra Lee** (Nottingham) started by presenting her work on angiosperm origins and the environmental factors affecting their survival in the Cretaceous. Whether they were pioneer weeds basking in potentially deadly sunlight or humble forest dwellers, it seems the earliest flowering plants were highly adaptable. **Matt Pound** (Northumbria) then dovetailed by explaining ways to reconstruct regional vegetation patterns in the Late Pliocene, focusing on the feedbacks from soil and lakes, which are crucial factors affecting the predictive power of palaeoclimate models.

Still in the Cenozoic we were given a rare insight in to the mid Miocene climate optimum by **Lyndsey Fox** (Leeds), who presented a wealth of new stable isotope data taken from planktonic foraminifera from the equatorial Pacific. We're indebted to Lyndsey not only for filling in for an absent speaker last minute, but also for organising the field trip. Lastly before lunch, **Nicola Clark** (Leicester) made us all jealous of her fieldwork in South America, where she has been studying the regional climate changes recorded in East Pacific bivalves throughout the Neogene, data which suggest the local Pliocene climate was much warmer than it is today.

The vertebrate evolution session began with **Joe Keating** (Bristol), who guided the delegates through the early evolution of the vertebrate skeleton. His project involves elucidating ontogenetic processes and trends in bone development using synchrotron tomography data from a growth sequence of heterostracan dermal plates. Then, for something completely different, **Mark Puttick** (Bristol) shared work from his PhD looking at the rate of evolution during the early radiation of birds. Interestingly, body size was found to have changed dramatically to form the Paraves, possibly alongside changes in limb length relating to flight adaptations. Continuing our vertebrate session, **Gabriela Sobral** from the Museum für Naturkunde, Berlin presented work attempting to fill gaps in our understanding of Neodiapsid braincase evolution with new CT-scan data of *Elachistosuchus* from the Triassic of Germany. The last vertebrate talk by **Tom Stubbs** of Bristol looked at the radiation of marine reptiles in the Triassic using morphospace analysis of their lower jaws, with a rapid emergence of novel morphologies restricted to their early radiation.

Our final session was exceptional preservation, and **Peter Adamson** (Cambridge) gave a great talk about the biostratigraphically important, but enigmatic, acritarchs of the Ediacaran of Southern Norway. Sticking with the very old, we then heard **Katie Strang** (Durham) explaining the significance of differences between the Burgess Shale and Sirius Passet formations' preservation of fauna from the all-important Cambrian Explosion. Our penultimate presentation by **Charlotte Kenchington** (Cambridge) was a feast for the eyes, examining some of the bizarre Ediacaran fauna which continue to inspire debate about their affinity, and the earliest ecosystems. **Oliver Knevitt** (Leicester) finished with an analysis of decay patterns in phyllocarids, which struck a chord with many delegates who discussed the potential impact on already described taxa, and biases on biodiversity estimates.
It was a fascinating note to close on, and before delegates were led to a camera-friendly part of the campus for a group photograph, I had the pleasure of announcing that Leeds would be hosting the 2014 Palaeontological Association Annual Meeting.

That evening, after a buffet dinner at the 'Spice Quarter' in Leeds city centre, we descended on the restaurant's bar for the annual prize-giving. This year we decided that the system for judging the prizes should be a little more democratic, so the Eurovision system of half public vote, half committee choice was employed.

Leeds' own **Magdalena Georgieva**, with a huge portion of the public vote, won best poster for her project looking at polychaete worm evolution, and best talk went to **Peter Adamson** of Cambridge, for his work on exceptionally preserved acritarchs.

After the prize-giving delegates were treated to what I think is a ProgPal first, a belly dance (from a professional, not – I must add – from the organisers), before heading out to enjoy the city's nightlife.

Not so bright, but certainly early the next day, Cayton Bay beckoned, a wonderfully rich stretch of Yorkshire's Jurassic coast. Bitterly cold, soaking wet, and with gale force wind just for fun, it wasn't the best weather for a field work jolly, but 20 brave delegates soldiered out on to the beach nevertheless. As the weather improved, so did our spirits as Dr Cris Little guided us through the Middle Jurassic strata and we started to find fossils. Huge fossil leaves, ammonites, dinoturbation, and hundreds of metres of trace fossils were a few of the myriad forms we found preserved in Cayton's rocks, and as we went further from the car park the finds came thick and fast. Finally the tide turned against us, so we scrambled up the cliff for a pub lunch before heading home, drawing to a close ProgPal 2013.

I'm very grateful to everyone who contributed to this event, whether attending, presenting, or helping on the day. I for one thoroughly enjoyed it, and was hugely impressed by the quality of research, and the genuine passion invested in it by our young palaeontologists.

Tom Fletcher
University of Leeds

Sylvester-Bradley REPORT

Anoxia and the demise of the Devonian reefs: project summary

David Bond
Norwegian Polar Institute, Tromsø

The Frasnian–Famennian (Late Devonian) mass extinction has become a popular topic in palaeontology during the past two decades, and was the focus of my PhD research from 2001 to 2004. Several years later, despite having climbed the stratigraphic ladder as high as the very latest Palaeozoic (shudder), I was left with a nagging question: what killed the Devonian reefs?

The Late Devonian extinction affected most marine settings, but Frasnian reef communities, which were the largest and most spectacular reefs of all time (Kiesling *et al.* 2000), suffered particularly heavy losses (Copper, 2002). In some regions, Frasnian reefs formed 1,000 km long belts comprising microbial and stromatoporoid sponges, calcareous algae, tabulate and rugose corals, and they supported a wide range of dwellers and predators. These were replaced in the Famennian by an assemblage of (dysoxia tolerant?) taxa dominated by calcimicrobes, algae, and sponges (Wood, 2000, 2004), but such complex and large reefs never developed again after the Frasnian.

During my PhD I examined the close temporal association between marine extinctions and the development of two geographically widespread, discrete anoxic "Kellwasser" events that provide evidence for an anoxia-extinction causal link in level-bottom communities (House, 1985; Buggisch, 1991; Bond *et al.* 2004; Bond and Wignall 2005). These "Kellwasser" events are classically manifest

The author examines basal Famennian sandstones belonging to the Sassenach Formation.

as two beds of black, bituminous limestones or shales in basinal settings, such as in the eponymous section in Germany and elsewhere in Europe, North America, North Africa, and China. However, anoxia was ruled out by Becker *et al.* (1991) for the demise of the reefs, because the "Kellwasser" events are not recorded in such settings. This has been cited as key evidence by those who dispute the anoxia-extinction hypothesis (*e.g.* Becker *et al.* 1991, 1993; House *et al.* 2000; Casier *et al.* 2002). In 2001 I visited a reef section in Poland, and our trace metal analyses tentatively pointed to the development of anoxia during the latest Frasnian (Bond *et al.* 2004), yet in the field this section does not display evidence for anoxia. Clearly, detecting anoxia can sometimes require cryptic evidence.

Mountain sheep enjoy the view from the Early Famennian Palliser Formation.

In 2009 I was awarded a Palaeontological Association research grant of £5,000 to undertake fieldwork in Alberta, Canada, and in the Canning Basin of Australia – two of the most spectacular Devonian reef settings – to collect samples and look for such cryptic evidence for anoxia. In August 2009 I visited the beautiful mountain Roche Miette, in the Jasper National Park of Alberta (having got permission from Parks Canada, of course!). Then, my post-doc finished and I spent two years in a "real job" with little time for enjoying fieldwork. That, combined with the arrival of my first child in 2010, during the only possible fieldwork window, ensured I never did get out to Australia. Happily I am now back in research, working at the Norwegian Polar Institute in Tromsø until August, when I take up a permanent post at Hull. This has finally given me time to publish the results of the Canadian trip, in an article recently published in *Lethaia* (Bond *et al.* 2013). I had made a pledge that if I failed to submit this article before the royal wedding – that of William and Kate in 2011 – I would watch the whole event. That is precisely what happened, punishment enough for procrastination!

I only managed to spend a third of the research grant, but one paper is a fairly decent return for £1,600. I am extremely grateful to Palass for funding this project, because staying "active" during my two years outside of academia, even in a small way, certainly contributed to getting me back into palaeontological research. There follows a summary of our *Lethaia* paper:

Evidence for shallow-water "Upper Kellwasser" anoxia in the Frasnian–Famennian reefs of Alberta, Canada

by David P. G. Bond, Michał Zatoń, Paul B. Wignall & Leszek Marynowski

Since the typical Kellwasser facies of bituminous limestones and shales are not obviously recorded in shallow-water settings, it is unclear if anoxia played a role in reef losses. This paper evaluates geochemical, petrographic and facies evidence for oxygen restriction from an extremely shallow-water carbonate platform section. A 26-metre thick Frasnian–Famennian succession was measured on the north-western flank of Roche Miette, northeast of Jasper. This is a fragment of the Miette Reef Complex that includes isolated reefs separated by peritidal carbonate environments (recorded here), and in total is about 400 m thick and covers 80 km^2 (Mountjoy, 1965). During the Late Devonian, the Miette reef was located at about 10° S and was part of an extensive system that, with present-day outcrop area $>$ 100,000 km^2 and a total area perhaps six times this size, was amongst the largest ever to have existed (Peterhänsel and Pratt, 2001).

The section was logged, sampled, and thin-sectioned for microfacies and fossil identifications. Samples were prepared for scanning electron microscope (SEM) imaging for pyrite framboids (as a palaeoredox indicator), and analysed for total organic carbon (TOC) and trace metals including U and Th. The late Frasnian (Ronde Member of the Southesk Formation) is dominated by wavy (algal?) laminated micrites and packstones, with two spectacular erosive surfaces bounding latest Frasnian laminated mudstone. Unfortunately, the true extent of Frasnian faunal diversity has been concealed by a combination of abrasion and dolomitisation. Sequence stratigraphy (in the absence of conodont dating) places the Frasnian–Famennian boundary at a sequence boundary that tops the finely laminated carbonate mudstone and interrupts carbonate platform deposition. Above the Frasnian–Famennian boundary, 4 metres of ripple-laminated sandstone (Sassenach Formation) record the widely reported basal Famennian eustatic sea-level fall. The overlying Palliser Formation sees a predominance of curiously "bioeroded" micritised peloid beds (see Peterhänsel and Pratt, 2001), and meshworks of the labechiid stromatoporoid *Clathrostroma*, which appears to flourish in the aftermath of the extinction elsewhere in Canada and the western USA (Stearn, 1988; Peterhänsel and Pratt, 2008; Morrow *et al.* 2011).

Facies analysis allowed us to recognise the major transgressive pulse associated with Transgressive–Regressive Cycle IId of the famous Devonian eustatic sea-level curve of Johnson *et al.* (1985). This transgression is associated with the anoxic Upper Kellwasser Horizon and extinction in level-bottom communities. What evidence exists for anoxia at Roche Miette? Our geochemical proxies indicate that this transgression, as well as a slightly earlier one that may or may not be equivalent to the Lower Kellwasser Horizon, were accompanied by an influx of dysoxic or anoxic waters. Thus,

Latest Frasnian conglomerate tops a sequence boundary at the Frasnian–Famennian boundary.

Roche Miette as seen from the section.

organic carbon and U enrichment in the Frasnian, particularly just below the Frasnian–Famennian boundary (TOC up to 3.8% – extremely high for Devonian limestone – and authigenic U up to 2ppm), points to episodic dysoxic conditions that probably persisted into the basal Famennian and were coincidental with the global Upper Kellwasser Event.

An intriguing feature, the section is a flat-pebble conglomerate, deposited immediately above topmost Frasnian limestone. Flat-pebble conglomerates are also seen in the aftermath of the Permo–Triassic extinction (Wignall and Twitchett, 1999) where their origin is ascribed to the absence of bioturbation in the aftermath of that extinction due to benthic oxygen restriction and early-onset carbonate lithification. Could the same model apply here?

This study provides the first evidence for the smoking gun of an anoxia-driven extinction in very shallow waters, implicating this potent killer in the demise of the Devonian reefs. Ultra shallow-water dysoxia in the latest Frasnian may have its origins in warming and eutrophication, with a causal link to contemporaneous Viluy Traps volcanism in Siberia (Courtillot and Renne, 2003), and enhanced pedogenesis and terrestrial run-off (Algeo *et al.* 1995). Such a scenario is analogous to the shutdown of Tethyan carbonate platform productivity during the Cretaceous, which saw shifts between photozoan and heterozoan modes of carbonate production during a time that also saw intense volcanic activity on the Ontong Java Plateau, a change towards tropical and more humid climate conditions, and an associated increase in continental weathering rates and detrital and nutrient fluxes into the ocean – and ultimately the development of shallow-water anoxia during Oceanic Anoxic Event 1a (*e.g.* Stein *et al.* 2011).

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Talking with Dinosaurs

As with pretty much everything nowadays, an evening class I taught recently asked the participants to complete an end-of-course feedback form. The topic had been ‘Life Through Time’, and I had attempted to cover the fossil record in eight two-hour sessions.

The class members were a diverse and interesting group, including geography and biology teachers, a professor of music, and a university director of research. I tried to introduce them to evolutionary palaeontology, combining its development and key figures with some of the latest discoveries and hypotheses. In a fairly short course, though, there had to be restrictions. I made it clear that I would not spend a lot of time assessing dinosaurs, since they constituted only a small portion of the subject.

Being an invertebrate palaeontologist, part of this was an acceptance of my own limitations. I don’t know much about reptiles, Mesozoic or otherwise. This ignorance was also evident at the Lyme Regis Fossil Festival (about which more elsewhere in this issue), where most under-12s displayed far more knowledge about the creatures’ size, speed and feeding habits than I did.

I didn’t neglect the beasts completely though. The class discussed the phylogeny of feathered theropods and thence the question of why birds weren’t bird-hipped. *Nyasasaurus* made an appearance, as did the topic of warm-bloodedness and, of course, the K-Pg extinction. Archosaurs just didn’t play a starring role.

When the class questionnaires were returned, however, I found a few choice words in one of the comments boxes. It said, “Dinosaurs are not the enemy!”

Being fairly sure which participant had written it, I suspected it was slightly tongue-in-cheek, but I also knew it was truthful. The author was quite right. They may attract a disproportionate public interest, but dinosaurs are certainly not the enemy. My decision to relegate them to a minor role was probably unnecessary. From funding cuts to a lack of jobs to the teaching of creationism as science, there are an enormous number of things that should attract a palaeontologist’s ire more than the over-promotion of lizards.

To try and show it was nothing personal, I went a few weeks later to see “Walking With Dinosaurs: The Arena Spectacular” in Newcastle. I’m pretty sure I wasn’t the target demographic; if my better half hadn’t accompanied me I fear it would have looked somewhat suspicious, but I wanted to re-engage with my inner ten year-old. I was secretly quite excited to see how the monsters would be resurrected in a half-full ice hockey arena.

The show was excellent, a mix of mechanics, puppets and special effects. It included the colliding and breaking up of continents and the greening of Pangaea. The scientific explanations weren’t bad either – lots of proper names, lots of information on dinosaur ecology and biology and even some ichnology. I don’t know what the children made of those sections, but they seemed to enjoy the overall experience. I enjoyed it too.

Afterwards, I found myself wondering about the educational uses of dinosaurs, and how (or indeed if) children make the connection from loving these giants to learning about palaeontology. At the Lyme Regis Fossil Festival, I asked a few groups of children if they could tell me the name of a fossil. Ammonites, belemnites, trilobites, bones, came their answers; dinosaurs were almost always an afterthought. The impression seemed to be that there was a distinction: “They aren’t fossils, they’re *dinosaurs*!”

That they (and every other primary school group I’ve worked with) were interested bodes well though. Whether the pupils know it or not, they have an enthusiasm for palaeobiology and palaeoecology. The problem is that there doesn’t appear to be a clear mechanism for channelling this, especially after they turn 11. Unless they are fortunate to be at a secondary school with a fossil-loving teacher, their exposure to palaeontology diminishes significantly. From what I’ve seen, those who retain their early love of dinosaurs often become hobby fossil hunters. If they end up choosing a palaeo-related degree programme it is often in spite rather than because of the system.

This is where I see an opportunity. If, as a learned society, the Association is genuinely concerned about the future of palaeontology, we must look at targeting this period, the transition from primary school to university, from the ages of 11 to 18. Pupils making decisions about their career paths should be one of the focuses of our attention. We should be providing them and their schools with high-quality information to facilitate a better understanding of what palaeontology really is and what palaeontologists really do.

I’m not claiming this is a novel observation. Lots of my colleagues are aware of the issue and have been discussing it for some time. Education and outreach have both featured strongly in recent Association Council meetings; plans are afoot to try and use our position and financial strength to help projects in both areas get off the ground.

One of the developing conversations is with the Earth Science Teachers’ Association (ESTA), who are hosting their annual meeting at Plymouth University in September. ESTA points out that A-Level courses (the UK pre-university qualifications aimed at 16-18 year-olds) are due for a rewrite. Initial discussions have suggested that there is an opportunity for the Association to help drive a change in the course specifications, with professional palaeontologists identifying what subjects should be leading the teaching of Earth sciences within the syllabus.

A recurring comment we’ve had from teachers is that more resources are needed to explain how fossils are used to determine palaeoecology and palaeoenvironments. Dinosaurs can play a key role. They may be a big business, but they are also a source of so much interesting research. From coprolites and colour to feathers, flight and footprints, the potential to use these prehistoric monsters to explain ancient biology and ecology is enormous. Taking such an approach might also act as stealth-learning, where more obvious, glamorous subjects are used to educate pupils about rather more cryptic disciplines. From there we can move on to the ecosystems of Solnhofen or the Burgess Shale or (my favourite) the Wenlock Limestone.

In preliminary discussions, teaching colleagues have come up with seven key points, arguing that resources:

[1] Must be online;
[2] Must have good quality, downloadable images;
[3] Must incorporate feedback so that students are able to see what they have understood;
[4] Must be interactive;
[5] Should have links to external resources, such as university websites;
[6] Need to have downloadable, printable exercises;
[7] Should summarize key information at the end.

The Association has the capacity – and the need – to facilitate the creation of such materials. If it did so, putting them online would ensure that the resources were available to anyone who wanted to use them, anywhere in the world. The resources should emphasize clearly the uses and applications of palaeontology rather than just the idea of collecting fossils.

I realize I am writing this all from an Anglocentric perspective and that the situation will be different in other regions. I am sure, though, that similar issues exist elsewhere. As such, I am very interested to hear any suggestions members have on the topic, wherever in the world you are and whatever you palaeontological persuasion. I can then include these in future discussions.

As for my personal mission, I have agreed to start showing reptilian respect by (literally) running a class on footprints, speed and sediments for a Geoscience Club at a local secondary school. Combining jogging on a beach with some of the famous trackways from the Jurassic of the Yorkshire Coast, I will try to show how we can use a modern approach to understand fossil behaviour. I promise to begin giving dinosaurs the treatment they deserve.

Liam Herringshaw
Durham University
<reporter@palass.org>

Outside The Box

Clare Torney: Conservation Scientist

In my relatively new role as Conservation Scientist for Historic Scotland I often get asked about my previous research experience. My current work focuses on the analysis of building repair materials with the aim of establishing their compatibility with historic stone substrates and their suitability for use on conservation projects. Based on this, there is an apparent assumption that my doctoral research revolved around deterioration mechanisms in sandstone, 'greening' of building stone or something else equally obscure to the palaeontologist. So, I delight in informing people that I spent the most significant chunk of my research career thus far studying trilobite eyes – a statement that is often met with utter confusion!

Given my post-PhD major career diversion, I often question whether my palaeontologist past is of any relevance. When I mention the word 'palaeontologist' to my new colleagues, it seems to conjure up the stereotypical Hollywood vision of someone dressed in beige and khaki digging up dinosaur bones. In reality, my research couldn't have been more different. Studies on trilobite eyes these days demand the use of some pretty high-tech analytical instruments, including SEM and TEM, which I still get to use occasionally, and I also dabbled in some computer modelling. However, my starting point was always the geologist's best friend – a good old hand lens, something that I just couldn't do without in my current work. As my PhD supervisor, Alan Owen, likes to remind his undergrad students … "a geologist without a hand lens is like an egg without salt, or a kiss without a moustache"… although I'm not sure they were ever in agreement with his analogies, especially the latter!

Perhaps two of the most important tools required in my current role are things that go beyond the ability of any hand lens or microscope – firstly, the thought process and vision that allows me to tie microscale observations to much larger scale processes and their impact on historic building 'health', and secondly the ability to communicate my results with an incredibly diverse audience, from academics to contractors, to members of the public.

So, although initially it may appear as though I stumbled upon my new career accidently, in reality it is quite the opposite. My training as a palaeontologist and the research experience gained through it has paved the way for a career as a different kind of scientist. Without a doubt my training as a geologist has equipped me with the skills required to question, observe and assess situations in such a way that allows me to take a holistic approach to my work and then communicate my findings in the best way possible.

The one downside to my exciting 'alternative' career – leaving the last one behind!

*

Clare continues to publish her work on trilobite eyes as well as her work on stone repair materials. Contact Clare at <**claretorney@hotmail.co.uk**>.

Checking out the giant trilobites in Portugal at the Trilo08 conference.

Getting some insider tips on the study of trilobite eyes from Euan Clarkson – at the Trilo08 conference in Toledo.

Further Reading

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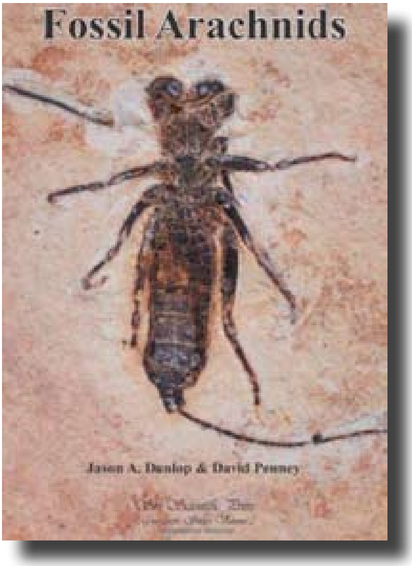
Studying the deterioration of Brownstones at the 2012 Stone conference in New York with some Historic Scotland funded research students.

Book Reviews

Fossil Arachnids

Jason A. Dunlop and David Penney. 2012. Siri Scientific Press. Monographic Series, Volume 2. 192pp. £60.00. ISBN 978-0-9567795-4-0.



This book, written by two of the world's foremost experts on fossil arachnids, is a comprehensive yet accessible account of a diverse group of arthropods, and represents the first thorough overview since Petrunkevitch's 1955 *Treatise*. Since then the number of arachnid species in the fossil record has tripled to a total of 1,787. The book is dedicated to Prof. Paul A. Selden, the eminent palaeoarachnologist, who supervised both of the authors' PhDs.

The book is simply structured with an introduction, chapters on each of the arachnid orders and a short chapter at the end entitled 'Perspectives'. The introduction covers some history of the study of the subject area, explains what an arachnid is, with a detailed account of the general anatomy, techniques for studying fossil ones, a key to orders and a brief discussion on their evolutionary relationships.

The main part of the book comprises chapters on each of the 16 orders of arachnids known from the fossil record. The classification follows standard traditional classifications, with the addition of the extinct order Uraraneida, erected by Paul Selden in 2008, and the splitting of the traditional order for mites and ticks (Acari) into the orders Acariformes and Parasitiformes.

The chapters on each order start with an introductory section, followed by an outline of the classification; a description of the diagnostic characters; a detailed description of all the characters; a mention of the number of species from each of the three eras; a list of all the fossil localities; a list of all the families in the fossil record, whether they are known from amber, copal and rock and whether they are extinct; an account of their palaeoecology, and a summary of important studies. Although these chapters are very good, there is room for improvement. The description of the characters could have been improved with accompanying line drawings and a glossary, as some of the terms used are not explained anywhere. It would have been more useful to list the number of species known from each period rather than just from each era. The list of families could have been improved with the range of the periods in which each family occurs.

Each of these chapters is accompanied by superb photographs (many in colour) of representative specimens, both living and fossil, including many holotypes. It is a pity that some of the photographs of the Natural History Museum types are poor. In the acknowledgements they do thank the Keeper for permission to use photographs of NHM specimens. However, about ten years ago many of the NHM fossil arachnid types were professionally photographed by the NHM photographers. The authors may not be aware of the existence of these images.

On page 38, the authors dismiss the giant scorpion *Praearcturus gigas*, one of the largest arachnids known, as fragmentary. This is probably because parts of this animal used to be split amongst different parts of the fossil arthropod collections at the NHM, reflecting its chequered history and earlier speculations as to its identity. However a major drive to curate the chelicerate collections a decade ago brought all the pieces together, including hitherto unrecognised pieces in the eurypterid collection. This incredible animal is known from a complete coxo-sternal region with corresponding dorsal thoracic plates, a nearly complete chela and other parts. Thus it is ripe for re-description.

I only spotted a couple of errors, though this is just nit-picking (to forgive the pun). On p. 115, the Bembridge Marls and the Isle of Wight are listed as separate localities, when they are one and the same. In the ‘Perspectives’ chapter, on p. 160, the authors casually mention large scorpions as being common in the forests of the British Carboniferous Coal Measures. However the largest ones are from the Early Devonian (*Praearcturus*, *Brontoscorpio*) and the next largest are from the Early Carboniferous (*Gigantoscorpio*, *Pulmonoscorpius*), whereas the Coal Measures examples were generally of normal size.

The only significant reference that the authors have missed is Brasier *et al*. (2009) who described the earliest spider silk in amber.

The book is very well written and is a very thorough and up-to-date treatment of this subject area. It would be a worthwhile addition to any palaeontologist’s library. It would also be useful to arachnologists who want an overview of the fossil record. I do feel that at £60 it is overpriced, which puts it out of reach of a more general readership.

Andrew Ross
National Museums Scotland, Edinburgh

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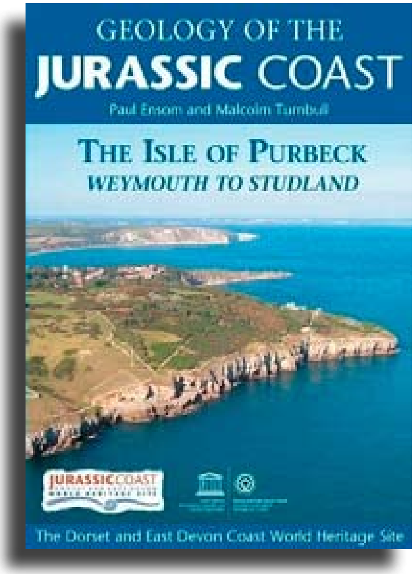
Geology of the Jurassic Coast. The Isle of Purbeck: Weymouth to Studland

Paul Ensom and Malcolm Turnbull. 2011. Coastal Publishing, UK. 128 pp. £9.50. ISSN: 978-1-907-70100-9.

The Dorset and East Devon Coast is a UNESCO World Heritage Site. This book, the latest in a series designed to inform visitors to the area and to support the work of the local Heritage Trust, will be of interest to the general public but also provides a wealth of general background for more experienced geological readers. It is a sister volume to ‘The Red Coast Revealed’ by Richard Edwards,



published in 2008, which covers the geology of the coast from Exmouth to Lyme Regis; leaving a gap in the middle from Lyme to Weymouth!

The authors are expert at conveying their enthusiasm for the area, and use their experience in engaging the general public, honed as a former Keeper at Dorchester Museum and Country Park Ranger at Durlston. The book is written in accessible language and superbly illustrated. In my opinion the most attractive and innovative features of the book are the annotated photographic illustrations, many of them taken at sea and from low-level flights. These provide even the most experienced geological visitors with new insights.

The text starts with an introduction to the Heritage Coast and its geology, including a tribute to the work of W.J. Arkell. A very brief review of the overall tectonic setting and structure reproduces tectonic maps from the BGS, which are sadly far too small to be of much use. This is followed by an introduction to the principles of stratigraphy for the non-specialist and then a chronological introduction to the rocks of the Purbeck coast. The account of the 'strata dramatis' [*sic*] is written in enthusiastic language and starts to develop the main strengths of the book: describing the relationships between the landscape, the scenery and the geology. The oblique air photographs and cliff sections are simply stunning. The lively text includes information about the sediments and the fossils, their depositional setting and early diagenesis. Notes on the historical uses of the rocks, interwoven with contemporary research data, provide a wide range of context and background information. Illustrations include details of cliff faces (photos of the cliff on fire in the 1970s), rock and fossil samples, and some very dramatic reconstructions of Purbeck and Portland environments. (All those vertebrates on land and in the sea would have been constantly bruised by physical contact with each other if they had really lived in such close proximity!) Each part of the stratigraphic column is given an accessible header: so the Lower Greensand is characterised as 'the returning sea'. Sadly the section 'After the dinosaurs' detailing the last 65 Ma does not link back to the development of the structures.

The next main chapter of the book presents an 'Itinerary' traversing the scenery and geology from west to east along the coast. Each of the five sections is introduced by a reproduction of part of the relevant 1:25,000 Ordnance Survey map (though at variable scales). It would have been useful for those unfamiliar with the area if places mentioned in the text were highlighted on these maps – or like Furzy Cliff, actually appeared on these maps at all! This is not a conventional geological itinerary with detailed locality information: rather it is a description of the scenery of the sections of the coast with descriptions of the geological, historical and palaeontological highlights. The reader is entertained by stories of paintings by John Constable, dramatic fossils finds, major floods, and the history of conservation. The geological descriptions make reference to specific stratigraphic horizons but I suspect the less experienced reader would need access to one of the more conventional geological guides to be able to locate and find these in the field. It is admirable that the authors make efforts to explain rather than just document: in the main text examples of this approach include explanations of the origins of changes in stratigraphic thickness, the geological structures, coastal landforms and major features such as landslips. Separate asides at appropriate places in the text include: 'Caves, Arches, Stacks, Coves and Landslides', 'Fossil Collections', 'Local History', 'Quarrs and Quarries', 'Victorian Geologists', 'Cottages and Castles', and 'Fossil Fuel'.

The final bit of the itinerary is in part a repetition of material already covered in the main transect, but is designed to act as a guide to accompany boat trips from Lulworth and around Swanage. Again, superbly illustrated with colour photographs, this section provides an account of the main changes in geology and landscape which are visible from offshore: it is illustrated both by panoramic sea-level photos of the whole coast section (perhaps reproduced at too small a scale to be really useful on the boat) and highly vertically-exaggerated sketch geological cross-sections of the cliffs. References here to small-scale features and fossils, visible only onshore and up-close, might frustrate the reader; or encourage them to go back and visit on foot. The final paragraphs deal with the underwater geology of the area. Stunning colour imagery of the sea floor topography from the Dorset Integrated Seabed Survey demonstrates the patterns of rock ledges on the offshore (Pleistocene?) coastal platform, which define the overall periclinal structure of Weymouth Bay and enable you to map the patterns of fault displacement. You can also see the superimposed contemporary sand and shingle mega-ripples which had an influence on the Olympic sailing events in 2012.

The glossary explains common geological terms to the lay reader; though the choice of terms, including 'calciostrontianite', seems a little random in places. The list of further reading provides an appropriate background of historical documents (Arkell's book), previous popular geology books and Geological Survey volumes, but does not extend to the primary sources that have obviously contributed to the material in the book.

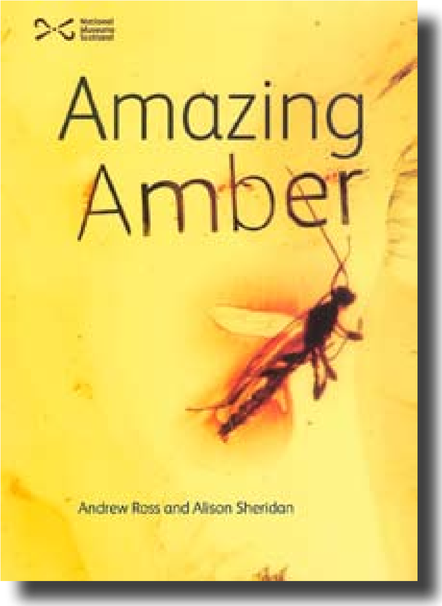
Overall this is an accessible, informed and highly readable account of the geology and scenery of a classic area of British Geology. It should help enthuse visitors and give them some understanding of the spectacular scenery and its origins. For those with some experience of Dorset geology it is well worth its price for the historical insights and the novel aerial and ship-based pictures!

Jim Marshall
University of Liverpool

Amazing Amber

Andrew Ross and Alison Sheridan. 2013. National Museums Scotland. 64pp. £7.99 (softback). ISBN: 978-1-905267-79-8.

This very nice little book has been produced to complement an exhibition of the same name at the National Museum of Scotland (10th May to 18th September 2013). However, it is not strictly a souvenir guide. It only includes around half the items on display at the Museum, so should also function to attract people to see the exhibit. It forms a nice stand-alone book in its own right, albeit one that can be read from cover to cover in a little over an hour.



Following a short foreword and introduction, the chapters include: What is Amber?; Where is Amber from?; Amber in Scotland's Past; Amber Jewellery; Decorative Amber; Fakes; Insects and other Inclusions; DNA from Amber; followed by a short bibliography (general reading rather than academic works) and the acknowledgements. Although general and global in scope there is, not surprisingly, a strong emphasis on the 5,500 year-old Scottish association with amber, as evidenced from archaeological sites. The text reads well and is accurate and up to date, correctly citing the oldest inclusion-bearing amber as from the Triassic of Italy. Various dates have been proposed for the age of Baltic amber as a result of different dating methods. Here, the authors have opted for the younger end of this spectrum (28–38Ma), whereas elsewhere in the scientific literature an age assignment of 44–49Ma is not uncommon. The authors refer to the 400 insect species described to date from Dominican amber, but the actual number is probably around twice that value (see Penney, 2010) and considerably higher still when the non-insect fossils such as spiders are included. Despite the brevity of the text a reasonable amount of the content was new to me (even as an amberphile of two decades). The book is richly illustrated throughout and I found the images of the Hunterston Brooch (p. 26) and the religious carving (p. 40) particularly impressive. Also of interest was the unusual cattle charm (p. 29) that would have been dipped in the drinking water of sick cattle, whilst chanting a spell, in order to cure any ailments.

The general layout of the book is pleasing to the eye and the 150+ photographs are sufficiently large and clear. These are split approximately evenly between palaeontological inclusions and others (raw amber, historical artefacts, contemporary jewellery), hence striking a good balance in the content. Several new family or higher taxon records are photo-documented for various deposits: Cecidomyiidae in Chinese (Fushun) amber (p. 46), Miridae in Burmese amber (p. 50), Rhagionidae in Mexican amber (p. 55), Zygoptera in Mexican amber (p. 55), Geophilomorpha in Mexican amber (p. 55), Diplatyidae in Mexican amber (p. 55) and Tropiduchidae in Mexican amber (p. 56).

A handful of typos have slipped through the proofing stage (pp. 13, 57) and although Burmese amber is still referred to as such, the country of origin should now be cited as Myanmar (pp. 15, 38). Unfortunately, it would seem that the authors have been let down by their printer. At least in my review copy, many of the pages have smudges from the opposite page, while others have multiple black specks (*e.g.* pp. 39, 42, 43). Although in most cases these are very faint and will probably go unnoticed by the reader, I would not be happy (as an author and publisher) if I received this quality of work from my printer.

Despite these minor quibbles, I think this is a very nice book. It contains new information and new images, and at such a low price deserves a place on the shelves of anybody interested in amber, in addition to those interested in the cultural history and folklore of Scotland. It will also no doubt encourage many new people to delve deeper into the fascinating world of amber.

Dr David Penney
Faculty of Life Sciences
University of Manchester, UK

REFERENCE

PENNEY, D. (ed.). 2010. *Biodiversity of Fossils in Amber from the Major World Deposits*, Siri Scientific Press, Manchester, 304 pp.

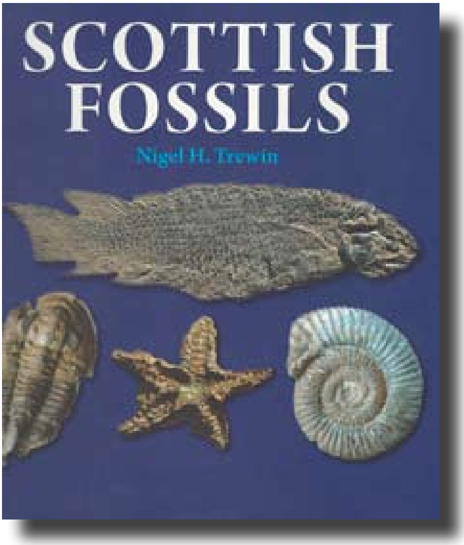
Scottish Fossils

Nigel H. Trewin. 2013. Dunedin Academic Press Ltd, UK. 118pp.
£30.00 (hardback). ISBN: 978-1-780460-019-2.

For a small country Scotland boasts some of the most famous and scientifically important fossil localities in the world. This book provides a 'virtual museum' of more than one hundred scientifically important, interesting or controversial fossils and has been compiled and written by one of Scotland's leading palaeontologists. Hence, the information presented can be considered accurate and up to date.

The introduction provides the history of the author's interest in fossils and a brief history of Scottish palaeontology. This is followed by brief summaries of the variety and range of fossils found in Scotland (recorded in ascending stratigraphic order), with information on collectors, collections, preservation, palaeoenvironment and relevant palaeontological literature. There is also a list of palaeontology displays that can be visited at various Scottish museums. The introduction concludes with a summary table including the geological periods, major fossil deposits and geological events with respect to the region covered.

The majority of the book consists of photographs of the fossils with associated classification information, including phylum, class, species, locality, age and stratigraphy. Included are (number of fossils): Bacteria (2), Algae (1), Plants (12), Sponges (1), Corals (5), Worms (2), Bryozoa (1), Brachiopods (5), Cephalopods (8), Bivalves (6), Gastropods (2), Echinodermata (9), Graptolites (3), Arthropods (14), Fish (15), Amphibians (4), Reptiles (5), Mammals (2) and Trace Fossils (7). Each of these sections is accompanied by a brief introduction to the group and each fossil



is provided with additional information relating to morphology, lifestyle, preservation, history of collection and identification. Many of the entries are accompanied by illustrations, either of models or artistic reconstructions. The latter vary in quality and it is easy to distinguish those that have been reproduced from published papers from those provided by the author. The book concludes with a list of specimen locations, a list of references cited, an index and a gazetteer.

The text is written in an easily readable style. It will no doubt inspire readers to venture further into the history of Scottish palaeontology and the characters involved, for example to find out more about the fearsome mantrap employed by Hugh Miller to safeguard his fossil collection. Maybe some will even be tempted to try deep-frying brachiopod pedicles. Other interesting accounts include the destruction of a particularly nice Devonian eurypterid by an RAF WWII bombing mission.

Overall the physical production quality is good. However, typographical and inconsistency errors were noted on 19 pages (= 16%). The scale bars on figures 12 and 98 are inconsistent with those in the rest of the book and figures 49, 61b, 66, 70 and 80 appear a little out of focus. Figure 77b should have been labelled as a reconstruction rather than a model.

Despite being published by an academic press, this book is aimed at a general readership. It is not an identification guide, nor a comprehensive reference source. However, it does contain some nice images of some rare and also some type specimens. A particularly fascinating specimen is the oldest evidence of plant–animal interaction in the fossil record, consisting of a nematode worm inside a Rhynie Chert plant! There can be little doubt that Scotland has a very rich palaeontological heritage (every geological period during which life existed is represented), and this book is a celebration of these fossils. It will appeal to anybody with a general interest in British palaeontology.

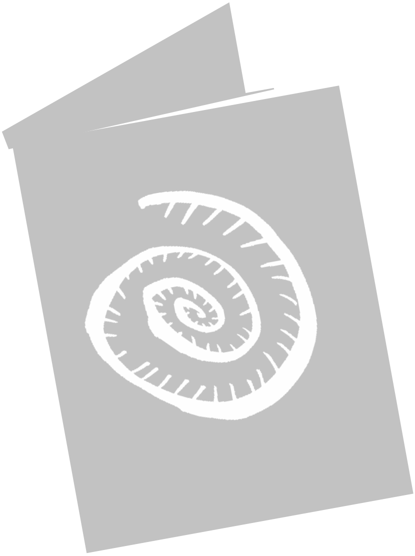
David Penney
Faculty of Life Sciences
University of Manchester, UK

Books available to review

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

- *Dinosaur Paleobiology* by Stephen L. Brusatte.
- *The British Silurian Crinoidea* by D. N. Lewis and S. K. Donovan.
- *The Cambrian Explosion* by Douglas H Erwin and James W Valentine.
- *Dinosaurs of Eastern Iberia* by A. Galobart, M. Suner and B. Poza.
- *Embryos in Deep Time* by Marcelo R. Sánchez.
- *Pterosaurs: Natural History, Evolution, Anatomy* by Mark P. Witton

Dr Charlotte Jeffery Abt
Book Review Editor,
Department of Earth & Ocean Sciences,
School of Environmental Sciences,
University of Liverpool,
4 Brownlow Street,
Liverpool L69 3GP,
UK



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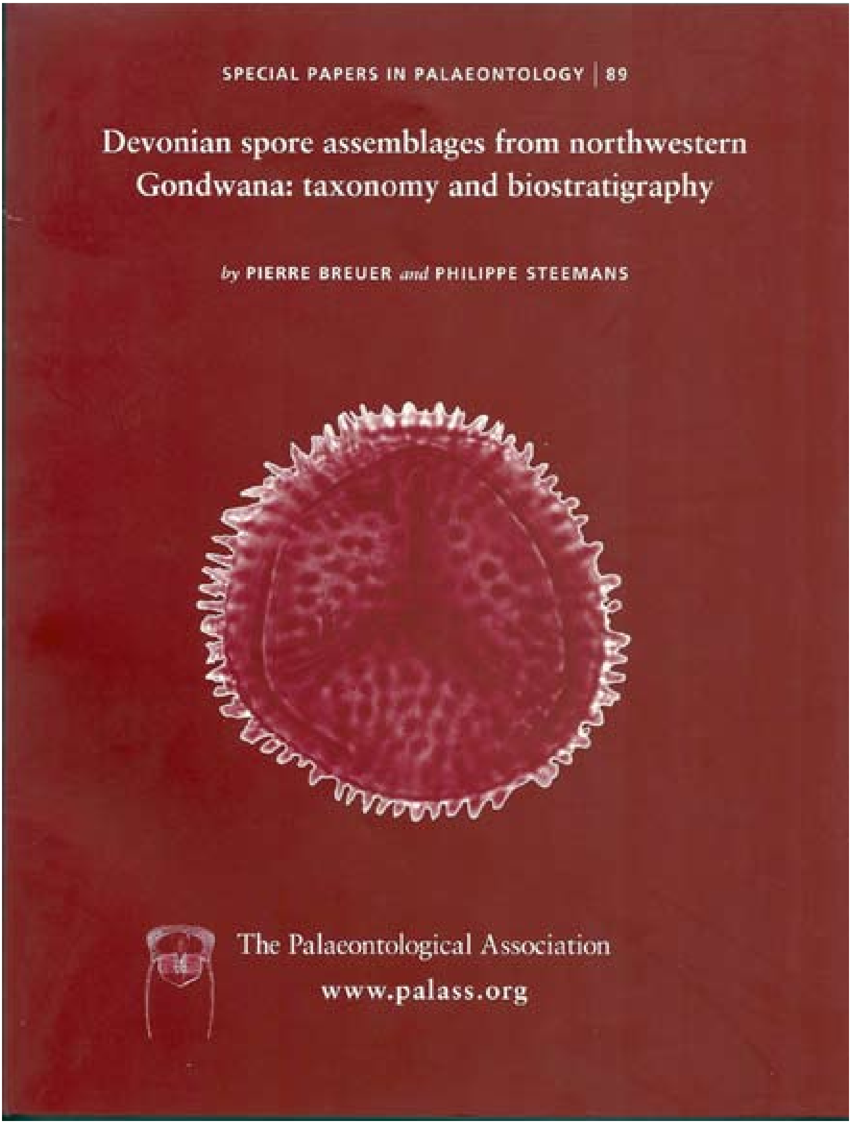
Special Papers in Palaeontology No. 89

Devonian spore assemblages from northwestern Gondwana: taxonomy and biostratigraphy

Pierre Breuer and Philippe Steemans

Abstract: Devonian spores from 16 subsurface successions in Saudi Arabia and North Africa are systematically documented to characterize assemblages for the northern margin of western Gondwana. The taxonomic study provides the identification and description for 205 spore taxa and forms the basis for a refined biostratigraphy and palaeogeography. Most species are illustrated by multiple specimens to document morphological variation and the effects of taphonomy. Numerous species have considerable morphological variability and require examination of larger populations to become fully understood. These spores show intergrading morphological variation and were grouped into morphons. Although a majority of spore species were previously described, many others are new and endemic to north-western Gondwana. Forty-two species (*Acinosporites tristratus*, *Alatisporites? trisacculus*, *Biornatispora elegantula*, *B. microclavata*, *Brochotriletes crameri*, *B. tenellus*, *B. tripapillatus*, *Camarozonotriletes asperulus*, *Chelinospora carnosa*, *C. condensata*, *C. densa*, *C. laxa*, *C. vulgata*, *Coronaspora inornata*, *Cristatisporites streelii*, *Cymbosporites variabilis*, *C. variegatus*, *C. wellmanii*, *Cyrtospora tumida*, *Diaphanospora milleri*, *Dibolisporites tuberculatus*, *D. verecundus*, *Dictyotriletes hemeri*, *D. marshallii*, *Elenisporis gondwanensis*, *Emphanisporites laticostatus*, *E. plicatus*, *Geminospora convoluta*, *Grandispora maura*, *Granulatisporites concavus*, *Hystricosporites brevispinus*, *Raistrickia commutata*, *R. jaufensis*, *Retusotriletes atratus*, *R. celatus*, *Samarisporites tunisiensis*, *Verrucosisporites nafudensis*, *V. onustus*, *V. stictus*, *Zonotriletes brevivelatus*, *Z. rotundus* and *Z. venatus*), five varieties (*Cymbosporites stellospinosus* var. *minor*, *C. variabilis* vars *variabilis*, *densus* and *dispersus*, and *Dictyotriletes biornatus* var. *murinatus*) and seven combinations (*Ambitisporites asturicus*, *Camarozonotriletes retiformis*, *Cristatisporites reticulatus*, *Cymbosporites ocularis*, *Dibolisporites gaspiensis*, *Grandispora stolidota* and *Jhariatriletes emsiensis*) are newly proposed. As the reference spore zones usually used and defined in Euramerica are not all recognized in the Gondwanan coeval sections, a new biostratigraphical scheme based on the own characteristics of the spore assemblages described here is proposed. It consists of nine assemblage zones, nine interval zones and one acme zone spanning from the upper Pragian to lower Frasnian.

Key words: Trilete spores, cryptospores, taxonomy, biostratigraphy, Devonian, Gondwana.



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Devonian spore assemblages from northwestern Gondwana: taxonomy and biostratigraphy

by PIERRE BREUER *and* PHILIPPE STEEMANS

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[see Article 8.2 of the International Code of Zoological Nomenclature (4th Edition, 1999)].

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Editors and Trustees:
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— — — **Newsletter design by Emma Davies, 31 Stafford Street, Edinburgh EH3 7BJ** — — —