The Palaeontology Newsletter

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Reminder: The deadline for copy for Issue no 81 is 3rd November 2012.

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

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Editorial

Summer is upon us, whatever that means for you. For me in Scotland it is the long hours of daylight and the chance to get round lots of mountaintops in a day and collect fossils in better light than usual. As the short report about Ken Shaw's fossil fish find in a paving slab in the heart of Edinburgh shows, sometimes exciting finds await us in rather unexpected places. For others, school is out – but Gordon Neighbour's article on palaeontology and schools reminds us that we should be looking to what we can do to help encourage school pupils to engage with palaeontology. Although Liam Herringshaw's somewhat downbeat article about the lack of retention of post-Ph.D. palaeontologists by UK universities and other institutions may have those pupils asking why they *should* focus on palaeontology. The analytical palaeobiologist in me would ask immediately whether other "clades" of Earth Scientists are having a similarly hard time of it. I suspect this is the case.

The Publications Board has a short item on changes to *Palaeontology*, I would urge everyone who submits papers to the journal to read the relevant updated sections on the website. An editor is always happier when submissions follow the protocol. On the subject of submissions for the *Newsletter*, I repeat my invitation for people with a desire to become Newsletter correspondents to contact me.

Another area where the *Newsletter* always needs help is with the book reviews section. As well as volunteers to review books, we would also greatly appreciate it if you have copies of books or monographs you have authored that you can pass on, or persuade your publisher to send a review copy, to Dr Charlotte Jeffery-Abt (<**chj@liverpool.ac.uk**>) for scrutiny by your peers.

Al McGowan
University of Glasgow

Newsletter Editor
<newsletter@palass.org>

Association Business

Nominations for Council: AGM 2012

At the AGM in December 2012, the following vacancies will occur on Council:

- Vice President
- Newsletter Reporter

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 **1st October 2012**. They should be sent to the Secretary: Dr Richard J. Twitchett, School of Geography, Earth and Environmental Sciences, Plymouth University, Plymouth, PL4 8AA, UK; email: <**richard.twitchett@plymouth.ac.uk**> or <**secretary@palass.org**>.

The following nominations by Council have already been received:

Vice President: Dr Andrew B. Smith
Newsletter Reporter: Dr. L. Herringshaw

Trustees Annual Report 2011

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 2010: President: Prof. J.E. Francis; Vice Presidents: Prof. J.C.W. Cope and Dr P. Orr; Treasurer: Mr P. Winrow; Secretary: Dr H.A. Armstrong; Chair of Publications Board: Prof. M.P. Smith; Editor

Trustee: Dr P. Orr and Dr P.C.J. Donoghue; Book Review Editor: Dr C. Jeffrey-Abt; Publicity: Dr E. Rayfield; Newsletter Reporter: Dr L. Herringshaw; Newsletter Editor: Dr R.J. Twitchett; Web Officer: Dr M. Sutton; Meetings Coordinator: Dr D. Schmidt; Ordinary Members: Dr C. Underwood, Dr E. Rayfield, Dr P. Upchurch, Dr C. Klug, Dr W. Renema, Dr C. Buttler and Dr T. Vandenbroucke. The Executive Officer: Dr T. J. Palmer and Editor-in-Chief: Dr S. Stouge continued to serve Council but are not Trustees.

Membership. Membership on 31st December 2011 totalled 1,167 (1,197 at the end 2010). Of these 707 were Ordinary Members, 182 Retired and Honorary Members and 278 Student Members. There were 62 Institutional Members and 83 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 £662,101 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 £80,990 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 2012 totalled £743,091.

Finance. Total income in 2011 was £305,204. Total charitable expenditure, through grants to support research, scientific meetings and workshops in 2011 was £266,982. Governance costs were £16,481. Total resources expended were £310,318.

Risk. Despite the small operating deficit in 2011, 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 2012.

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

Grants. Palaeontological Association Research Grants were awarded to Dr D. Loydell (University of Portsmouth), "Integrated biostratigraphy of the Trannon River section, Wales"; Dr H. Hughes (University of Plymouth), "Biotic responses to Silurian global environmental change"; and Dr A. Daley (Natural History Museum), "Early evolution and ontogeny of the anomalocarids".

Grants–in-aid. The Association provided funds to support the following meetings: Bivalve Chemosynthetic molluscs (NHM); Rockwatch meeting to support events at reopening of Fossil Grove, Victoria Park (Glasgow); World Conference on Marine Diversity (Aberdeen); Geobiology and Environments of silica biomineralizers (Lille); Rotting fish and fossils (University of Leicester);

and Late Carboniferous terrestrial environments, Ukraine (IGCP 575). A grant was made to Prof. N. Hughes (Riverside, University of California) to support publication of a book for children in India on the origin of silicified wood.

Small Grants Scheme. The new Callomon Award and Whittington Award were managed alongside the Sylvester-Bradley Award as part of an integrated Small Grants Scheme. The scheme received sixteen applications. Eight were recommended for funding in 2012. Sylvester-Bradley Awards will be made to P. Andreev, S. Brusatte, B. Henrick, M. Hoffmeister, P. Hull and O. Reyes. The Callomon Award will be made to J. Ortega Hernandez, and the Whittington Award to A. Otero.

Online activities. The online activities of the Association continue to expand. Funding was provided to develop palaeontological outreach through the website. The Association continues to host mirror sites for *Palaeontologia Electronica*, the EDNA fossil insect database, the Palaeontographical Society website, and a database of fossils from Kent produced by the Kent RIGS Group. Payments in the Online Shop are now made via Worldpay.

Public meetings. Four public meetings were held in 2011, and the Association extends its thanks to the organisers and host institutions of these meetings.

55th Annual Meeting. This was held on 17–20 December at Plymouth University. Dr R. J. Twitchett with local support from colleagues and PhD students organised the meeting, which included a symposium on "Ancient and modern biotic crises" and comprised a programme of internationally recognised speakers. There were 257 attendees. The Annual Address entitled "Climate and Evolution in the Cenozoic Oceans" was given by Prof. P. N. Pearson (University of Cardiff) and attendance included non-academics and local sixth form students. The President's Award for best oral presentation from a member under 35 was made to Alexander Liu (University of Cambridge). The Council Poster Prize was presented to Samantha Giles (University of Bristol). The post-conference field trip was to the English Riviera Global Geopark and Kents Cavern.

British Science Festival, Palaeontological Association Symposium This is an annual forum for presentations to the public and general scientists. The Symposium "Paradise Lost? Strange environments and major events from the geological past" was organised by Dr C. T. S. Little (University of Leeds) 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 Laurent Darras, David Riley and Alison Tasker, and was held at the University of Leicester.

Lyell Meeting. The Association hosted the Lyell Meeting in 2011 on the topic of "Island faunas, migration and evolution", organised by Prof S. Donovan.

Publications. Publication of *Palaeontology* and *Special Papers in Palaeontology* is managed by Wiley Blackwell. Volume 54 of *Palaeontology*, comprising six issues, was published. *Special Papers in Palaeontology* 85, "The Phylogeny of Post-Palaeozoic Asteroidea (Neoasteroidea, Echinodermata)," by Andrew S. Gale; and *Special Papers in Palaeontology* 86, "Studies on Fossil tetrapods," edited by Paul M. Barrett and Andrew R. Milner, were also published during the year. One *Field Guide to Fossils*, on "English Wealden Fossils", edited by D. J. Batten, was published. 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 of *Palaeontology Newsletter*. The Association remains a Tier 1 sponsor of *Palaeontologia Electronica*, and the *Treatise on Invertebrate Paleontology*

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

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. R. A. Aldridge (University of Leicester). 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 G. Edgecombe (Natural History Museum). 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 R. Butler (Ludwig Maximilian University, Munich). The Mary Anning awards, for an outstanding contribution by an amateur palaeontologist, were made to Mr C. Duffin and Mr D. Brockhurst. Council also awards an undergraduate prize to each university department in which palaeontology is taught beyond Level 1. Honorary Life membership was awarded to Prof. D. J. Batten and Dr P. Lane. Golden Trilobite Awards were made to the following websites: <**www.ultimateungulate.com**>; Links for Palaeobotanists (<**www.equisetites.de/palbot1.html**>); Burgess Shale Online Exhibition (Royal Ontario Museum; <**www.burgess-shale.rom.on.ca/**>); and <**www.ammonites.fr**>.

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 Servais represented the Association. Dr Armstrong acted as the Association representative on the International Palaeontological Association. During the year the Association responded to requests for information from the HEFCE consultation on the Research Excellence Framework, NERC and the BGS.

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. A total of £10,797 will be allocated from the Small Grants Scheme to fund the eight individuals who were successful in the 2011 application round. 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 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 2012, 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 fund a new Outreach Officer position. The 56th Annual meeting will be held at University College Dublin. Progressive Palaeontology will be held at the University of Cambridge. The Association will sponsor a symposium at the British Science Festival, "Our fossil-fuelled future," 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 2011

			General Funds £	Designated Funds £	TOTAL 2011 £	TOTAL 2010 £
Incoming Resources						
Generated Funds						
Voluntary income	Subscriptions	61,916			61,916	66,913
	Legacies	0			0	30,000
	Donations	0		1,250	1,250	1,589
			61,916	1,250	63,166	98,502
Charitable activities						
Sales	Palaeontology	202,710				
	Special Papers	11,314				
	Offprints	728				
	Field Guides	12,283				
	Distribution	1,680				
			228,715		228,715	226,874
Investment income			13,238	85	13,323	12,163
TOTAL INCOMING RESOURCES			303,869	1,335	305,204	337,539
Resources expended						
Costs of generating funds						
For voluntary income	Administration	23,640				21,029
Investment management	Stockbroker fees	3,215				2,845
			26,855	0	26,855	23,874
Charitable activities						
Publications	Palaeontology	82,360				
	Special Papers	9,899				
	Offprints	1,317				
	Field Guides	14,174				
	Newsletters	13,655				
	Distribution	2,215				
	Marketing	2,238				
	Editorial costs	58,168				
	Total Publications	184,026			184,026	178,403
Scientific Meetings & Costs		29,060			29,060	70,931
Grants and Awards		3,091		6,896	9,987	14,785
Research Grants		14,358			14,358	5,619
Administration of charitable activities		29,551			29,551	26,286
			260,086		266,982	296,024
Governance costs	Examiner's fee	400				
	Trustee expenses	10,171				
	Administration	5,910				
			16,481	0	16,481	13,107
TOTAL RESOURCES EXPENDED			303,422	6,896	310,318	333,005
NET INCOMING RESOURCES			447	-5,561	-5,114	4,534
INVESTMENT GAINS/LOSSES						
Realised gain/(loss)		-1,665				
Unrealised gain/(loss)		-10,552				
			-12,217		-12,217	46,249
NET MOVEMENT IN FUNDS			-11,770	-5,561	-17,331	50,783
TRANSFERS BETWEEN FUNDS			0	0	0	0
SURPLUS/DEFICIT FOR THE YEAR			-11,770	-5,561	-17,331	50,783
FUNDS BROUGHT FORWARD			673,871	86,551	760,422	709,639
FUNDS CARRIED FORWARD			662,101	80,990	743,091	760,422

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369

BALANCE SHEET as at 31st DECEMBER 2011

2010 £			Note			2011 £
		INVESTMENTS				
	534,720	At market value	**9**			520,606
		CURRENT ASSETS				
138,151		Cash at Banks		199,212		
126,690		Sundry Debtors	**6**	111,900		
264,841		Total Current Assets			311,112	
		CURRENT LIABILITIES				
20,795		Subscriptions in Advance		23,500		
18,344		Sundry Creditors	**7**	65,127		
39,139		Total Current Liabilities			88,627	
	225,702	NET CURRENT ASSETS				222,485
	760,422	TOTAL ASSETS				743,091
		Represented by:				
	673,871	GENERAL FUNDS				662,101
		DESIGNATED FUNDS	**8**			
20,325		Sylvester Bradley Fund			17,218	
22,805		Jones-Fenleigh Fund			21,914	
13,421		Hodson Fund			11,828	
10,000		Callomon Fund			10,010	
20,000		Whittington Fund			20,020	
	86,551					80,990
	760,422					743,091

Notes to the Financial Statements for the year ended 31st December 2011

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 March 2005 and cover all the charity's operations, all of which are continuing.

The effect of events relating to the year ended 2011 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 2011 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 Council in furtherance of the general objectives of the charity and which have not been designated for other purposes.

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

- Sylvester-Bradley Fund: Grants made to permit palaeontological research.
- Jones Fenleigh Fund: Grants to permit one or more students annually to attend the meeting of the Society of Vertebrate Palaeontology and Comparative Anatomy (SVPCA).
- Hodson Fund: Awards made in recognition of the palaeontological achievements of a worker under the age of 35.
- 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.

All investment gains and losses, both realised and unrealised, are allocated to General Funds; designated funds are held as cash.

2. Analysis of Financial Resources Expended

	Staff costs £	Other costs £	Total 2011 £	Total 2010 £
Generating Funds	17,059	9,796	26,855	23,874
Charitable activities	60,449	206,533	266,982	296,024
Governance	4,265	12,216	16,481	13,107
	81,773	228,545	310,318	333,005

3. Staff Costs

	Salary £	National Insurance £	Pension Contributions £	Total 2011 £	Total 2010 £
Publications: 1 employee (2010: 1)	34,378	0	4,747	39,125	34,112
Administration: 1 employee (2010: 1)	32,167	3,444	7,037	42,648	39,130
	66,545	3,444	11,784	81,773	73,242

4. Trustees Remuneration and Expenses

Members of Council neither received nor waived any emoluments during the year (2010: nil)

The total travelling expenses reimbursed to 12 Members of Council was £10,086 (2010: £7,450)

5. Costs of Independent Examiner

	2011 (£)	2010 (£)
Examination of the accounts	400	400
Accountancy and payroll services	1,450	1,400
	1,850	1,800

6. Debtors

	2011 (£)	2010 (£)
Accrued income – receivable within one year	111,900	126,690

7. Creditors – falling due within one year

	2011 (£)	2010 (£)
Social Services costs	3,303	3,182
Accrued expenditure	61,824	10,462
	65,127	13,644

8. Designated Fund

(See page 11.)

9. Schedule of Investments

(See pages 12–13.)

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369

STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2011

DESIGNATED FUNDS Note 8 to the Accounts

	Sylvester-Bradley £	Jones-Fenleigh £	Hodson £	Callomon £	Whittington £	TOTAL 2011 £	TOTAL 2010 £
Donations	764	487	0	0	0	1,250	1,589
Interest Received	20	22	13	10	20	85	94
TOTAL INCOMING RESOURCES	784	509	13	10	20	1,335	1,683
Grants made	3,890	1,400	1,606	0	0	6,896	7,261
NET SURPLUS/(DEFICIT)	-3,106	-891	-1,593	10	20	-5,561	-5,578
TRANSFERS BETWEEN FUNDS	0	0	0	0	0	0	50,000
SURPLUS/(DEFICIT) FOR THE YEAR	-3,106	-891	-1,593	10	20	-5,561	44,422
FUNDS BROUGHT FORWARD	20,325	22,805	13,421	10,000	20,000	86,551	42,128
FUNDS CARRIED FORWARD	17,218	21,914	11,828	10,010	20,020	80,990	86,550

Note 9 to the Accounts

Nominal	Holding	Cost (pre 2011)	Value (end 2010)	Proceeds (in 2011)
£18,000	UK 4.75% Stock 07/03/20 GBP 100	18,145.87	20,072.00	
£20,000	UK 4.5% Gilt 07/03/19 GBP 0.01	20,092.99	22,030.00	
£64,176.46	COIF Charities Fixed Interest Fund	85,000.00	81,523.36	
804	Royal Dutch Shell B shares	12,432.00	17,005.00	
1,425	BP Ord 25c shares	5,047.35	6,634.00	
600	BHP Billiton $0.5 shares	4,341.48	15,306.00	
500	BG Group Ordinary 10p shares	3,977.95	6,480.00	
1,825	HSBC Holdings Ordinary 0.5 US Dollar shares	5,512.91	11,883.00	
6,800	Lloyds TSB Ordinary 25p shares	10,169.91	4,468.00	
875	BAE Systems Ord 2.5 P shares	3,542.00	2,888.00	
1,000	3I Group Ordinary £0.738636 shares	3,058.76	3,285.00	
1,150	Tesco Ord GBP 0.05	4,583.22	4,888.00	
1,550	Kingfisher Ord GBP 0.157142857	3,554.45	4,083.00	
175	Carnival Plc Ord USD 1.66	3,996.49	5,219.00	
650	Glaxo Smithkline Ordinary 25p shares	10,232.42	8,060.00	
2,499	Bluecrest Allblue Ord Npv GBP shares	3,020.28	4,248.00	
1,100	Wood Group (John) Ordinary 3.33p shares	2,975.36	6,149.00	6,874.01
550	Amec ord 50P			
7,000	Ing Global Real Estate Securities Ord NVP shares	7,084.00	6,003.00	
4,175	Vodaphone Group Ord USD 0.11428571	6,034.20	6,922.00	
2,150	BT Group Ordinary 5p shares	7,787.53	3,887.00	
225	Brit Amer Tobacco Ord GBP 0.25	4,991.81	5,543.00	
300	Unilever PLC Ord GBP 0.031111	4,326.21	5,889.00	
460	Pearson Ordinary 25p shares	8,069.00	4,637.00	
490	Serco Group Ord 2P	3,005.01	2,722.00	
700	National Grid Ord GBP 0.113953	3,648.26	3,871.00	
420	Experian Ord 10C	3,444.95	3,352.00	
670	Blackrock World Mi Ord 5P	4,019.09	5,434.00	
315	Standard Chartered Ord USD 0.50	5,514.48	5,435.00	
650	RIT Capital Partners Ordinary £1 shares	4,903.90	7,794.00	
1,000	Balfour Beatty 50P	2,913.17	3,129.00	
20	Schroder Alt Solut Agriculture C GBP Dis Hdg	2,987.22	2,790.00	
1,500	British Empire Sec & Gen Trust Ordinary 10p shares	5,005.61	7,290.00	
425	Findlay Park Partners US Smaller Companies	6,158.47	13,130.00	
2,825	Ishares S&P 500 GBP	20,319.63	22,819.00	
900	JPMorgan Am UK Ltd Emerging Markets I Instl	5,043.10	5,620.00	
8,000	Bny Mellon Glb Fds Erg Mkts Debt Loc Crr C			
1,750	Cazenove Inv Fd Mt European Fund X Acc Nav	6,107.82	7,948.00	6,835.08
425	Fidelity EUR Value Ordinary 25P shares	4,059.07	4,730.00	
3,900	Edinburgh Dragon Trust Ordinary £0.20 shares	4,478.10	9,965.00	
3,100	Capita Morant Wright Japan B Inc Nav	5,170.11	6,423.00	5,687.62
160	GLG Japan Corealpha Equity IT Acc			
5,200	Scottish Widows Property Trust B	4,669.49	4,678.00	
100	Bluebay Funds SA LI.FD-D GBP Base	11,581.33	11,252.00	10,707.94
26	Veritas Asset Mgmt Veritas Asian A GBP	8,182.27	8,462.00	
1,320	Goldman Sachs Fund US Equity I GBP Inc Nav	14,640.81	14,559.00	
65	Roche Hldgs Ag Genusscheine Nvp	7,226.55	6,104.00	
6,600	Henderson Gbl Invs European Special Sits I Inc	7,037.91	8,336.00	
55	Shd Umbrella Funds Paragon Capp App Ire B	9,894.52	9,927.00	
1,283.80	COIF Charities Investment Fund Acc Units	75,000.00	101,847.58	
	Total	462,987.06	534,719.94	30,104.65

Investment Portfolio 2011

Cost (in 2011)	Gain realised (in 2011)	Value (end 2011)	Gain unrealised (at end 2011)	
		22,469.00	2,397.00	UK 4.75% Stock 07/03/20 GBP 100
		24,370.00	2,340.00	UK 4.5% Gilt 07/03/19 GBP 0.01
		85,669.16	4,145.80	COIF Charities Fixed Interest Fund
		19,730.00	2,725.00	Royal Dutch Shell B shares
		6,562.00	-72.00	BP Ord 25c shares
		11,265.00	-4,041.00	BHP Billiton $0.5 shares
		6,883.00	403.00	BG Group Ordinary 10p shares
		8,962.00	-2,921.00	HSBC Holdings Ordinary 0.5 US Dollar shares
		1,762.00	-2,706.00	Lloyds TSB Ordinary 25p shares
		2,495.00	-393.00	BAE Systems Ord 2.5 P shares
		1,810.00	-1,475.00	3I Group Ordinary £0.738636 shares
		4,640.00	-248.00	Tesco Ord GBP 0.05
		3,886.00	-197.00	Kingfisher Ord GBP 0.157142857
		3,721.00	-1,498.00	Carnival Plc Ord USD 1.66
		9,565.00	1,505.00	Glaxo Smithkline Ordinary 25p shares
		4,176.00	-72.00	Bluecrest Allblue Ord Npv GBP shares
	725.01			Wood Group (John) Ordinary 3.33p shares
6,133.62		4,991.00	-1,142.62	Amec ord 50P
		5,705.00	-298.00	Ing Global Real Estate Securities Ord NVP shares
		7,469.00	547.00	Vodaphone Group Ord USD 0.11428571
		4,104.00	217.00	BT Group Ordinary 5p shares
		6,875.00	1,332.00	Brit Amer Tobacco Ord GBP 0.25
		6,489.00	600.00	Unilever PLC Ord GBP 0.031111
		5,566.00	929.00	Pearson Ordinary 25p shares
		2,323.00	-399.00	Serco Group Ord 2P
		4,375.00	504.00	National Grid Ord GBP 0.113953
		3,677.00	325.00	Experian Ord 10C
		4,231.00	-1,203.00	Blackrock World Mi Ord 5P
		4,438.00	-997.00	Standard Chartered Ord USD 0.50
		7,956.00	162.00	RIT Capital Partners Ordinary £1 shares
		2,648.00	-481.00	Balfour Beatty 50P
		2,338.00	-452.00	Schroder Alt Solut Agriculture C GBP Dis Hdg
		6,211.00	-1,079.00	British Empire Sec & Gen Trust Ordinary 10p shares
		12,891.00	-239.00	Findlay Park Partners US Smaller Companies
		23,031.00	212.00	Ishares S&P 500 GBP
		4,649.00	-971.00	JPMorgan Am UK Ltd Emerging Markets I Instl
10,745.39		9,957.00	-788.39	Bny Mellon Glb Fds Erg Mkts Debt Loc Crr C
	-1,112.92			Cazenove Inv Fd Mt European Fund X Acc Nav
		4,263.00	-467.00	Fidelity EUR Value Ordinary 25P shares
		8,463.00	-1,502.00	Edinburgh Dragon Trust Ordinary £0.20 shares
	-735.38			Capita Morant Wright Japan B Inc Nav
11,330.79		10,569.00	-761.79	GLG Japan Corealpha Equity IT Acc
		4,673.00	-5.00	Scottish Widows Property Trust B
	-544.06			Bluebay Funds SA LI.FD-D GBP Base
		6,663.00	-1,799.00	Veritas Asset Mgmt Veritas Asian A GBP
		14,045.00	-514.00	Goldman Sachs Fund US Equity I GBP Inc Nav
		7,119.00	1,015.00	Roche Hldgs Ag Genusscheine Nvp
		6,917.00	-1,419.00	Henderson Gbl Invs European Special Sits I Inc
		9,510.00	-417.00	Shd Umbrella Funds Paragon Capp App Ire B
		100,494.71	-1,352.87	COIF Charities Investment Fund Acc Units
28,209.80	-1,667.35	520,605.87	-10,551.87	

Independent Examiner's Report
on the Accounts of The Palaeontological Association
for the year ended 31st December 2011

Respective responsibilities of trustees and examiner

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

It is my responsibility to:

- examine the accounts (under section 43 of the Act as amended)
- follow the procedures laid down in the General Directions given by the Charity Commissioners (under section 43(7) of the Act as amended), and
- 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 I do not express an audit opinion on the accounts.

Independent examiner's statement

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

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

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

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

Dated: 25th April 2012

G R Powell F.C.A.

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

Grants and Awards

Grants-in-Aid

The Palaeontological Association is happy to receive applications for loans or grants from the organizers of scientific meetings that lie conformably with its charitable purpose, which is to promote research in palaeontology and its allied sciences. Application should be made in good time by the scientific organizer(s) of the meeting on the online application form. Such requests will be considered by Council at the March and October Council Meetings each year. Enquiries may be made to the <**secretary@palass.org**>, and requests should be sent by **1st March** or **1st October**.

Grants-in-Aid: Workshops and short courses

The Palaeontological Association is happy to receive applications for loans or grants from the organizers of scientific workshops or short courses that lie conformably with its charitable purpose, which is to promote research in palaeontology and its allied sciences. Application should be made in good time by the scientific organizer(s) of the meeting on the online application form. Such requests will be considered by Council at the March and October Council Meetings each year. Enquiries may be made to <**secretary@palass.org**>, and requests should be sent by **1st March** or **1st October**.

Lapworth Medal

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

Nominations must be supported by a resumé (single sheet of details) of the candidate's career, and further supported by a brief statement from two nominees. A list of ten principal publications should accompany the nomination. Council will reserve the right to not necessarily make an award in any one year. Details and nomination forms are available on the Association Website at
<**www.palass.org**>. Deadline is **1st May**. The Medal is presented at the Annual Meeting.

news

Recent changes at Palaeontology*: new faces and new procedures*

The past few months have seen some changes among the personnel responsible for the production of *Palaeontology*. Further, the Palaeontological Association has recently implemented a series of changes as to how manuscripts are processed that are designed to expedite the review process and publication. Finally, the scope of the journal has been broadened, and the types of article published extended.

New faces

A number of new personnel have joined the team at *Palaeontology* in the past few months. Firstly, we welcome Dr Sally Thomas as Assistant Editor to help with the manuscript production process. We are delighted to welcome Drs Julia Sigwart and Hannah O'Regan as new Scientific Editors. Prof. Paul Smith has completed his period as Chair of the Publications Board, and the following their terms as Scientific Editors: Drs Dave Polly and Paul Barrett. We thank all of these individuals for their invaluable contribution. A list of the personnel currently involved in production of the journal is available on the Association's website (<**www.palass.org**>).

Scope of the journal

Palaeontology publishes papers on any aspect of palaeobiology and allied disciplines (for example, facies analysis, biostatigraphy); its scope includes notices or discussion of new software packages for palaeontological evolutionary research. Papers on Recent material are welcome if their relevance to the history of life is clear.

The following types of article are published in *Palaeontology*:

- **Rapid Communications** – short manuscripts reporting findings that are particularly timely, noteworthy or novel;
- **Original Research Articles**, as either individual contributions or a thematic set (typically 10 to 25 printed pages each);
- **Comments and Replies** – discussion of any paper published recently in *Palaeontology*;
- **Review Articles**.

Further details of each type of article are available on the Association's website (**www.palass.org**) under 'Publications'.

Publishing in Palaeontology: new procedures

Full details on how to submit a manuscript to *Palaeontology* using Manuscript Central are available at <**http://www.palass.org/publishinginpalaeontology**>. The journal receives many more manuscripts than can be published. We have therefore implemented a number of changes as to how manuscripts are processed. All manuscripts submitted are reviewed first by a five-person Editorial Board. There are three principal criteria on which a manuscript is rejected, or returned to the corresponding author for amendment at this stage:

(a) The paper would be unlikely to have wide appeal to the readership. For example, papers solely describing new species of common genera will not usually be accepted. The significance of the paper to a wide audience should be demonstrated in its introduction.

(b) The paper has not been prepared in accordance with the *Instructions to Authors*. A comprehensive revised version of the *Instructions to Authors* is available on the Association's website (<**www.palass.org**>) under 'Publications'.

(c) The standard of written English could be improved. A list of independent suppliers of editing services can be found at <**http://authorservices.wiley.com/bauthor/english_language.asp**>. Please note that all services are paid for and arranged by the author, and do not guarantee acceptance for publication.

The peer-review process is, as before, managed by a Scientific Editor. A final decision on the suitability of the manuscript is made after comments by at least two referees and analysis by the Scientific Editor and Editor-in-Chief. The decision will be conveyed to the corresponding author by the Editor-in-Chief. Authors invited to submit a revised manuscript should consider what changes to the content of the manuscript have been requested, plus any technical comments that may be included.

A paper is only considered to be accepted for publication after all changes required have been made to the satisfaction of the Editor-in-Chief. This process may, of course, involve further consultation with the Scientific Editor and the original reviewers or, in some cases, a new set of reviews.

After acceptance, the manuscript will be copy-edited and the corresponding author will receive proofs (as a PDF file) from the publisher; only final, minor, corrections should be required at this stage.

During production, authors can track the progress of their paper via Wiley-Blackwell's *Author Services*. Information on this service is available at <**http://authorservices.wiley.com/bauthor/**>.

Palaeontology is included in the Wiley *Early View* service (whereby the Online Version of Record is published before inclusion in an issue). This is the finalized and typeset version of a paper; no changes can be made subsequently. To comply with the *International Code of Zoological Nomenclature*, papers in which new taxa are named are not made available via *Early View*, but appear first in the printed journal. We are currently in discussion with the International Commission on Zoological Nomenclature as to whether subsequent versions of the Code will allow us to change this approach.

We look forward to receiving your manuscripts for publication in *Palaeontology*.

Scottish Geodiversity Charter launched in Edinburgh

The new Scottish Geodiversity Charter (SGC) was launched by the Secretary for the Environment and Climate Change, Stewart Stevenson MSP, on 6th June 2012. The publication of the Charter represents the culmination of efforts by several learned societies, BGS, SNH and the grass roots Regionally Important Geological and Geomorphological Sites (RIGS) groups and their successors, the Geoconservation groups.

The Scottish Geodiversity Forum (<**http://scottishgeodiversityforum.org/**>) has proved a critical means for a broad alliance of organizations and individuals interested in geodiversity to unite and produce the SGC over the past year. The SGC is an especially important development, as it gives formal recognition to the need to survey, study and conserve the diversity of abiotic nature in Scotland. At the event it was particularly heartening to hear Dr Diarmaid Campbell, BGS Chief Geologist Scotland, lionizing the rich palaeontological finds that have come from Scotland and contributed so much to our understanding of early terrestrial tetrapod evolution.

Al McGowan
University of Glasgow

ASSOCIATION MEETINGS

56th Annual Meeting of the Palaeontological Association
University College Dublin, Ireland *16 – 18 December 2012*

2nd Announcement

The 56th Annual Meeting of the Palaeontological Association will be held at University College Dublin, Ireland, organised by Patrick Orr, Aoife Braiden and colleagues from UCD School of Geological Sciences.

Sunday 16th: Symposium, Annual Address and Icebreaker reception

The Meeting will begin with a symposium on Sunday 16th December, followed in the evening by the Annual Address and an Icebreaker reception.

Please note that this scheduling of the Annual Address is different from previous years.

The topic for the Annual Symposium this year is *'Taphonomy and the fidelity of the fossil record'*. The keynote speakers are:

Prof. Derek Briggs (Dept of Geology and Geophysics, Yale University),

- Dr Alan Channing (Dept of Earth and Ocean Sciences, Cardiff University)
- Prof. Susan Kidwell (Dept of the Geophysical Sciences, University of Chicago)
- Dr Maria McNamara (Dept of Geology and Geophysics, Yale University and UCD School of Geological Sciences, University College Dublin)
- Dr Rob Sansom (Dept of Biology and Biochemistry, University of Bath)
- Dr Clive Trueman (National Oceanography Centre, Southampton)

The Annual Address *'New views on the origin of our species'* will be given by Prof. Chris Stringer (Dept of Palaeontology, Natural History Museum, London, England). It will be followed by the Icebreaker reception.

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

Please note that options to purchase food will be extremely limited on the UCD campus on the Sunday. Those attending for the entire afternoon should avail themselves of the 'light meal' option (soup and sandwich, tea/coffee) that will be available between the Symposium and the Annual Address. This *must* be purchased at the time of registering for the conference.

Monday 17th – Tuesday 18th: Conference and UCD Earth Institute Lecture

The Conference itself will commence on Monday 17th December with a full day of talks and posters, and the Association AGM. In the evening there will be a drinks reception followed by the Annual Dinner. Tuesday 18th December will comprise a dedicated poster session and talks. The time allocated to each talk will be 15 minutes; parallel sessions, if required, will be organised for part of each day to accommodate as many speakers as possible.

Our meeting will conclude on Tuesday 18th December with an early evening lecture by Prof. Andy Knoll (Department of Organismic and Evolutionary Biology, Harvard University) on '*Systems Paleobiology: Physiology as the link between biological and environmental history*'. We are extremely grateful to the UCD Earth Institute (<**www.ucd.ie/earth**>) for their sponsorship of this lecture.

Please note that Prof. Knoll's lecture is being held in collaboration with the British Sedimentological Research Group (**www.bsrg.org.uk**); their Annual Meeting will also be hosted by UCD School of Geological Sciences and is to be held between 18th and 20th December – so why not come to Dublin for both?!

Registration and booking

Registration, abstract submission and booking (including payment by credit card) will commence on Monday 16th July 2012.

Abstract submission closes on Friday 21st September 2012; abstracts submitted after this date will not be considered.

Registration after Friday 21st September 2012 will incur an additional administration charge of €30.00 (approximately £25.00, US$38.00).

The final deadline for registration is Friday 16th November 2012.

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.

Registration costs include sandwich lunches on Monday and Tuesday, the reception on Sunday 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 Old Jameson Distillery, Smithfield (**http://www.tours.jamesonwhiskey.com/**). The evening's festivities will include a drinks reception, tour of the distillery and whiskey sampling, followed by a four-course meal. The evening will conclude with an after-hours 'get-together' hosted for us by the adjacent Generator Hostel, Dublin.

Venue and accommodation

The conference will take place at Belfield, the main University College Dublin campus, which is approximately 4km south of the city centre.

The recommended accommodation is, however, based in the Smithfield area of Dublin city centre, as this is where our evening social activities, including the Annual Dinner, will be based.

Note that a bus or taxi journey would be required in the morning and evening between the campus and the Smithfield area. If you would therefore prefer to stay in the vicinity of the UCD campus there are a number of guest-houses and two (moderately expensive) hotels nearby.

(a) Radisson Blu St Helen's Hotel, Dublin Stillorgan Road, Blackrock, Dublin 4 (003531 218 6000)

(b) Stillorgan Park Hotel, Stillorgan Rd, Mount Merrion, Stillorgan, Dublin 18 (003531 200 1800)

We will be happy to offer advice on guest-house accommodation to any individuals who require it.

Delegates should book their own accommodation unless advised otherwise. Rooms in a variety of hotels, hostels and guest-houses at a range of different prices are available in the Smithfield area and can be reserved through the usual channels.

We have reserved a limited number of rooms at preferential rates at the following two hotels and one hostel; these are available on a first-come-first-served basis. Please note carefully the booking procedure to ensure that you obtain the discounted rates. The Generator Hostel and the Maldron Hotel are less than two minutes walk from each other and from the venue for the Annual Dinner. The Jury's Inn, Christchurch is about ten minutes walk from the others.

(a) Maldron Hotel, Smithfield, Dublin 7:

<**http://www.maldronhotelsmithfield.com/**>

- €65.00 B&B per room per night for a single
- €75.00 B&B for a twin/double

To obtain the discounted rates book directly rather than online via the following:

Telephone: + 353 (0)1 485 0900
Fax: + 353 (0)1 485 0910
E-mail: <**res.smithfield@maldronhotels.com**>

Ensure that you direct your booking 'For the attention of Mr Philip Downes Reservations Supervisor.' and quote 'PALASS2012'.

(b) Generator Hostel Dublin, Smithfield Square, Dublin 7.

<**http://www.generatorhostels.com/en/dublin/**>

We have reserved a limited number of each of the following in this recently refurbished and very well appointed 'hotel-style hostel':

- twin-bedded rooms ensuite @ €40.00 per room per night
- six-bedded rooms ensuite @ €10.00 per bed per night
- four-bedded rooms ensuite @ €11.00 per bed per night

To obtain these rates ensure that you contact the hostel directly (*i.e.* do not book online) and ensure you use the code: "Palass & BSRG":

E-mail: <**louise.lawlor@generatorhostels.com**> or <**Jodie.hanratty@generatorhostels.com**>
Telephone: +353 1901 0222.

(c) Jury's Inn, Christchurch

<**http://www.jurysinns.com/**>

Saturday 15th December:

- €89.00 (bed & breakfast, single)
- €99.00 (bed & breakfast, twin / double)

Sunday 16th – Tuesday 18th December:

- €65.00 (bed & breakfast, single)
- €75.00 (bed & breakfast, twin / double)

Breakfast is available in the Innfusion Restaurant from 7am till 10am. The rates are per room, per night and include VAT at 9% (which is subject to change without notice).

To make a booking download and complete the booking form available on the conference website at <**www.palass.org**>. The form should be faxed (0044 161 774 0291) or e-mailed (<**ireland@jurysinns.com**>) to Jurys Inn Central Reservations Department. Ensure you quote the reference **PALA161212**. A credit card number is required at the time of booking as a guarantee for the room. The final cut-off date for this booking is **29th October 2012**. Cancellation of any booking will incur charges, details of which can be found on the booking form.

Getting to Dublin

Comprehensive information on Getting to Dublin was published in the previous *Newsletter* and is also available as a PDF document on the Palaeontological Association website.

Contacts

To contact local organisers Patrick Orr and Aoife Braiden please e-mail <**annualmeeting@palass.org**>.

Please check the Association's website <**www.palass.org**> for all details and updates.

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 Dublin2012 meeting, grants of less than £100 (or the € equivalent) will be available to student presenters who are travelling from outside Britain and Ireland. 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 (<**palass@palass.org**>) once the organisers have confirmed that their presentation is accepted, and before **1st December 2012**. Entitle the e-mail "Travel Grant Request". No awards can be made to those who have not followed this procedure.

Why not make a stay of it?

Dublin 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 city 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. We'll provide further details in the next *Newsletter* (and are happy to advise if we can). In the meantime, try

- <**http://www.discoverireland.ie/Places-To-Go/Discover-Dublin**>
- <**http://www.visitdublin.com/**>

We look forward to seeing you in Dublin in December!

From our Correspondents

The very Dickens of a palaeontologist

It's a rum business is the fossil trade. In the outside world, a palaeontologist is regarded as the most arcane of specialists, cranium filled to bursting with an encyclopaedic knowledge of the world's petrifactions. The palaeontologist, now, knows the awkward truth: that assumed expertise usually amounts to small islands of familiar ground dotted across an ocean of stuff that is either half-remembered or rendered in said cranium to the most absurd of cartoons.

For there it was, on the foreshore at Lyme Regis on the Dorset coast. A single ammonite, on a beautifully exposed bedding plane of Blue Lias that stretched for some metres in every direction. A triply iconic combination. Indeed, on any scale of iconicity in the fossil trade, one doesn't get higher. Even the fabulous *Archaeopteryx* sits – perhaps a little miffed – on a lower perch. But just *one* ammonite? – surely some mistake. Oh no, said our guide, who knows as much ammonite lore as anyone alive – they're quite rare in the Blue Lias.

And so another one of those cartoon images that one has in one's head (Lyme Regis=Blue Lias=ammonites) dissolves, to be replaced by the realisation of a clearly more complicated reality, that brings in its train a whole hatful of questions. Yes, there are those splendidly photogenic ammonites, scattered so artfully among the boulders on the beach that one might darkly suspect the Dorset Tourist Department of having a hand in their arrangement. And there is one magnificent ammonite pavement, looking as surreal in its way as the Sea of Holes in the Beatles' *Yellow Submarine*[1]. But, for the most part, ammonites seem to have been strangers to those particular seas[2].

If so, what kept them out? – and what brought them in those rare armadas? And whom might they have been competing with, for what kind of food? I was a stranger to these parts myself, and among excellent and well-informed company, gathered to see some good rocks and ruminate upon them a little. In brief, this assembly of genuine scholars announced itself baffled as to what caused these most elegant of molluscs to abound at some times, and disappear at others. Even in these charismatic, long-studied strata, therefore, in one of the genuine cradles of geology, there remain enough of those most basic of questions to quite overflow the brim of your finest fedora.

That local empress of fossil-collecting of two centuries back, Mary Anning would have been much amused – one can be *quite* sure – had she known that the rocks and fossils of those crumbling cliffs would still be perplexing the distant successors of the savants of her day. She, after all, probably knew these rocks better than anyone before or since, and she was curious too, so maybe that's a question that popped into her mind also.

Her spirit may have been less troubled, too, had she known that her flame has, in the intervening years, waxed to shine brighter than those of the scientific aristocrats – all men, of course – that

[1] An appropriately prehistoric cultural reference, that will naturally leave younger readers entirely baffled.

[2] It's the Black Ven Marls above that have produced a lot of those lovely concretion-bound ammonites – as Cope (2012) makes clear.

Mary Anning, in the famous portrait owned by and © the Natural History Museum, London (to whom thanks for permission to use the image here). The dog to which Miss Anning seems to be pointing is Tray, which apparently used to stay and guard fossil sites for her, until it perished in a mudslide that nearly killed Mary Anning too.

she felt exploited her hard-won discoveries – even as the mutual respect and friendship grew between she and them. There must now be some dozen – or more? – biographies of her life, together with those dramatized accounts for children, the historical novels, the appearances in historical romances… One would not be surprised to see *Mary Anning – The Musical!* take the West End by storm, complete with tap-dancing plesiosauri.

Far-fetched? Well, in Hugh Torrens' fine scholarly account of her life[3], her achievement was indeed (to my delight) compared with that of Ginger Rogers, who famously as a dancer did everything Fred Astaire did, but backwards in high heels. The comparison is not altogether inapt; and it is good to see that it also does credit to Ginger, who is too often dismissed as 'adding sex appeal to Astaire's dancing'. That might be narrowly true – Ginger Rogers was attractive, and Fred's charm was, well, quirkily old-fashioned – but entirely misses the point. Ginger was in the same league as a dancer as Fred (who Mikhail Baryshnikov considered a genius) but it was her style, not her sex appeal, which was complementary. Fred was the epitome of balance, speed and precision (that by itself one might – perhaps – just weary of, eventually, after a few centuries), to which Ginger's particular brand of quicksilver grace was an almost supernaturally appropriate counterpoint – and one she could employ not just in heels and going backwards, but also wearing what looks like nothing so much as a giant duvet encrusted with feathers[4]. It is no wonder that the entire oeuvre of dances they left – not much more than an hour's worth in total, spread across half a dozen or so films – will leave future generations gaping, open-mouthed, at what could once upon a time be achieved, in one take, without enhancement by a computer's infinite range of fakery.

Perhaps more to the point, Ginger extracted some independence and control in a world where men generally held the levers of power. Mary Anning took as much control as she could of her own life – and did it in an endeavour where those traditional male virtues, physical strength and endurance, are paramount. The ever-sliding cliffs of Lyme Regis are scarily high and downright dangerous, and when sections collapse they do so into a chaos of liquefied mud and shale slabs. Clambering across that exacting terrain to locate and then extract petrified reptile bones, simultaneously brutally heavy and nerve-wrackingly fragile, makes my own trade of graptolite-hunting seem like a carefree walk in the countryside[5].

Combine that ferocious persistence, maintained from childhood, with a keen forensic curiosity about the creatures themselves and an undisputed brilliance in practical fossil anatomy, all from a quite unprivileged background in a county with the lowest agricultural wages in Britain[6]. It is that which made her, in the title of Hugh Torrens' study, 'the greatest fossilist the world ever knew'[7].

Of course, the fascination goes beyond mere palaeontology. Torrens (see also Tickell 1996; Davies 2009, 2012) notes that the little that we know of her as a person, other than the bare facts of her life, simply adds to the mystery that surrounds her. What was she *like*, as a person? She

[3] Which does, deliciously, include a footnote to Angharad Wynne-Jones' 'Mary Anning – a natural history' danced at Chisenhale Dance Space on 3rd July 1987. The taxonomic affinities of the chorus line are not given in detail.

[4] See 'Dancing Cheek to Cheek' in *Top Hat*. It triumphs against all normal rules of gravity and aesthetics.

[5] Which it usually is.

[6] Hard to believe now, as one passes those expensively maintained thatched cottages with the shiny new cars parked on the drive. How times change.

[7] The phrase is taken, as Torrens writes, from an earlier paper on Anning; but one gets the feeling he doesn't disagree.

left very little in writing – one or two palaeontological notes of just a few paragraphs, a handful of letters, a few eyewitness accounts of visitors to her.

They provide a kaleidoscope of contradictions – which probably explains why two recent fictionalized accounts of her life have been said to describe two entirely different women. Gideon Mantell, who had his own problems with women, found her prim, pedantic, vinegary and satirical in conversation. Ludwig Leichardt, by contrast, approved of this 'strong, energetic spinster' who daily clambered across the cliffs. But then, Anna Maria Pinney found her head had been 'quite turned' by her celebrity and that she would 'offend all the world' – while John Kenyon remembered visiting her shop as a child where 'Miss Anning the Fossil woman would serve us with the sweetest temper … never finding us too troublesome'. The visiting American, George Featherstonhaugh, found her, now, 'a very clever, funny Creature'. The mineralogist Thomas Allan was amused, too, by her own accounts of her disputes with William Buckland over aspects of reptilean anatomy (she was quite prepared to spar academically with the great Dean, it seems). The suspicion that she had a sense of humour is deepened by her presenting to Oxford University – with Buckland in mind? – a small perfectly formed coprolite, some 4 centimetres high.

A Dickensian character, therefore – and one can say that quite literally. Charles Dickens did indeed write about her[8], and made some observations of characteristic vividness and penetration. He noted the esteem in which she came to be held by the savants of the day across Britain and Europe – Owen, Buckland, De La Beche and the great Baron Cuvier. The King of Saxony visited too, one fine day in 1844, securing 'six feet of reptile for fifteen pounds'. Closer to home, Dickens wrote, the local townspeople showed her less sympathy, not least among the gossip mills when she took to alcohol and opium to dull the pain of the breast cancer that was to kill her at the age of 49. Her chief value to the town seemed to be as bait for distinguished and free-spending tourists, with 'that magniloquent guide-book the *Beauties of Lyme Regis* ' framing its tribute to her by announcing that 'her death was, in a pecuniary point, a great loss to the place'. Quick returns, as Dickens observed, were the thing at Lyme.

Dickens, as a great showman himself, exulted in the dramatic possibilities of Mary Anning and her discoveries. He relished Cuvier's amazement when one of her plesiosaurs was sent to him ('altogether the most monstrous animal that has yet been found among the ruins of an ancient world'), only to revise his statement later, giving the 'palm of strangeness' to her newly uncovered 'monster half vampire, half woodcock, with crocodile's teeth … and scale armour', aka a pterodactyl. Dickens thought them 'grewsome beasts', and imagined them quite unsuitable as pets or cagebirds for any humans that might have lived, *Lost World*-style, in those days. He imagined some *highly* exceptional preservation, too, among Mary Anning's monsters, claiming that some of the saucer-eyes of the *Ichthyosaurus* were so perfect that their petrified lenses had been split off and used as magnifiers.

Unlikely, this, one suspects, though there seems more truth in his account of William Buckland (who else?) using pigment from the fossilized belemnite ink-sacs that Mary Anning had found to illustrate his Oxford lectures. But we come back to that prodigious wordsmith musing on the remarkable fossilist herself, and her confession, writing to a young girl in London: "I beg your pardon for distrusting your friendship. The world has used me so unkindly, I fear it has made me

[8] Or – very likely. The magazine that the article appeared in was one that Dickens owned and edited, and wrote most of the material for.

suspicious of every one". It's something of an oft-quoted phrase, this, within the circles of Anning folklore. Dickens' account suggests that she wrote it late in her life, when the cancer – and the merciful opium – already had a grip on her.

That letter, though, was written much earlier, in late 1824. Mary Anning herself was just 24 years old, and therefore much earlier in her career. Nevertheless, both the ichthyosaur and that 'monstrous' plesiosaur were under her belt by then, and she had already been tempered – if that is the right word – in her lifelong battle with poverty.

The young girl in London was Frances Augusta Bell, and was herself a character fit to live within Dickens' world – although, in this case, she would be one that that great stirrer of emotions might use to tug insistently at the heartstrings. I wonder whether she might, indeed, have been part-ancestor to one of Dickens' creations in that line? Her sex apart, she bears no small resemblance to Tiny Tim, that good and forbearing child in *A Christmas Carol* , wise beyond his years, and dying from some undetermined chronic illness. For Tiny Tim, Scrooge's conversion (and, implicitly, the release of some of that long-hoarded cash for medical treatment) spelt survival. For little Fanny Bell, there was no such get-out clause. Chronically ill throughout her life, she died almost exactly five months after receiving Mary Anning's letter, aged fifteen years and six months.

Almost all that seems to be known about Frances stems from her writings, from the age of nine, gathered together and published in 1827 by the Reverend Johnson Grant, M.A., Reverend of Kentish Town, together with commentaries from the Reverend himself. It is squarely within the canon of exemplary Victorian Christian literature, and one must wade through a great deal about the patient and cheerful bearing of suffering to find any real glimpse of this short life. Generally too ill to attend school[9], she was educated at home, in genteel circumstances, by her mother. She clearly found refuge in study to become something of a child prodigy, writing erudite commentaries on matters Biblical and moral, and on the Greek and Roman classics, and such matters. It is certainly an admirable collection of essays, if rather relentlessly well-meaning. But then fossils enter the scene, and the mood changes.

In the Summer of 1824, as her health worsened, Frances was taken to Lyme Regis. The sea air was ultimately to do little for her, but Providence (as the good Reverend puts it) threw in her way a congenial spirit. Somehow, the tough and shrewd Mary Anning and the sheltered invalid teenager met. The older girl clearly took to the younger one, and took her under her wing. She transmitted, too, an enthusiasm for collecting fossils. In two or three letters, to Mary Anning or to friends about her, Frances Bell's narrative briefly bubbles with life: about a growing fossil collection, with ichthyosaur jaws and ribs and bezoar stones and specimens of ammonite ('vulgarly called cornu ammonis'), 'Pentacrinite' ('a zoophite; the connecting link between the animal and vegetable world') and other such marvels; about the launch she witnessed of a new fishing boat, and about the impressive 'Cobb' (the harbour wall) in the town.

Autumn came, and Frances went home to London. Some weeks later, she wrote to Mary, enthusing that the fossils she took back with her had 'travelled delightfully' and were 'very much admired', gleefully reporting of the 'metalized ammonite' that 'they were more than half inclined to think … was gold'. She had been going to the British Museum and 'intend devoting a day in each room, in order to examine its beauties more minutely'.

[9] The nature of the illness is glossed over, but tuberculosis that later infected the bones might fit with what few clues there are.

'O! Mary, you never saw, nor can conceive, any thing so beautiful as are the minerals. I never go there without wishing for you to partake my pleasure'…. They have also a good collection of shells; and fossils, in fishes and leaves, but not in the grander specimens; I mean animals and ammonites. Although the head is larger, and the eye more conspicuous, I cannot admire the ichthyosaurus you first sent there as much as the one you now have.'

Mary's reply contained the lines that Dickens quoted, and the feeling of hurt – and relief too – is palpable. The friendship, and vulnerability, clearly lay on both sides.

My dearest Fanny
Many thanks for your kind, interesting letter, and I have to beg your pardon for doubting your friendship; not hearing from you for six weeks instead of two, I thought that if illness had been the cause of your silence, your dear good aunt would have sent me one line, just to tell me: the world has used me so unkindly, it has made me suspicious of all mankind. I hope you will pardon me, though I do not deserve it.

The mood lifts, though, with a finely-judged commentary that one might not expect from an early eighteenth-century woman from an artisanal background (not quite the lowest level within the local social stratification) whose formal education nevertheless stopped at eleven:

How I envy your daily visits to the museum! Indeed I shall be greatly obliged by your sensible account of its contents; for the little information I get from the professors is one-half unintelligible.

Before descending into gossip:

Very little doing in the fossil world; excepting, I have found a tail for baby, and a beautiful paddle, and a few other small specimens; nothing grand or new.

And only then, news of local tragedy:

Oh! My dear Fanny, you cannot conceive what a scene of horror we have gone through at Lyme, in the late gale: a great part of the Cobb is destroyed, every vessel and boat driven out of the harbour, and the greatest part destroyed; two of the revenue men drowned, all the back part of Mrs. England's houses and yards washed down, with the greater part of the hotel, and there is not one stone left of the next house; indeed, it is quite a miracle that the inhabitants saved their lives. Every bit of the walk, from the rooms to the Cobb, is gone; and all the back-parts of the houses, from the fish-market to the gun-cliff, next the baths. My brother lost, with others, a great part of his property. All the coal cellars and the coal being gone, and the Cobb so shattered that no vessel will be safe there, we shall all be obliged to sit without fires this winter: a cold prospect, you will allow.

Frances penned a response quickly. It seems to have been her last to Mary Anning, for her health deteriorated soon after

My very dear Mary
By the greatest chance I received your welcome letter; but it was my fault, for stupidly forgetting to give you my direction… I was however most grieved at the melancholy events you describe in it….
…
I do admire your false humility and flattery, in pretending that I can instruct you in my slight descriptions of the fossils, – you, who taught me all I ever knew about them; it quite made me laugh.

Frances Augusta Bell died on Monday 28th May, 1825. Writing to Frances' mother soon after, Mary Anning expressed considerable sense of loss over so brief acquaintance ('Dear Madam, I hope you forgive my impertinent scrawl, but I never think of my lamented friend but my heart is *full*').

Perhaps part of her sympathy – and admiration – for Frances Augusta Bell stemmed from that teenager's acceptance of her illness and likely fate. Acceptance of one's lot was something that most nineteenth-century society took as a virtue. Even Dickens, that fighter for social justice, seemed to take it for granted that Mary Anning's role was that of provider, rather than protagonist, in the fierce debates between the academic lions of the day ('Miss Anning's business, of course, was not to take sides, but to furnish the combatants with munitions of war – now a paddle, then a jaw, then a stomach full of half digested fish').

Mary Anning, by nature of life's lionesses[10], could never manage much in the way of philosophical equanimity against the slings and arrows of this kind of outrageous fortune: *she* – who knew the anatomy of her finds at least as well as the professors did, and who had taught herself French to study the publications of Baron Cuvier[11]. But she did see that Fanny Bell had been dealt far worse cards in life than she had been, and yet showed what one might regard, in Victorian times as now, as grace under unbearable pressure, and, in that condolatory letter, she said as much. It's but a footnote in Mary Anning's life, but for me it put her – for all the contradictoriness of her character – on the side of the angels.

That episode took place almost two centuries back. That is not so long ago – half a dozen human generations. Or, to put it geologically, in terms of the metre-scale limestone-shale couplets of those Lower Lias cliffs – assuming that they do represent 20,000 year astronomical cycles – about a millimetre.

A lot has changed since then. In life, most children, at least in this hemisphere, survive early illness to reach maturity. In palaeontology – well, those 'metalized ammonites' have now been minutely taxonomised, to enable the history of those cliffs to be rendered into hundreds of separate dynasties. The search for marine reptiles has continued apace, so that now over a hundred plesiosaur taxa have been recognised[12]. We are filling those Jurassic seas with new characters, and our vision of those seas, that Mary Anning first glimpsed, grows ever more sophisticated.

One wonders where that landscape, and the science, will be two centuries from now. Well, one of the spin-offs from that early fossil trade has been a skill, now finely honed, to use palaeontology to help navigate the realm of the underground. That has been used (for instance) to help extract the half trillion tons or so of fossil carbon that has driven and shaped our recent history. And as for the consequences of *that*, two centuries from today, pursuing this matter *entirely* locally?

A reasonable bet might be a sea level of the order of one or two metres higher than now, and rising. Therefore, that fine wave-cut platform at Lyme, with its ammonite pavements – its *occasional* ammonite pavements – will be drowned and on its way to being, as it were,

[10] As in Davies (2012), for instance.

[11] In life, because she was a woman, she was never was admitted into the Geological Society – though that Society did hold a commemorative event for her after her death.

[12] As recently compiled by Dr Mark Evans of Leicester New Walk Museum. In this, one post-Anning addition to the canon is the fabulously-named *Terminonatator*. Homage to Hollywood, and one of the more muscular cinematic epics of recent times, perhaps? A little disappointingly, it seems the name simply means 'last swimmer'.

secondarily fossilized. (It makes one think, that kind of thing, though of course the likes of Venice will be a greater loss, having no along-strike outcrop.) The waves will now be biting directly into those cliffs and triggering some spectacular new landslides. The Cobb will likely have succumbed some time back – or be a fine and evolving technical problem for new generations of engineers to cut their teeth on.

Our descendents, at this stage, will have quite a lot to ponder on in this new world, and quite a lot to do, one suspects. Logically, there may be so much to do that academic palaeontology may come to seem to be the most frivolous of luxuries.

But, humans being what they are, one suspects that time will always be found, by at least a few of our successors, to carry on the hunt for old bones in that new landscape. Personally, I would love to know if somebody by then had solved the mystery of that lonely ammonite, before it sank beneath the waters for one last time.

Jan Zalasiewicz

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Miss Anning of Lyme Regis says: "This PalAss Field Guide has definitely helped me to understand the curious formed stones that I have noticed in the rocks around here."

PalaeoMath 101
Going Round the Bend: Eigenshape Analysis I

Elliptic Fourier Analysis (EFA) has proven to be popular among morphometricians who need a technique that can deliver analyses of curves defined by sets of semilandmarks. In no small part this has been due to the provision of software for, and general championing of, the method, by F. James Rohlf (see Ferson *et al.* 1985; Rohlf 1986,1990). However, when examined in detail EFA has several limitations that constrain the domain of shape analysis problems it can be used to address. Foremost among these is the standard Fourier analysis constraint of requiring the curve to conform to the concept of a periodic function, a function that repeats its values at regular intervals or periods. In terms of outline analysis this effectively means that EFA—like all Fourier techniques—is designed primarily to analyze closed curves with the shape function's period representing one complete trip around the outline (Fig. 1). But not all biologically interesting curves are closed.[1]

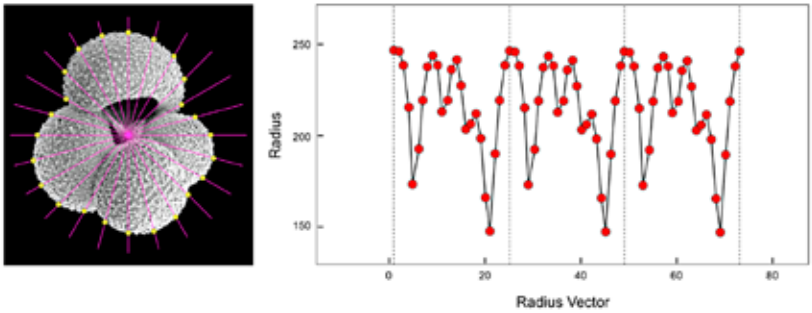


Figure 1. Globigerina bulloides *image with 24 superimposed equiangular radius vectors associated boundary outline points (left). The periodic boundary outline function plotted over three cycles (right, with cycle boundaries marked by dashed lines). In order to apply a Fourier approach to the characterization of semilandmark sampled boundary outline the implied shape function must be periodic. This constraint applies equally to Z-R Fourier and EFA representations of specimen outlines, though in these cases the constraint of equal semilandmark spacing does not necessarily apply.*

In addition, Fourier analysis simply redescribes the shape of a boundary outline curve by decomposing the positions of the set semilandmark points that represent the curve as an infinite series of harmonic amplitudes and phase angles (Fig. 2). This exercise achieves little in terms of shape analysis *per se*, but is typically used to prepare the semilandmark data for shape analysis. In this sense, transforming semilandmark data into a mathematical shape space via specification

[1] In some cases Fourier analysis has been used to analyse open curves (*e.g.*, dental arcades, craniofacial profiles, see articles in Lestrel 1997), but in all cases the mathematics of Fourier analysis is applied to the data as if it constituted a periodic function. Also it is well known that the application of Fourier analysis to forms that do not represent periodic functions introduces inaccuracies that must be handled by various *ad hoc* strategies (*e.g.*, discrete Fourier transform, discrete-time Fourier transform, Hamming windowing, see Oppenheim *et al*. 1999; Jacobsen 2003). Interestingly, these discrete signal-correction strategies have rarely (if ever) been applied in morphometric analyses.

of a series of normalized radius vectors, Zahn and Roskies (Z-R) shape functions, or the separate x and y (and z) functions of EFA prior to Fourier decomposition represents the conceptual equivalent of *Procrustes* alignment (see MacLeod 2009a) while the redescription of such data following conversion to a shape function format is the equivalent of principal warps analysis (see Bookstein 1991; MacLeod 2010a,b) for landmark data. In standard geometric morphometrics this procedure was once thought useful in its own right, but has now been largely abandoned because it is recognized as being unnecessary for the computation of shape space ordinations via a principal components analysis (PCA) or singular value decomposition (SVD) of datasets consisting of *Procrustes* residuals (see MacLeod 2009a,b).

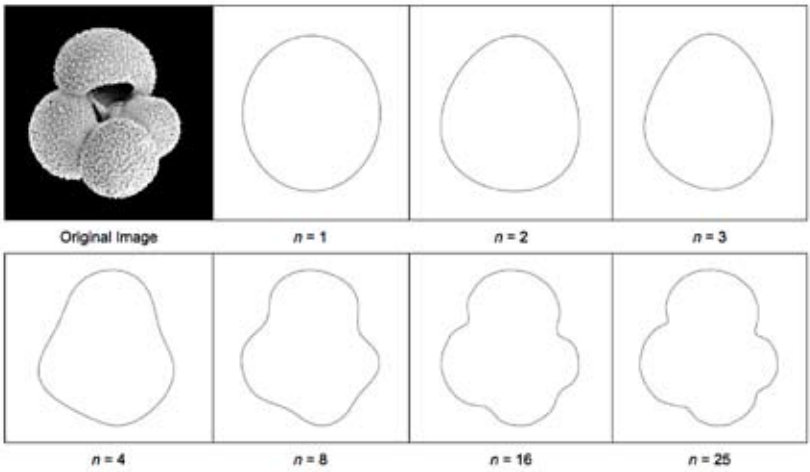


Figure 2. Reconstruction of the G. bulloides *specimen outline using different numbers of elliptical Fourier harmonic amplitudes (*n*). These Fourier harmonics constitute terms or variables that describe features of the form ordered by steadily decreasing spatial detail.*

Previously Rohlf (1986,1990) has argued that a Fourier analysis can be useful for smoothing boundary outline data prior to shape analysis. This smoothing is accomplished by using a subset of harmonic amplitudes and phase angles (*e.g.*, the first few, first 10, first 20) to represent the curve (Fig. 2). But while signal analysts and electronic engineers often use Fourier calculations to construct electronic filters for precisely this purpose, the logic for undertaking this operation seems inconsistent with Rohlf's advice always to use all principal warps when the principal warps redescription of landmark data is used as the basis for shape analysis (see Rohlf 1993). Note here that I'm not drawing attention to the infinite character of the Fourier series. The number of unique Fourier harmonics that can be used is set by the number of semilandmark points the data analyst chooses. Consequently, it is possible always to use the maximum number of unique Fourier harmonics that can be calculated for any given dataset. Moreover, if smoothing is what you're after the same sort of outline smoothing can be accomplished quickly, easily, and routinely when collecting the boundary outline data, by interpolating the total number of pixel coordinate points that represent an object's outline down to a much lower number of (usually) equally-spaced boundary outline semilandmark coordinate points (Fig. 3, see also Lohmann and Schweitzer 1990; MacLeod 1999).

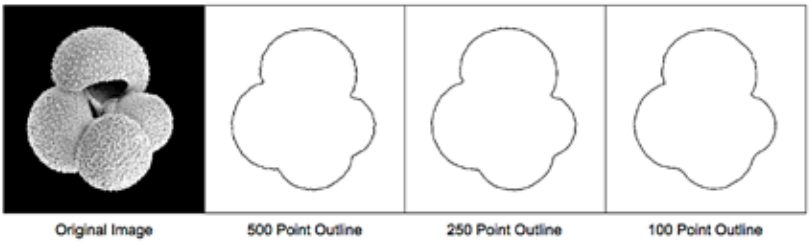


Figure 3. Example of outline smoothing achieved by interpolating a digitized representation of a specimen's boundary outline to a smaller number of equally spaced semilandmark points. The outline of the G. bulloides *image (left) was originally digitized using 647 points.*

Leaving these issues aside, there is also the fundamental objection to the application of boundary outline analysis strategies to biological morphometric problems first raised by Bookstein *et al.* (1982) in the context of Fourier analysis, but later extended to all outline data sets (Bookstein 1990). This argument involves the general nature of achieving biologically meaningful comparisons between shapes and, in particular, the role played by the principle of biological homology in informing such comparisons (Fig. 4).

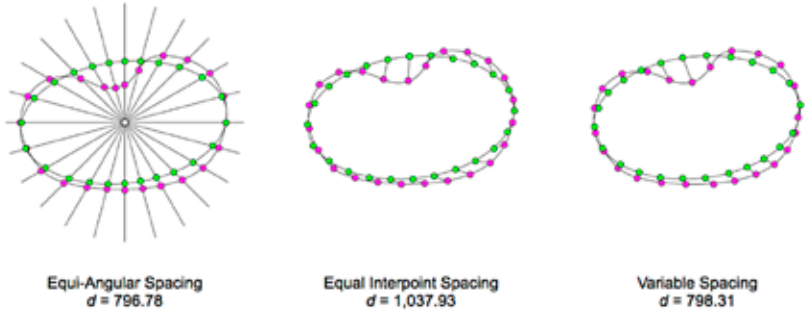


Figure 4. Variations in the shape 'distance' estimates for the same forms under different semilandmark sampling schemes.

Having worked in the area of mathematical outline analysis for most of my professional career I can say with a certain degree of authority that much confusion exists in the technical morphometric literature, and in the minds of many morphometricians, not to mention students and lay practitioners, regarding all these issues. In the final sequence of essays for this column I want to take this opportunity to offer a personal perspective on these matters by drawing together relevant arguments I have made in various technical articles over the years, but which are scattered across time and (literary) space. In the spirit of full disclosure I will unashamedly admit that my purpose in this series of essays will be to convince you that, if you have read anything about outline morphometrics before, much of what you have read is incorrect and/or out of date, including a number of my own previous publications. But regardless of whether you have or haven't considered these arguments or even thought much about outline morphometrics before, I hope you'll come away understanding more about the role the analysis of outlines—and their 3D extensions, surfaces—can play in contributing to the future of morphological data analysis in biological and palaeontological contexts.

To show how it is possible to undertake an outline analysis without going through an initial Fourier redescription, and the advantages inherent in doing so, let's go back to a consideration of the Z-R shape function. As you will recall, this function was developed for use with Fourier analysis as a way of representing a closed form outline as a periodic function without having to specify a centre from which a series of radius vectors emanate. Using the Z-R shape function a Fourier analysis can be used to decompose any boundary outline curve, no matter how complex (Fig. 5), into a series of harmonic amplitudes and phase angles; even multi-valued curves that cross themselves. Interestingly, the shape functions used as the basis for EFA have this same property (see MacLeod 2012), as does Bookstein's (1978) tangent angle approach to outline characterization. For now, however, let's use the Z-R shape function as a place to begin developing an alternative to Fourier analysis for the study of boundary outlines that's more in keeping with the spirit, and the mathematical letter, of geometric morphometrics.

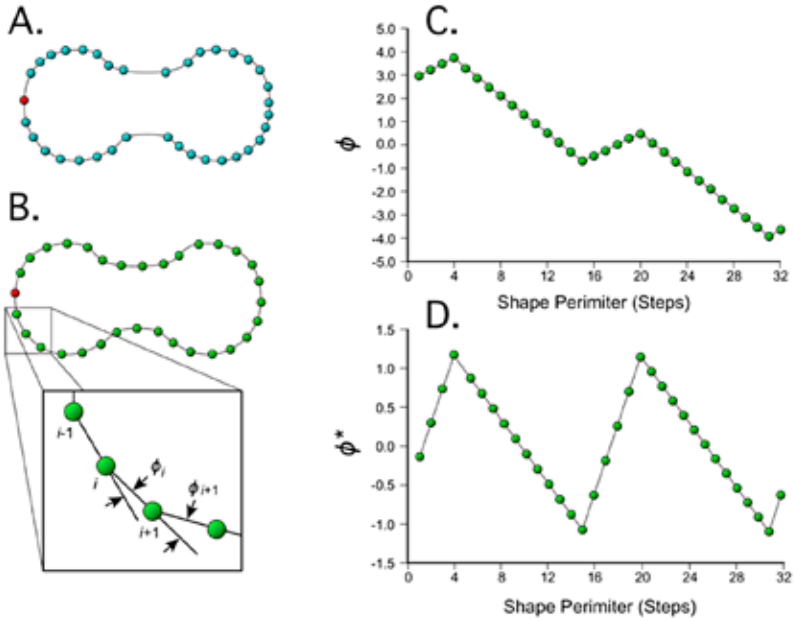


Figure 5. Steps in calculating the Zahn and Roskies (Z-R) shape function. **A.** *original set of semilandmark data points placed on the periphery of a hypothetical shape. The red landmark represents the starting point for digitization. Ideally this point should be placed on a topologically homologous landmark. Note the uneven interlandmark spacing.* **B.** *Adjustment of original data (via interpolation) to a set of equally spaced semilandmark points. Again, the red landmark represents the starting point for digitization. The inset illustrates the expression of the shape of the outline as a series of net angular deviations (see text for discussion).* **C.** *the* ϕ *form of the Z-R shape function with a typical ramp that denotes a closed curve.* **D.** *the* ϕ^* *form of the Z-R shape function which represents the shape residual after removal of the ramp of circularity.*

The Zahn and Roskies procedure (usually) begins with the collection of a set of equally spaced x,y coordinates (or x,y,z coordinates if a three-dimensional analysis is required, see MacLeod 1999)

along an outline or curve of interest (Fig. 5A). If the curve has a closed form it can be regarded as being an n-sided polygon where n is the number of semilandmark points used to represent the curve's geometry. Since the distance between each point is the same we need only remember one distance value for the entire outline. This is termed the 'steplength'. For curves that have been sampled to the same number of semilandmark points the steplength will be proportional to the length of the outline, which is to say its size. Size may be removed or retained in an analysis by eliminating or including the steplength for each boundary outline curve in the sample data matrix.

Once control over size has been gained in this manner, the shape of the outline can be represented in a 'street direction' manner of the Z-R shape function: as a series of angular turns that need to be executed in order to travel around the outline in steps of equal length and (if the curve is closed) arrive back at the starting point. Mathematically it is convenient to express these angles as a series of net angular deviations from the direction taken in the previous step, and to express them in radians rather than in degrees.[2] This operation effectively removes differences in the rotational orientation between the specimens. Since we're expressing the shape of the curve as a set of angles, differences in the position of specimens within the system of semilandmark coordinate values are automatically rendered irrelevant. Accordingly, calculation of the Z-R shape function of the original semilandmark data, in addition to redescribing the form of the outline exactly, also accomplishes the three tasks of a *Procrustes* alignment: removal of positional, rotational, and scaling differences between specimens. To be sure, the Z-R shape transformation does not accomplish this task using the same mathematics as *Procrustes* alignment. But the result is largely the same irrespective of the calculations employed (Fig. 6).

In the early 1980s George (Pat) Lohmann, who was (and still is) a Woods Hole Oceanographic Institution micropalaeontologist, stumbled onto the Z-R shape function while looking to develop a method to organize the outlines of microfossils quickly, easily, accurately, and as simply as possible. The Z-R shape function is well suited to the job Pat had in mind, for not all microfossil outlines are single-valued, and often the mathematical centre of a microfossil's outline does not correspond closely to its anatomical centre. But unlike Zahn and Roskies (1972), Pat didn't see any need to redescribe the redescription of these outline shapes using Fourier harmonics and then analyse sets of harmonic amplitude values using a multivariate ordination technique such as principal components analysis (PCA) or singular value decomposition (SVD). Instead, he felt it would be more efficient to regard the values of the n angular terms of the Z-R shape function as a set of valid shape variables in their own right.

Lohmann dubbed his direct approach to the analysis of specimen outlines by means of the Z-R shape function 'eigenshape' analysis (Lohmann 1983). This name signifies the two critical aspects of his procedure: (1) complete representation of the set of outlines as sets of geometrically equivalent shape functions, and (2) assessment of the major directions of observed and measured shape variation in a dataset by means of eigenanalysis. However, in addition to these procedures Pat adopted several conventions early in the development of eigenshape analysis that, with the benefit of hindsight, I feel have tended to limit the scope of its application and obscure links between his eigenshape procedure and what came later to be known as geometric morphometrics.

[2] A radian is the ratio of an angle's arc to its radius. It's used to express the value of an angle as a dimensionless distance rather than as a number of degrees of a circle.

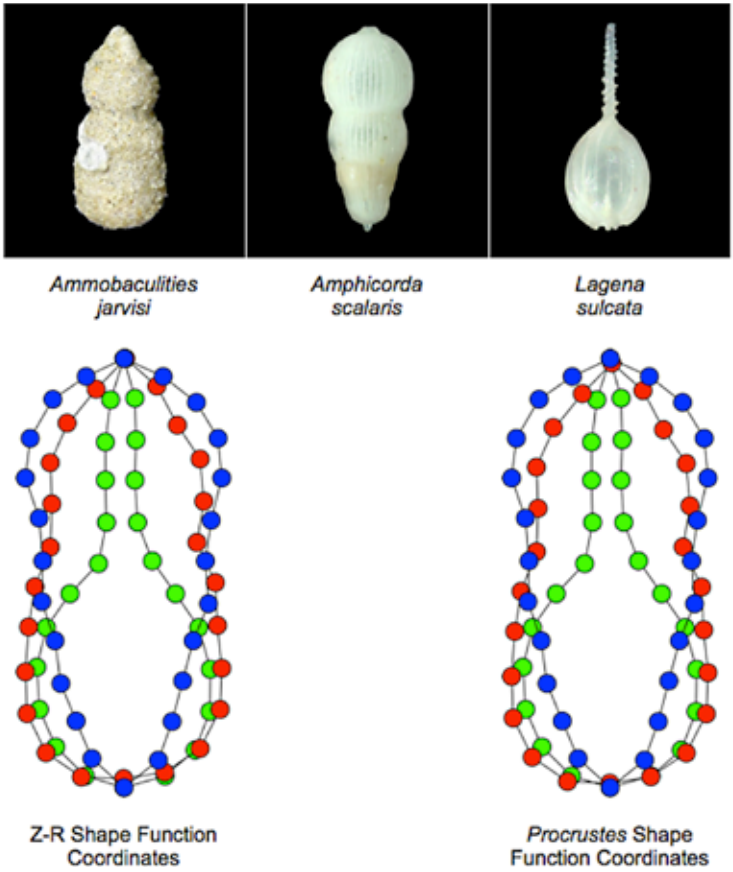


Figure 6. Comparison of shape coordinates calculated on the basis of the Z-R and Procrustes *procedures for a set of 24 equally-spaced semilandmark points around the peripheries of three benthic foraminifer species.*

In particular, Pat followed Zahn and Roskies' (1972) recommendation to use a 'normalized' version of the raw Z-R function as his preferred form of the shape function. The factor Zahn and Roskies recommended be removed from shape data was the form of a circle which they described as 'the most shapeless closed form' (Zahn and Roskies 1972, p. 270). Mathematically, this operation means that normalized Z-R shape functions express patterns of deviation from circularity.

It should be appreciated that this suggestion is entirely in keeping with the Fourier-based aesthetic of Zahn and Roskies' original work. After all, the 0^{th} harmonic of a radial Fourier series is a circle, and all subsequent harmonics in the series express patterns of deviations from this circular ideal. Also, removal of the ramp that denotes constant angular deviation in the raw Z-R shape function (see figs 5C and 5D) makes the function appear to fit the ideal of a periodic function to a greater extent than the typical form of the raw shape function (compare Fig. 5D with Fig. 1)—another nod to the exigencies of applying a Fourier decomposition to such representations of shape.

Strictly speaking, however, use of this normalization procedure is at best unnecessary and at worst detrimental, from the standpoint of shape analysis. The raw Z-R shape function data is an exact description of the outline's geometry all by itself. Indeed, the raw Z-R shape function is a more complete representation of the boundary outline's geometry than the normalized version because it contains all the information necessary to reconstruct the measured shape. By removing the factor of circularity from the raw function the normalized form, in a sense, 'hides' the circular nature of the curve's geometry from view (and from subsequent analysis). But most importantly from the standpoint of shape theory, arbitrary selection of a circle as the reference shape means that the linear plane(s) tangent to the Kendall shape space onto which the outline data will be projected by the PCA and/or SVD procedures in order to represent patterns of similarity and difference within a sample of outline shapes will always be located in a suboptimal orientation relative to the data of any given sample (see Kendall 1984; Bookstein 1991; MacLeod, 2009c). This, in turn, means that the resulting ordinations in PCA/SVD-determined geometric subspaces will contain a systematic bias in the placement of shapes, the severity of which will be proportional to the difference between the samples' true mean shape and that of a circle. To be fair, the problems inherent in arbitrarily selecting a shape to use for shape normalization were not known in the early 1980s, much less the early 1970s. In this regard Zahn and Roskies' and Pat's failure to appreciate the effect this type of normalization would have on subsequent shape analyses is perfectly understandable. But these issues are well understood now and need to be kept in mind when evaluating classical eigenshape analysis as well as subsequent developments in the formulation, as well as options for application, of the eigenshape procedure.

The other aspect of the original eigenshape procedure that can be questioned legitimately is the manner in which biologically common features are matched across a sample of outlines by eigenshape analysis. In standard radial, Z-R, and elliptical Fourier analysis the issue of feature mapping does not arise as the coefficients of the Fourier amplitudes are insensitive to the starting point for outline digitization. Indeed, it is for this very reason that most Fourier representations of outline shape employ only the amplitude terms as shape descriptors. This is fine for a wide variety of physical shapes (*e.g.*, sand grains). But the outlines of biological specimens differ from the outlines of most natural physical objects. Most biological outlines include combinations of discrete anatomical regions (*e.g.*, head, trunk, appendages), structures (*e.g.*, eye, nose, mouth) and substructural characters that exhibit polarities of various sorts (*e.g.*, proximal, distal). Ideally, discrete subsets of semilandmark points in the outline sequence should fall on biologically comparable parts of the form across all specimens in the sample. Fourier analysis finesses this critical issue because such distinctions don't exist in terms of harmonic amplitude-based representations of outline shape. But exist they do in the real worlds of biology and palaeontology. Morphometricians who decide to throw this information away do so at their peril, because any single set of Fourier harmonic amplitudes, when taken in isolation from their associated phase angles, is non-unique. Such data actually describe an infinity of shapes.

Lohmann (1983) approached this issue in the context of eigenshape analysis in two ways. First, if a landmark could be identified on the outline that was common to all specimens in the sample it was recommended this be used as a common starting point for outline digitization. By using a common point of reference for sampling the outline, and by sampling the outline using a constant number of equally spaced semilandmark points, the outline is 'homologized' in

a topological sense, irrespective of which biological structures individual semilandmark points fell on across the sample. In this way outlines on which truly comparable point locations are few could be matched in terms of their computed geometries. In cases where the specimen outlines included no landmark that could be used as a starting point for outline digitization, Pat recommended that a reference specimen be selected and the Z-R shape functions be rotated to positions of maximum correspondence with this reference. Again, the homology is topological and is computed rather than interpreted, but only because the biological information necessary to match outlines using other criteria is lacking.

In no case was any pretence made that this method of computing topological homology maps between specimens was preferable to the location of genuine landmarks provided these were available. Rather, the eigenshape strategy was justified as simply being preferable to pretending that landmark point locations existed on a structure when they clearly did not or were subject to a great deal of uncertainty with regard to their exact positions. Eigenshape approaches to the outline analysis problem are regarded by their practitioners as an efficient and pragmatic solution that, while far from perfect, is undeniably preferable to giving up and foregoing the quantitative, geometric analysis of a large number of important biological structures that taxonomists, palaeoecologists, palaeogeographers, biostratigraphers, *etc*. have been comparing qualitatively for (literally) centuries. Indeed, those with direct experience of how taxonomists actually make qualitative comparisons between differing sets of morphologies in the absence of the biological signposts provided by valid landmarks know that most use an approach essentially identical to the computation of topological homology maps.

Once the outlines for a set of specimens had been quantified via specification of equal series of semilandmarks, redescribed using the Z-R shape function, and assembled into an n x m data matrix (where n = the number of specimens in the sample and m = the number of semilandmarks collected from each outline), Lohmann (1983) advocated description of the structure of relations among the semilandmarks by calculating an m x m pairwise correlation matrix. Selection of the correlation matrix as the basis for structural comparison seems an odd choice as all the values in the data matrix cells are angles (expressed as radians) and so represent the same types of both quantities and magnitudes. In most instances the covariance matrix would be chosen to represent data of this type. However, use of the covariance matrix would mean that some parts of the outline—specifically the parts characterized by more angular bends—would have a differential influence in determining the orientation of the eigenvectors that are used to assess patterns of shape variation. Pat made the decision that he did not want certain regions of the outline to 'pull' the eigenvectors toward themselves in an orientational sense, so opted to represent structural relations in a manner that ensured that all regions of the outline would count equally in determining the final result. This decision is contrary to what has become standard practice in geometric morphometrics of employing the covariance matrix to represent structural relations among landmark variables and simply accepting that, within such a system, landmarks whose relative positions are more variable across the sample will be more highly weighted in the result than more conservative landmarks.

After calculation of the covariance matrix Lohmann recommended using SVD to decompose the correlation matrix. If X is the n x m data matrix of n specimens and m shape function values, the basis matrix of structural relations among variables can be provided by either of two matrices.

$$Z_r = X\,X' \tag{26.1}$$

$$Z_Q = X'\,X \tag{26.2}$$

Where: X' = transpose of X
Z_r = matrix of covariances/correlations between semilandmarks
Z_Q = matrix of distances/correlations between specimens (shapes)

If each shape function is normalized to have a zero mean and unit variance (= row normalization) Z_Q will contain the pairwise correlations between specimens, otherwise these values will be distances. Similarly, if each term of the shape function is normalized to have zero mean and unit variance (column normalization) Z_r will contain the pairwise correlations between shape variables, otherwise these values will be covariances.

The Eckart-Young Theorem tells us that any matrix can be expressed as the product of three matrices.

$$X = V\,W\,U' \tag{26.3}$$

Where: V = eigenvectors of Z_r
W = diagonal matrix of singular values (= square roots of the eigenvalues of V and of W)
U' = transpose of eigenvectors of Z_Q

If Z is a symmetrical, square matrix the sets of eigenvectors contained in V and U will be identical. These m eigenvectors will coincide with the major directions of variable-normalized shape variation present in the data subject to the constraint that all eigenvectors be oriented at right angles to one another (= orthogonality). The eigenvalues represent the lengths of these eigenvectors which, when added together, will be equal to the sum of the variances of each of the original (shape) variables. Because the eigenvectors are aligned with the maximal directions of variation in the set of variables as a whole—taking account of inter-shape variable covariances/correlations—the first few eigenvectors will represent a greater proportion of the observed shape variation than any single shape variable can represent, often a dramatically greater proportion. Geometrically the m eigenvectors contain m values each of which is a covariance or correlation between the eigenvector and each of the m original variables, so long as $n \geq m$. If $n < m$ (which is often the case in an eigenshape analysis) only n eigenvectors and with n positive eigenvalues will be extracted.

In standard eigenshape terminology these eigenvectors are termed 'eigenshapes', though this is somewhat confusing insofar as the eigenvectors do not represent singular shapes. Rather, these coefficients (or loadings or weights) represent patterns of association between the orientation of the eigenvector and the positions of the original variables in the space defined by between variable covariances/correlations. In effect, each eigenvector represents a hypothetical trend or pattern of outline shape deformation, with some regions of the outline being more directly aligned with a particular eigenshape axis than other areas. The geometric signature of this alignment takes the form of the positively and negatively aligned regions becoming more differentiated from one another at the positive and negative extremes of shape variation seen in the sample, and less differentiated from one another near the centre of the observed shape distribution (see below for a graphical example).

As with principal components analysis and/or principal coordinates analysis individual outlines the covariance or correlation of Z-R shape functions of equivalent dimensionality with each of the m eigenshapes (= eigenvectors) can be determined either by using the standard covariance/correlation equations or by using their matrix algebraic equivalents, either:

$$scores = X\,V \tag{26.4}$$

or

$$scores = U\,X' \tag{26.5}$$

Now that we have the basics of a standard eigenshape analysis down let's take a look at the results of a typical analysis by applying the Lohmann (1983) procedure to our sample of foraminifer outlines (Fig. 7).

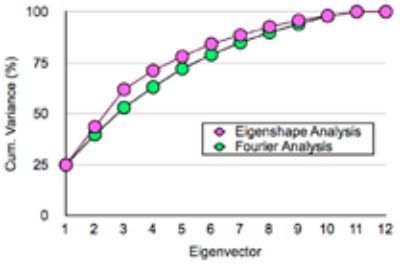
Figure 7. Zahn & Roskies shape function representations of the outline shapes of 12 benthic foraminifer species. The outline of each specimen was interpolated to 100 equally-spaced semilandmark points with outline digitization beginning at the centre of the aperture in each case. Note the highly diagnostic character of the outline shapes along with the lack of consistently identifiable landmark points (other than the aperture) on the peripheries of these specimens.

As has been the case typically with classic Lohmann-style eigenshape analysis, the resolution of the boundary coordinate outlines for this dataset was set arbitrarily to a value of 100 semilandmark points (see Lohmann 1983). This figure is based on experience with eigenshape analyses and seems to result (in most cases) in representation of an outline's geometry to a level of accuracy such that the form of most taxonomically important morphological substructures are recognizable while, at the same time, suppressing the incidental variation associated with surface texture, minor imperfections in structure, adhering sediment particles and/or dust, *etc*. These x,y coordinate points were transformed into their equivalent normalized Z-R shape functions (ϕ^*) and the values of those functions used to construct a 12 x 100 data matrix of outlines and shape function coefficients.

Eigenanalysis decomposition of the pairwise correlation matrix resulted in the extraction of 12 eigenshapes (= eigenvectors) of which the first nine represented >95 percent of the observed shape variation (Table 1). By way of comparison, an eigenanalysis of a matrix of 50 Z-R Fourier harmonic amplitudes and phase angles also resulted in the extraction of 12 eigenvectors of which the first ten represented >95 percent of the observed shape variation. While the saving of a single eigenvector may not sound terribly significant, remember that this is a very small example dataset. When larger datasets are considered the dimensionality reduction that can be achieved by eigenshape is often more impressive. Still, even with these data it is clear that Lohmann's (1983) eigenshape approach results in a more efficient analysis than the equivalent Fourier procedure; more information relevant to the characterization of shape variation in the sample is loaded onto the first few eigenvectors which, in terms of the qualitative interpretation of major shape trends, are typically the only shape variables that are inspected in any detail.

Table 1. Comparison between eigenvalues extracted from the eigenshape and ZR-Fourier analysis of the benthic foraminifer data.

	Eigenvalues	
Eigenvectors	Eigenshape	Z-R Fourier
1	24.7607	24.8702
2	43.4817	39.6529
3	61.8433	52.9220
4	71.1037	62.9865
5	77.9684	71.9990
6	84.1625	78.8567
7	88.4970	84.8566
8	92.5691	89.7922
9	95.7202	93.9723
10	97.9810	97.8552
11	100.0000	100.0000
12	100.0000	100.0000



The diagram included in Table 1 represents a tabular and graphic demonstration of one of Lohmann's main practical arguments for the eigenshape approach over that of Fourier analysis. Greater efficiency is gained by allowing the data to specify the modes of shape variation most suitable for its own characterization than by forcing this characterization to be routed through an arbitrary—though highly elegant—set of idealized shape descriptors: the Fourier series. In addition, if the pairwise covariance rather than the correlation matrix is used to represent

geometric relations within the data, eigenshape analysis has the advantage of allowing regions of pronounced shape variation within the boundary outline to attract the eigenvector axes to themselves in an orientation sense.[3] This improves the interpretability of the eigenshapes in contexts that are useful for testing biological hypotheses. The distribution of foraminifera outline shapes within the space of the first three eigenshapes is shown in Figure 8.

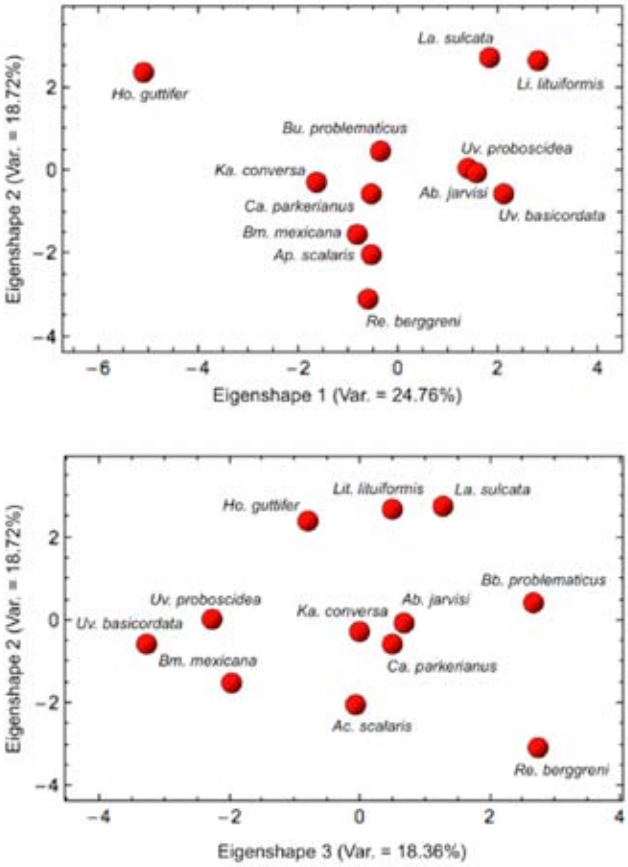


Figure 8. Distribution of benthic foraminifer shapes in the subspace formed by the first three eigenshape axes. See text for discussion.

While this plot may seem superficially similar to those we have seen for this dataset before, the outline shape grouping we see recorded there is actually rather remarkable and certainly gives quite a different picture of patterns of shape similarity and difference for this sample from that offered by elliptical Fourier analysis (EFA, compare with Fig. 6 in the previous *PalaeoMath 101* column, MacLeod 2012). This plot also shows nicely why you need to develop skill in visualizing point distributions in (at least) three dimensions in order to interpret these data correctly.

[3] This feature was not taken advantage of in the example analysis included here because I want to begin the discussion of eigenshape with an example presentation of its original form. An equivalent covariance-based analysis for this dataset results in additional efficiencies in eigenanalysis over the results presented above.

There are three obvious groups of outline shapes along the first eigenshape axis (ES-1). *Hormosinelloides guttifer* projects to the lower end of ES-1, which seems appropriate as it is the only species exhibiting inflated, spherical, uniserially-arranged chambers. At the other extreme of this axis *La. sulcata*, *Li. lituiformis*, the two *Uvigerina* species and *Ab. jarvisi* form a heterogeneous group whose unifying characteristics appear to be common possession of a pronounced apertural neck or, in the case of the latter species, pointed apertural constriction. This group is further subdivided along the second eigenshape axis by the relative length of the neck/constriction with relatively short features plotting low along ES-3 and relatively long features plotting high. In the middle of ES-1 lies a heterogeneous grouping of species that possess neither of these (for this sample) extreme morphologies.

Interestingly, while accounting for a smaller proportion of the observed shape variation, the ordination of shapes along the third eigenshape axis (ES-3) is as informative if not more so. Here shapes whose outlines are pinched at either end and inflated in the middle (the two *Uvigerina* species and the bulimulid) are contrasted with shapes that are narrow along their long axis, but inflated at either one (*Bu. problematicus*) or both (*Re. berggreni*) ends. Again, this seems quite a natural distinction given the set of shapes present in the dataset, but one that is far from obvious as the third most important shape trend in these data from a simple visual inspection of Figure 7. Also far from obvious in Figure 7 is the fact that these major shape groupings are quite well structured within this dataset. The uvigerinid and bulimulid species form a distinct subgroup within this subspace that does indeed reflect their distinctive shapes, as do the 'long-necked' species *La. sulcata* and *Li. lituiformis*. There are no intermediates occupying the theoretical shape space between these well-defined regions. Uniquely-shaped species such as *Ho. guttifer*, *Re. berggreni*, and *Bu. problematicus* are also identified as such in this subspace, along with unanticipated—and rather charming—underlying organizational similarities (*e.g.*, the geometric link between *Bu. problematicus* and *Re. berggreni* in the context of this small sample of shapes.

Some, but by no means all, of the structure we see in the eigenshape results is present in the ordination spaces created as a result of the PCA analysis of EFA amplitude coefficients extracted from the same empirical data (compare Fig. 8 with Fig. 6 of the previous *PalaeoMath 101* column, MacLeod 2012). But with the exception of a few of the extreme shapes (*e.g.*, *La. sulcata*, *Li. lituiformis*, *Re. berggreni*) the same level of clarity in the recognition of outline shape-based subgroupings achieved by eigenshape analysis is simply not present in the EFA-based shape space ordinations. Presumably this is because of the intermediate step taken by EFA of decomposing and redescribing outline shape variation as a series of Fourier harmonic amplitudes.

It's also worth noting here that, while the EFA analysis was conducted using 97 variables (and so was comparable to the eigenshape analysis in terms of overall dimensionality), only 25 EFA harmonics were used to characterize each shape. It could be the case that these 25 harmonically-defined shapes were insufficient to capture all of the salient morphological features present in the outlines of these sample shapes. If so, this a deficiency that could be addressed by simply increasing the harmonic resolution of the EFA analysis. However, this would increase the dimensionality of the data analysis and, as we have already seen (*e.g.*, Bellman 1957; MacLeod 2007), increasing the dimensionality of a dataset often has unanticipated consequences for a data analysis and usually requires dramatic increases in the sample size in order to be confident in the results. But even if we accept this as a potential strategy for EFA analysis, it still does not

change the fact that eigenshape analysis was able to sense and represent accurately the structure of shape relations in this small dataset in the context of a dimensionality that was comparable to that of an EFA *of the same empirical data* to an extent that the latter procedure was not. Neither analysis is wrong. But the result produced by eigenshape analysis is the more biologically informative.

It probably should go without saying at this point, but all the shape modelling tools I have introduced you to and illustrated the utility of in previous columns are also available for eigenshape analysis. Their use greatly improves the interpretability of the ordination spaces in which eigenshape data are often portrayed (*e.g.*, Fig. 8). Along-axis shape models for the first three eigenshape axes of the benthic foraminifer outline dataset, along with accompanying model overlay or 'strobe' plots, are shown in Table 2.

Table 2. Along axis models existing at coordinate locations along the first three eigenshape axes of the benthic foraminiferal dataset. The specific coordinate position at which each model was calculated is shown below each model (in parentheses).

Eigenshape Axis	Model 1	Model 2	Model 3	Model 4	Model 5	Overlay
ES-1	 (-5.05,0.00,0.00)	 (-3.09,0.00,0.00)	 (-1.13,0.00,0.00)	 (0.84,0.00,0.00)	 (2.80,0.00,0.00)	
ES-2	 (0.00,-3.12,0.00)	 (0.00,-1.67,0.00)	 (0.00,-0.21,0.00)	 (0.00,1.25,0.00)	 (0.00,2.71,0.00)	
ES-3	 (0.00,0.00,-3.25)	 (0.00,0.00,-1.75)	 (0.00,0.00,-0.25)	 (0.00,0.00,1.26)	 (0.00,0.00,2.76)	

Comparing these models with the equivalent EFA shape space models (see Table 3 of the previous newsletter's *PalaeoMath 101* column, MacLeod 2012) is also instructive. The eigenshape models look decidedly rougher, more asymmetric; on occasion virtually pathologic (*e.g.*, ES-1, Model 1). This rough look may strike many as disquieting compared to the overt symmetries that Fourier shape models usually display. But this rough look underscores the fundamental strength of eigenshape analysis and the reason it delivers better results in the vast majority of instances than radial Fourier, Z-R Fourier or elliptical Fourier analyses. The outline shapes present in the dataset are also rough, asymmetric and full of relatively small irregularities. In some cases these are nothing more than idiosyncrasies of the specimen chosen for analysis—part of the noise that is present in any shape analysis. But in others these roughnesses, asymmetries and irregularities are part of the fundamental geometry, not only of the specimen, but part of the group the specimen represents—part of the signal the data analyst is seeking. Fourier analysis passes

the representation of these geometrically 'difficult' features through the filter of a set of highly structured, smooth, symmetrical shape variables. Accordingly, it often takes quite a number of Fourier harmonics to represent these aspects of organismal outlines accurately.

Eigenshape analysis, on the other hand, is not troubled in the least by roughness, asymmetry or irregularity. All eigenshape responds to is the collection of shapes at whatever level of spatial resolution the data analyst has chosen to represent them. All it does is deliver an efficient representation of this observed shape variance. Eigenshape analysis zeroes in on precisely those features of the outline shapes that are responsible for shape variation in the sample and does not concern itself with the elegance of the shape variables it uses for this purpose. Rohlf (1986) assumed that these rough sorts of features are more likely to be part of the shape noise than part of the shape signal and so would lead to the production of spurious and difficult-to-interpret results in an eigenshape analysis. I must say that after almost 30 years of personal involvement performing eigenshape analyses in a wide variety of contexts, my experience has been just the opposite. In the vast majority of cases eigenshape analysis does a better job of recognizing the geometric structure of the distribution of shapes present in a sample than Fourier (and other forms of) outline analysis, because real specimens exhibit a variety of shape-based similarity and difference patterns at a variety of scales and because these are highly complex, geometrically 'difficult' patterns. These are the very stuff of biological shape variation; the aspects of that variation which biologists are interested in, the aspects that comprise the subjects' morphological taxonomy, morphological ecology, morphological biogeography, morphological function, and other facets of morphology.

Best of all, the eigenshape approach to outline analysis I've described and demonstrated here is just the starting point for a set of variations on the eigenshape theme that—as we'll see in the next column—can (i) expand the utility of eigenshape analysis beyond the assessment of closed curves, (ii) improve the link between topological and biological homology in the representation of boundary curves, (iii) combine the analysis of landmarks with the analysis of outlines, and (iv) align this technique with the basis of geometric morphometrics in a formally mathematical (rather than simply a conceptual) sense.

As for software, since classical eigenshape analysis amounts to little more than a PCA of Z-R shape function data, and since the Z-R shape function is quite easy to calculate from normal x,y coordinate point data (see the section in the *PalaeoMath 2 Spreadsheet* for this column and for MacLeod 2011), with a little ingenuity this method can be implemented by anyone using resources available to them in the public domain. I have made available my personal eigenshape routines for eigenshape analysis as compiled applications for both Mac and PC operating systems. Øyvind Hammer's *Past* (<**http://folk.uio.no/ohammer/past/**>) program package implements a form of eigenshape analysis. Both standard and extended versions of eigenshape analysis based on my algorithms are also available for use as web-based applications from the Morpho-Tools website (<**http://www.morpho-tools.net/**>). Finally, the *Mathematica*™ routines I have developed for the implementation of eigenshape analysis, and that I used to perform the analyses I reported here, are available for users of that software computing system. I also am aware that R-based eigenshape routines are included in Claude (2008).

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

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

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

5th Workshop on Non-Pollen Palynomorphs
Amsterdam, The Netherlands *2 – 5 July 2012*

This workshop will be held at the Institute for Biodiversity and Ecosystem Dynamics of the University of Amsterdam, The Netherlands. On 5th July we will organize an optional excursion for participants.

The systematic use of NPP (for example fungal and algal spores, cyanobacteria) in Quaternary lake and peat deposits started more than 40 years ago at our institute and nowadays more and more palynologists use the extra information that can be obtained from NPP-analysis. Based on the number of participants during the first four workshops we will organize the 5th workshop for a maximum of 50 persons. If more than 50 colleagues respond with a pre-registration form then we will put these persons on a waiting list.

If you are interested in participating, send a message to <**b.vangeel@uva.nl**> asking for the pre-registration form. Those who respond will be informed with further circulars. Final registration will be by paying the registration expenses (probably *ca* €50).

45th Annual Meeting of AASP – The Palynological Society
Lexington, Kentucky, USA *22 – 24 July 2012*

This meeting will be held on the campus of the University of Kentucky and co-hosted by the Kentucky Geological Society and the Department of Earth and Space Sciences at Morehead State University. A CIMP-sponsored symposium will be convened at the Lexington Meeting in honour of Dr Geoffrey Clayton and Dr Kenneth Higgs who have made tremendous contributions to our understanding of Late Palaeozoic palynology for more than three decades.

There will be a pre-meeting field trip on 21st July 2012 to Natural Bridge State Park – the centrepiece being a natural arch of Early Pennsylvanian sandstone. The post-meeting field-trip on 25th July 2012 will explore the world-class outcrops that expose Devonian and Carboniferous strata focusing on the Devonian "black shales". Collecting of macro- and microfossil samples will be encouraged.

For additional information on the meeting and organisational updates please visit the Palynological Society website at <**http://www.palynology.org/**>.

34th International Geological Congress
Brisbane, Australia *5 – 10 August 2012*

The IGC was first held in 1878, and the Oceania region has only hosted the event once in its prestigious history. High-level political and scientific support secured in Australia and New Zealand for the Congress will underpin this outstanding event.

Under the theme "Unearthing our Past and Future" the IGC will showcase the Oceania region's geoscience strengths, innovations and natural wonders, through an exciting range of pre- and post-Congress field-trips.

AUSTRALIA 2012, to be held at the Brisbane Convention and Exhibition Centre, will include a GeoExpo, an education outreach programme, and a support programme to encourage young delegates to attend. The IGC will demonstrate the crucial role that geoscience plays in the quest for sustainable development and show how geoscience contributes directly to the future of its resource-based industries, land and water management and mitigation of geohazards.

Further details can be found on the conference website at <**http://www.34igc.org/index.php**>.

Ichnia 2012 – The Third International Congress on Ichnology
Memorial University of Newfoundland, St John's, Canada *11 – 23 August 2012*

The Third International Congress on Ichnology will be held at the Memorial University of Newfoundland, St. John's, Canada in August 2012. The meeting will bring together scientists working on all aspects of trace fossils and bioturbation, and will be of interest to palaeontologists, sedimentologists, ecologists and biologists.

The Congress will begin with a pre-conference field-trip to western Newfoundland, examining the Cambro–Ordovician ichnology of the region, and studying benthic ecology at Memorial University's Bonne Bay research station. The intra-conference field-trip will visit Bell Island, home to some spectacular early Palaeozoic trace fossils, and the post-conference excursion will examine the Precambrian–Cambrian GSSP at Fortune Head, as well as the famous Ediacaran biota of the Avalon Peninsula.

The meeting will be hosted by the Ichnology Research Group in the Department of Earth Sciences. Pre-register your interest in attending by visiting the Ichnia 2012 website at <**http://www.ichnology.ca/index.php/**> or for more information please e-mail <**ichnia@mun.ca**>.

12th International Paleolimnology Symposium
Glasgow, Scotland *21 – 24 August 2012*

This Symposium, organized by the International Paleolimnology Association and covering all aspects of paleolimnology, will be held in Glasgow, Scotland. The lead organizers are Helen Bennion, University College London, and Andy Henderson, University of Newcastle.

The meeting will take place in the Scottish Exhibition and Conference Centre (SECC) in the centre of Glasgow where there are first-rate facilities for both oral and poster sessions.

Further details can be found on the conference website at <**http://www.paleolim.org/ips2012/**>. Abstract submission deadline: **1st July 2012**.

13th International Palynological Congress / 9th International Organisation of Palaeobotany Conference
Chuo University, Tokyo, Japan *23 – 30 August 2012*

Our world is changing dramatically. There are many urgent environmental issues, such as pollution, climate change, landscape and land-use changes, that have affected the ecosystem, biological diversity and human life. Palynology and Palaeobotany have provided baseline information on the past biological and environmental changes, which have in turn become critical for sustainable environmental management and nature conservation.

In Japan and elsewhere more medical doctors are actively involved in Aerobiology and Palynology to prevent further spread of pollen-related allergies influenced by human-induced environmental changes. Our disciplines now have wider implications and applications relevant to modern society than ever. The main theme "Palynology and Palaeobotany in the Century of the Environment" is thus timely for the IPC/IOPC 2012 meeting in Tokyo, Japan.

Further details can be found at <**http://www.psj3.org/ipc-iopc2012/Welcome.html**>.

32nd International Geographical Congress
Cologne, Germany *26 – 30 August 2012*

The Theme 'Down to Earth' will focus on Global Change and Globalisation, Society and Environment, Risks and Conflicts, Urbanisation and Demographic Change.

Further details can be found on the conference website at <**http://www.igc2012.org/**>.

Palaeopathology Workshop
The Natural History Museum, London, UK *29 – 30 August 2012*

This workshop will be held at The Natural History Museum (London), organised by The Natural History Museum and the KNH Centre for Biomedical Egyptology, The University of Manchester, as part of a joint project funded by The Wellcome Trust.

The first Archaeological Survey of Nubia published its final report just over 100 years ago, drawing to a close one of the largest sets of palaeopathological investigations ever carried out. The human remains from this and other such studies during the last century have granted us incredible insights into the lives and deaths of the ancient Nubians and their neighbours to the north, the Egyptians.

The skeletons and mummies of these two great civilisations have also helped drive the development of palaeopathology as a discipline. To celebrate this centenary, we invite you to attend a workshop to learn about and discuss the past work, present research, and future direction of human and animal palaeopathology in this region.

Further details can be found on the workshop website at <**http://www.knhcentre.manchester.ac.uk/research/nubiaproject/palaeopathologyworkshop/**>.

5th ESA-European Symposium on Aerobiology
Krakow, Poland *3 – 7 September 2012*

The 5th European Symposium on Aerobiology will be held in Krakow, Poland, on 3–7 September 2012, and will be organised under the patronage of the Rector of Jagiellonian University.

Further details can be found on the conference website at <**http://www.5esa.cm-uj.krakow.pl/**>.

29th International Association of Sedimentologists (IAS) Meeting of Sedimentology
Schladming, Austria *10 – 13 September 2012*

The International Association of Sedimentologists (<**http://www.sedimentologists.org/**>), and the Department of Applied Geosciences and Geophysics, Montanuniversitaet Leoben (Austria) invite you to the 29th IAS Meeting of Sedimentology.

The Meeting will bring together all facets of sedimentology under the theme of Sedimentology in the Heart of the Alps. It will feature a wide-ranging interdisciplinary scientific programme, and an exciting range of pre- and post-meeting field-trips, which are being organised with important contributions from our Austrian partners and inputs from our Slovenian, Croatian, Hungarian and Slovakian neighbours. Expert training pre- and post-meeting short courses, an exhibition and leisure options will be other features.

Further details are on the conference website at <**http://www.sedimentologists.org/ims-2012**>.

Andrew Scott's Retirement Conference
Royal Holloway University of London *14 September 2012*

The Earth Sciences Department at Royal Holloway are organising a conference to celebrate the work and interests of Professor Andrew Scott (Professor of Applied Palaeobotany) on his retirement. Presentation topics will include palaeobotany, fire and palaeoclimate.

Speakers: Jean Galtier, Brigitte Meyer-Berthaud & Nick Rowe (Montpellier); Barry Lomax (Nottingham); Richard Bateman (Kew); Derek Siveter (Oxford); Deborah Martin (USGS); Mark Hardiman (Royal Holloway), Laura McParland (UK), Scott Anderson (Northern Arizona); Chris Roos (Southern Methodist University, Dallas); William Bond (Cape Town, South Africa); Claire Belcher (Exeter); Jane Francis (Leeds); Artemi Cerda (Valencia).

Please contact Kathryn Hardy (<**k.hardy@es.rhul.ac.uk**>) at Royal Holloway to register and for further information. Registration is free. Evening reception and dinner *c.* £40 to be paid in advance when registering. Please book your evening ticket by Friday 17th August.

Centenary Meeting of the Paläontologische Gesellschaft:
Palaeontology in Society – 100 Years of the Paläontologische Gesellschaft
Museum für Naturkunde, Berlin *24 – 29 September 2012*

The Centenary Meeting's theme is Palaeontology in Society – 100 Years of the Paläontologische Gesellschaft, underscoring the relevance of palaeontology not only to science, but also to society and the public at large. The deep time perspective of the fossil record provides a unique baseline for current environmental concerns such as global climate change, loss of biodiversity, and the recovery from mass extinctions. Palaeontology also raises public awareness in addressing questions about the origin and the evolution of organisms, ourselves included.

"Palaeontology in Society" also refers to the multidisciplinary and integrative nature of palaeontological research, including organismic and molecular biology, geology, and geochemistry. Finally, "Palaeontology in Society" highlights the role of palaeontology in communicating authentic research, based on real fossils, to the general public.

This meeting is dedicated to celebrating the past and, more importantly, to exchanging and developing new ideas and projects "in society" with your colleagues.

The Abstract submission deadline is 15th July 2012. Further details can be found on the conference website at <**http://palaeo100.naturkundemuseum-berlin.de/en/home/**>.

Linnean Society Palynology Specialist Group's Annual Meeting
The Linnean Society, Burlington House, London *1 November 2012*

The Palynology Group meeting is open to anyone with an interest in pollen or spores. There is no registration fee as the meeting is generously supported by funding from the Linnean Society.

Please contact Carol Furness (<**c.furness@kew.org**>) at the Royal Botanic Gardens, Kew, for more information.

The Future of Quantitative Paleontology: Biometry, Computer Vision and Machine Learning: 2012 GSA Annual Meeting & Exposition
Charlotte, North Carolina *4 – 7 November 2012*

Taxonomic data play a crucial role in understanding Earth history. Accurate identifications and classifications are necessary to document the origin and radiation of major groups, estimate historical patterns of taxonomic richness and diversity, and provide age estimates for various evolutionary and geological events.

This topical session will draw together contributions from researchers who are developing and/or applying tools from fields such as digital imaging, pattern recognition, computer vision and machine learning, to classification problems in paleontology and allied sciences. We welcome contributions from researchers working on organisms from all branches of the tree of life and all parts of the stratigraphic column.

Further details can be found on the session website at <**http://www.nhm.ac.uk/hosted_sites/paleonet/GSA/**>.

Annual International Conference on Geological and Earth Sciences (GEOS 2012)
Hotel Fort Canning, Singapore *3 – 4 December 2012*

Topics of interest include, but are not limited to: Mineralogy, Petrology, Geochemistry, Geomorphology, Palaeontology, Stratigraphy, and Structural Geology. For a complete list view the 'Call for Papers' section of the conference website <**http://www.geoearth.org/CallforPapers.html**>.

Best Paper and Best Student Paper awards will be conferred at the conference, and there is the opportunity to submit papers for the conference proceedings publication.

For further details see the conference website <**http://www.geoearth.org/**>. (Final paper submission deadline: **13th July 2012**; Early-bird registration until **13th September 2012**.)

6th International Symposium on Lithographic Limestone and Plattenkalk
Museo del Desierto, Saltillo, Mexico *4 – 8 March 2013*

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, but also to new localities.

Please e-mail <**ISLLP2013@geow.uni-heidelberg.de**> for more information.

SAGE 2013: 2nd Southeast Asian Gateway Evolution
Museum für Naturkunde Berlin, Humboldt University Berlin *11 – 15 March 2013*

The Museum für Naturkunde Berlin and the Humboldt University will host the second international conference on Southeast Asian Gateway Evolution (SAGE 2013).

This meeting focuses on the origin, diversification and conservation of Southeast Asia's megadiverse fauna and flora against the background of the region's complex geology and climate history. We aim to attract climatologists, biogeographers, palaeontologists and geologists to this multidisciplinary meeting and look forward to welcoming you in Berlin in March 2013.

Check the conference website at <**http://www.sage2013.org/**> for more information.

Volcanism, Impacts and Mass Extinctions: Causes and Effects
The Natural History Museum, London *27 – 29 March 2013*

London's Natural History Museum will host an international, multi-disciplinary conference that brings together researchers across the geological, geophysical and biological disciplines to assess the state of research into the causes of mass extinction events. The main goal of this conference will be to evaluate the respective roles of volcanism, bolide impacts, sea level fluctuations and associated climate and environmental changes in major episodes of species extinction.

Check the conference website at <**http://massextinction.princeton.edu/**> for more information.

10th North American Paleontological Convention
Venue TBA *Summer 2013*

Please send your proposals for the meeting venue to Mark Wilson (e-mail <**mwilson@wooster.edu**>, Department of Geology, The College of Wooster, Wooster, OH 44691).

Check The Paleontological Society website (<**http://www.paleosoc.org/**>) for updates.

2nd International Joint Congress APLE-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 will be available in due course on the APLE (<**http://aple.usal.es/**>) and APLF (<**http://w3.laplf.univ-tlse2.fr/**>) websites.

46th Annual Meeting of AASP – The Palynological Society. Joint meeting with DINO 10 and the North American Micropaleontology Section (NAMS)
San Francisco, USA *Autumn 2013*

Further information will be available in due course on the Palynological Society website at <**http://www.palynology.org/**>.

9th European Palaeobotany-Palynology Conference
Padua, Italy *end August – early September 2014*

The Italian group of Palaeobotany and Palynology is very glad to be able to invite all of you to Padova in 2014 for the next EPPC.

All scientific sessions will be held at the new Department of Geoscience, however also the famous Botanical Garden and the Museum of Palaeontology will be involved during 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 at <**Evelyn.Kustatscher@naturmuseum.it**>.

4th International Palaeontological Congress (IPC 2014)
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.

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 near the whole stratigraphic record.

Further details will follow.

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

Meeting REPORT

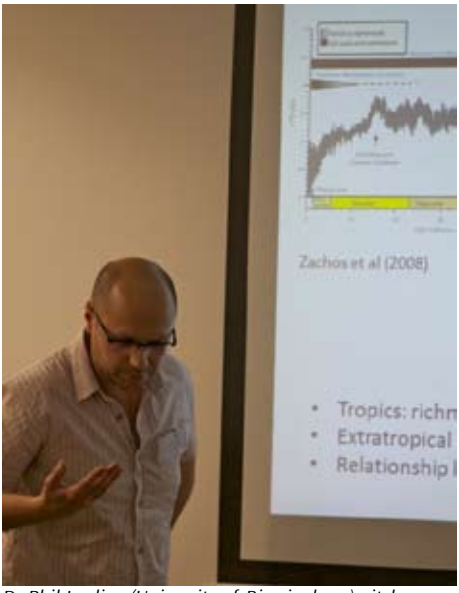
Inaugural meeting of the British Ecological Society (BES) Macroecology Special Interest Group

Charles Darwin House, London *20 June 2012*

The title for the inaugural meeting was 'What is Macroecology?' After a brief welcome from **Georgina Mace** (Imperial College, President of the BES) it was up to **Ian Owens** (NHM, London) to answer this in a talk with a lot of audience participation, which tried to identify how much progress had been made on key topics outlined in a volume of edited papers by Blackburn and Gaston (2003) that arose from the BES Symposium on the subject in 2003. While it was agreed that there had been considerable progress on all of the questions, it was conceded that much of the progress had been about framing questions in such a way that the data available could be used to meaningfully address them. The other point that Owens made was how wide the reach of macroecology has become, although there was wry commentary about the fact that the emphasis on birds and mammals in macroecological papers was completely disproportionate to their representation in the Earth's biota. Some parts of the presentation, particularly the jokes, were aimed at those in the know, which might not have made this entertaining presentation quite as open to all as it might have been, but the talk was certainly lively.

Sean Connelly's talk was a change of pace. Connelly worked on Ordovician biodiversity with Arnie Miller in the mid and late 1990s and they produced a series of papers that were ahead of their

The macroecology group compares interests amid posters and refreshments in Charles Darwin House.



Dr Phil Jardine (University of Birmingham) pitches his work (with Dr Guy Harrington on macroecological patterns in fossil plants) to the macroecologists.

time. Since then Sean has become a leading theoretical macroecologist working on corals at the ARC Centre of Excellence for Coral Reef Studies at James Cook University in Australia. Connelly talked about how macroecology does not fall into the Popperian model of how science is done and explained the relationships among data, theory, ideas and experiment in a clear fashion that made the case for the development of clearer theoretical models to accompany the developments in data-sharing and statistical modelling that have accompanied the development of macroecology.

After the buffet lunch and much discussion of the morning's talks, we returned to the auditorium for three more talks. **Katrin Böhning-Gaese** (LOEWE Biodiversität und Klima Forschungszentrum), examined the reciprocal relationship between community ecology and macroecology. I was intrigued by the distribution models presented, which caught the tension between macroecological (top-down) views of the controls on distribution and bottom-up models of community ecology. The conclusion that while abiotic factors (court jester) have the largest role to play, the addition of even simple models of competiton, such as how many con-generics are found in the same area, can improve the fit of modelled distributions to observed ones substantially, echoing the biotic/abiotic controls on extinction debate in palaeontology. The next speaker, **Nick Dulvy** (Simon Fraser University), discussed the likely effects of climate change on the shift in ranges of terrestrial ad marine organisms. He discussed an intriguing pattern where there tends to be a very good fit between the predicted ranges of marine organisms, based on temperature, but terrestrial taxa tend to have ranges that extend further poleward than expected and not so far towards the equator as expected. My immediate thought was that there are several excellent palaeontolgical data sets that could be used to test whether this has always been the case. The final speaker of this session, **Trevor Price** (University of Chicago), extolled the incredible avian biodiversity of certain mountain ranges, explaining that his work focused on understanding the gradient in species richness in the Himalayas, which had a lot to do with habitat diversity and generalist versus specialist taxa. Again, I can think of ways this could inform palaeontological work in a number of aspects.

A number of posters were up in the coffee area, my own included, and we were all give the chance to give a one-minute pitch for our posters either at the end of this session or the final session of the day, which consisted of two talks. The first, from **Felix Eigenbrod** (University of Southampton) discussed how macroecological thinking, which tends towards pattern detection and pattern analysis with statistical tools, might help improve the understanding and use of ecosystems

services. We then heard the case for applying macroecological models to inner space, the microbial communities within animals and plants, from **Kate Jones** (UCL).

The day was rounded off with an appeal for more members to join the Special Interest Group from **Tom Webb** (University of Sheffield), a marine macroecologist who has turned his attention to palaeontological matters from time to time. You can join the group and mailing list, and find out what is happening, through the group website at <**http://www.britishecologicalsociety.org/getting_involved/special_interest_groups/Macroecology.php**>.

So were there other palaeontologists there? Yes, there were. Phil Jardine from Birmingham was there to represent himself and Guy Harrington and I met a few M.Sc. students from other institutions. Andy Purvis (Imperial) is a macroecologist and knows his fossil forams, as his sets of foram Trumps given out at a past Annual Meeting shows. The group would welcome involvement from palaeobiologists, so please think about joining and attending future meetings.

Al McGowan

REFERENCE

BLACKBURN, T. M. and GASTON, K. J. (eds). 2003. *Macroecology: concepts and consequences*. Blackwell Science, Oxford. 464 pp.

With thanks to Alan Crowden (BES Bulletin Editor) for the photographs.

A Fossil-Fuelled Future?

I thought I had reached a halfway-to-the-grave age without undergoing an existential crisis, but then I sat down to write this piece, and – rather than coming up with the usual frippery – found myself wallowing in seriousness. I blame the British Science Festival.

BSF 2012 is being held in Aberdeen this September, and I'm in charge of organizing the PalAss-sponsored session. Perhaps unsurprisingly, given its location, the festival theme is Energy. Trying to tap into this, I have called the session 'Our Fossil-Fuelled Future'.

Inevitably, the organizers thought this meant we would be talking about fossil fuels, but that was only part of my intention. I wanted to include a combined discussion of applied palaeontology and the future of our subject. What do palaeontologists do in the 21st century, and why does palaeontology still matter?

We all have our own opinions on the most important aspects of our science, but we know why fossils matter. The public, though, are often confused as to what we do, and what benefits it brings to the world. I'm also not sure if engaged school pupils get useful advice as to what opportunities there are if they're keen to follow a fossiliferous path.

I've therefore put together a selection of mostly young, mostly applied palaeontologists to speak in the session, and explain how they got where they are, what they do, and how rosy they think the future of palaeontology is. And thinking about that last aspect was where my existential crisis began.

The Association is in rude financial health; the Annual Meeting is one of the world's best and best-attended palaeontological conferences; and the impact factor of *Palaeontology* seems to be on a consistent upward trajectory. It all looks very rosy in the PalAss garden.

I'm not sure it is, though. I fear that these encouraging signs mask a problem, and one we as an association needs to consider carefully. The problem that, at least in the UK, there isn't much demand for palaeontologists.

I was an undergraduate at Liverpool, at a time when the department had Pat Brenchley, Chris Paul, Pete Crimes and Charlie Underwood on its staff. Their enthusiasm and love of the subject played a major role in my becoming a palaeontologist; I look back on my time there with great fondness. Soon after, however, they all retired or moved on, and – though I could be wrong – our esteemed Book Review Editor seems to be their only replacement.

As a postgraduate in Birmingham, the palaeobiology research group was large, with Ph.D. students a-plenty. The group is still going strong, but when I look back to those palaeo postgrads of a decade ago, a worrying realization hits me. Of the dozen or so Ph.D. colleagues I overlapped with, not one has a permanent academic job in the UK. Every one has either left the field, left the country, or both.

Some never wanted to be academics, of course, and with a Midlands bias, my sample size is limited. A couple of my erstwhile colleagues are also working in at least partly palaeontological museum jobs. But some extremely talented scientists tried and failed repeatedly to get university

positions, and the same tale is true of many of my contemporaries from other institutions. In essence, the UK taxpayer funded the training of a swathe of academic palaeontologists, and the net product of that investment was: 0 academic palaeontologists.

One could quite reasonably ask the question: what was the point?

After faffing about for a while, I became an odd-job post-doc in Aberdeen (which might explain why I'm running this year's BSF session). I was quickly given various palaeontological lecture courses to run, as the department no longer had staff with the training (or inclination) to teach those courses. Only two lecturers had a fossiliferous background.

I taught the courses, but was a frank disappointment to the department. The cause of palaeontology in the Granite City was not advanced, and when I moved on after a couple of years, the sole other palaeo postdoc took over my teaching. One of the two lecturers retired shortly afterwards, and looking at the current department website, the 18 permanent members of staff include just one who could be described as palaeontological.

It's similar in Durham, where I currently work: 28 permanent members of staff, two palaeontologists. Clearly there are institutions where palaeontology *is* a strong point, but of the 27 British universities teaching geology courses, most seem to have decided that fossils ain't the future.

In these times of public penny-pinching, fossils aren't seen as the future in museums either, and palaeontological jobs are also in short supply. My local museum – the Yorkshire – for example, has large, nationally and historically significant fossil collections, and no Curator of Palaeontology. They're not likely to appoint one, as the management doesn't see the value. Recently, they demanded the removal of an ammonite photo from a publicity brochure because "people aren't interested in fossils." The Curator of Natural Sciences – with an MSc in Palaeobiology – had to assure them that they definitely are.

So if jobs in academia and museums are so hard to find, are industry opportunities any more abundant? From the online job sites, micropalaeontologists certainly appear to be needed, which bodes well for the new M.Sc. course in Birmingham. Surely long-term prospects for jobs in the declining fossil fuels industry aren't great though?

Do we need more palaeontologists, then? There's plenty of student interest, but if there aren't the jobs, and with the very low success rate in research grant applications, should we be encouraging them to aim for careers in palaeontology? Are we just misleading them? Jere Lipps asked some of these questions in a *Palaeontologia Electronica* editorial a few years back: <**http://palaeo-electronica.org/2007_1/editorial/future.htm**>. I hope we'll be able to debate some of these topics in 'Our Fossil-Fuelled Future'.

I don't want this discussion to become negative and recriminatory. I'm an optimist; I think we have the power to change things, and I don't want to whinge and moan and not offer any constructive comments. For I reckon there's a way in which we, as an association, can make a big difference, and for this we need to look more broadly, at the societal benefits of palaeontology.

In May, I was part of the PalAss posse who ran an event – *What's In A Name?* – at the Lyme Regis Fossil Festival. It was the first time the Association had taken part and, thanks to the efforts of

Fiona Gill and the team, our contribution was very popular. Etymology and taxonomy might not appear to be topics the public can get their teeth into, but Fiona's idea proved that wrong: they could and did.

Hundreds of people visited our stall, heard about the Association, and learnt about fossil names. The vast majority of them went away with a smile on their face (and a set of surplus PalAss postcards in their hand). There was no doubt the public liked palaeontology.

Some months earlier, at the opposite end of the country, a colleague and I ran a trace fossils class for schoolchildren and their parents. They were from a deprived, industrial region of the north-east, so I called the session 'Middlesburrow' and explained the geology of their area, and how the iron and steel industry was tied into Jurassic sea life.

Some of the kids were already interested in fossils, but many weren't. Many of their parents definitely weren't. Yet by the end of the class, we had converts galore: initially sullen participants were bombarding us with questions, asking where they could go to find fossils, eager to learn more. It was a revelation.

What both these events have made me realize is that palaeontology has the power to make people happy, particularly if it can be tied into their lives directly. Surprise people by explaining how fossils underpin local industries, history, geography and ecology, and they're hooked. They also go away happy, which might seem a trivial thing to aspire to, but it genuinely improves people's lives. Since the country benefits immensely from having happier people, it's a very strong reason for funding palaeontology.

I doubt it's a strong enough reason to persuade the government to cough up monies, though, so I think this is where the Association can step in. We are a charity, we have money to spend, and investing in outreach will provide long-term benefits. People still don't understand what palaeontologists do, and science festivals are exactly the kinds of events where we can address this.

With well-attended public events and world-class public resources (websites, apps, and the like), we can get greater public support, enthuse them to get involved, and use this to demonstrate the value of and need for palaeontology. Maybe then we will see greater public investment in our science, which we can spend in university research, and museum curation, and outreach, creating opportunities and jobs. And maybe then our future really will be fossil-fuelled.

Liam Herringshaw
Durham University
<reporter@palass.org>

Sending palaeontology back to school: encouraging the next generation

As part of the 2010 secondary workshop of the Earth Science Teachers' Association (ESTA), Dr Tony Grindrod, Gordon Neighbour and Dr Maggie Williams formed a working group which considered how ESTA should respond to an offer from the Palaeontological Association to work with ESTA in the future on the development of teaching material related to palaeontology. As part of this work we reviewed:

- existing specifications and listed the requirements of different schemes such as GCSE Geology and 'A' Level Geology,
- palaeontological resources presently available on the Geology Teachers' Resource Exchange (GeoTRex) section of the ESTA website, and
- the range of other palaeontological activities and resources currently available on different websites such as Palaeontological Association, the Geological Society of London, the British Geological Survey, the Natural History Museum and various universities.

By the end of the secondary workshop members of the working group recognised that palaeontology can be a major factor in attracting students to follow Geology courses in schools. Members also noted that there has been an increase in the take-up of Geology at GCSE, A-level and AS-level over the last few years (King and Jones 2011), and hoped that this current trend will continue.

The Earth Science Teachers' Association has been at the forefront of developing teaching resources to support Geology teaching in UK schools for over 40 years. During this time it has not only developed its own teaching resources and courses, but it has also produced resources and/or professional development courses in collaboration with a range of organisations including the following:

- Geological Society of London,
- Earth Science Education Unit (ESEU), which is based at Keele University,
- National Science, Technology, Engineering and Mathematics (STEM) centre,
- Geographical Association,
- Geologists' Association,
- British Geological Survey,
- GeoConservationUK: the Association of UK RIGS Groups,
- Joint Earth Science Education Initiative (JESEI).

Although it has a long history of collaboration with other organisations, ESTA welcomes the offer to work with a more specialist organisation such as the Palaeontological Association to develop teaching materials. The exercise undertaken at the annual ESTA secondary workshop in 2010

identified where our resources needed additional materials. Tables 1, 2 and 3 summarise the sections of the relevant courses for England and Wales (two courses at Advanced Level and one at GCSE) and indicate where there is scope for development of teaching materials/resources with the Palaeontological Association. Individual teachers have produced some excellent materials but they are often restricted by the material to which they have personal access. The members of the group also recognised that in the ideal world students will have access to good-quality palaeontological specimens or replicas, but in the current economic climate this is not realistic. It is clear that not all schools will have access to all specimens (although working together with local HE institutes can be a fruitful exercise for both groups). In the absence of a local HE institution there is therefore a need for support from specialist organisations such as the Palaeontological Association.

Organisations such as the Geological Society of London are making efforts to support Geoscience education through their Geoscience Education Academy where they have been able to provide free INSET (in-service training) for UK Science teachers who have no Earth Science background and are expected to deliver the Earth Science component of the National Curriculum.

The Geological Society has a number of regional groups and many of these are now actively engaging with schools, allowing access to scientific meetings, and this year many of the regional groups are running a schools competition. In addition they have established the Schools Affiliate programme which gives a number of benefits to schools and "School Affiliates" including provision of:

- a Schools Affiliate e-newsletter
- access to Regional Groups, who may provide local events/talks for schools to attend
- copies of the Earth Science Week Material
- the ability to email questions to a 'real-life' palaeontologist

As another example of a recent development, the Geological Society of America is developing materials to support palaeontology teaching and I look forward to the latest guide, edited by Prof. Rowan Lockwood and Prof. Peg Yacobucci, which will be a GSA special publication on 'Teaching Paleontology', to be published in 2012. The American Geological Institute is also producing a number of materials to support the teaching of geology.

So what can the Palaeontological Association do to help support and develop the teaching of palaeontology in schools? In the first instance, access to good quality copyright-free images of fossils would be extremely beneficial to school teachers. It would also be of great help if the Association could develop a resource showing what fossils look like in different sections through the complete fossil. (After all, this is how we find bits and pieces of fossils in the field!) To help capture the imagination of school pupils it would be useful if the Association could offer ESTA advice, assistance and support with the development of interactive web-based resources and palaeontological-themed games and activities. The Palaeontological Society could also consider developing a Schools Affiliate Scheme similar to the scheme operated by the Geological Society of London: an online speakers list of palaeontologists willing to give talks and willing to visit schools would be an excellent starting point here. A similar Schools Affiliate scheme for membership of the Palaeontological Association may be of equal benefit to both students and the organisation. A reduced membership fee for

school students would increase membership, and although there will be some 'drop-off', it is likely that some of these students will go on to become full members of the Association.

If you need further information or advice, please feel free to contact me as the ESTA contact for the project: Palaeontology-related materials in the classroom:

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TQ2 7DY
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REFERENCE

KING, C. and JONES, B. 2011. "Reasons to be cheerful?" *Geoscientist* **21.05** June 2011.

Table 1 – OCR A Level Geology

OCR Advanced Level Geology		
Level	**Topic**	**Additional comment on materials and their development**
OCR A2 A2 Unit F795: Evolution of Life, Earth and Climate	Module 1: Formation of fossils	
	5.1.1 Understand the different types of preservation of hard skeletal tissues	Visual resources/animations covering the topic would be very helpful.
	5.1.2 Understand exceptional preservation of fossils	1. Possible development of more comprehensive information about evolutionary trends. 2. Clear photographs of fossils needed to support work covered. 3. Perhaps develop a special collection of illustrations and explanations of exceptional fossil preservation.
	5.1.3 Know about trace fossils and understand their use in interpreting palaeoenvironments	There is scope to develop this as a more visually exciting exercise using photographs of fossils and videos and photos of present-day environments.
	5.1.4 Understand the use of fossil assemblages in interpreting palaeoenvironments	There is scope to develop this as a more visually exciting exercise using photographs of fossils and videos and photos of present-day environments.
Module 2: Morphology of fossils and adaptation of organisms to live in different environments		
Trilobites	5.2.1 Know the morphology of trilobites and understand the adaptations for different environments	Students and teachers need access to a good collection of photographs of British fossil trilobites. It would also be a good idea to link the fossil forms to trace fossils. Maybe develop an animation?
Corals	5.2.2 Know the morphology of tabulate, rugose and scleractinian corals; understand that fossil corals may indicate a tropical, marine, reef environment	Students and teachers need access to a good collection of photographs illustrating and relating present day environments and organisms to fossil forms. (Perhaps something that could be developed for other extant groups with a good fossil record?) .
Brachiopods	5.2.3 Know the morphology of brachiopods	Clear photographs of a variety of different fossils.

Echinoids	5.2.4 Know the morphological differences between regular and irregular echinoids that reflect their respective modes of life	Produce a collection of labelled photographs of the fossil echinoids showing the morphological features. Perhaps link to photographs of echinoids and their habitats today?
Bivalves	5.2.5 Know the morphology of bivalves and understand their adaptations for different environments	Clear photographs of fossils needed.
Minor Fossil Groups	5.2.6 Recognise minor fossil groups and the environments in which they live	Produce a collection of labelled photographs of the fossil gastropods showing the morphological features. Perhaps link to photographs of gastropods and their habitats today?
Microfossils	5.2.7 Know about the main microfossil groups and understand their use in stratigraphy	
Module 3: Fossil evidence of the evolution of organisms and mass extinctions		
	5.3.1 Know the meaning of evolution	
	5.3.2 Know the morphology of graptoloids (graptolites) and the morphological changes that show the evolution of graptolites in the Lower Palaeozoic	Suggest clear photographs of graptolites showing the morphological features A Level students would be expected to recognise.
	5.3.3 Know the morphology of nautiloids and ammonoids and the morphological changes and evolution of nautiloids and ammonoids in the Palaeozoic and Mesozoic	
	5.3.4 Know about the evolution of amphibians from fish	Illustrations of vertebrate fossils to link to worksheets/notes such as these.

	5.3.5 Know about the evolution of dinosaurs	Illustrations of vertebrate fossils to link to worksheets/notes such as these.
	5.3.6 Know about the major mass extinction events	
Module 4: Dating methods, correlation methods and interpretation of geological maps		
	5.4.2 Know about relative dating	Scope for developing specific resources and why fossils are useful.
	5.4.3 Use dating evidence to interpret geological maps	
	5.4.5 Know how rocks can be correlated	
	5.4.6 Know the main appearances and extinctions of key fossil groups and their use as zone fossils	

Table 2 – WJEC A Level Geology

WJEC Advanced Level Geology		
WJEC AS Level		
III TIME AND CHANGE		
Key Idea 1: Study of present day processes and organisms enables us to understand changes in the geological past		
	(b) Fossils are evidence of former life preserved in rocks. They provide information on the nature of ancient organisms.	Collections of clear labelled photographs of the fossil groups would be helpful.
	(c) Preservation can give rise to a wide range of fossil materials: actual remains, hard parts, petrification by mineral replacement (calcification, silicification, pyritisation), carbonisation, moulds/casts, trace fossils (tracks and trails, burrows, coprolites).	1. Clear photographs of fossils needed to support work sheets and powerpoints. 2. Basic summary notes and fill-in-the-spaces-type worksheets giving a summary of factors that help (or limit) preservation. Would be helpful to have access to images showing the processes & environments operating.
	(d) Fossils may occur as "life" assemblages (preserved without transport) or "death" assemblages (preserved after transport), or as derived fossils incorporated in later sediments.	Visual resources and/or animations covering the topics listed in column 2 would be very helpful.
Key Idea 2: Geological events can be placed in relative and absolute time scales		
	(c) Fossils play an important role in relative dating and stratigraphic correlation. The factors contributing to good zone fossils are: wide and plentiful distribution, ready preservation, rapid evolutionary change, a high degree of facies independence, easy identification of index fossils. The utility of graptolites and cephalopods as zone fossils assessed in relation to the above factors.	Supporting illustrations and/or a more interactive way of learning about succession of life. (Time is one of the hardest topics to teach at all levels.)

<table>
<tr><td colspan="3">WJEC A2</td></tr>
<tr><td colspan="3">E3: PAST LIFE AND PAST CLIMATES</td></tr>
<tr><td colspan="3">Key Idea 1: Fossil morphology is related to function and to particular modes of life, and fossils may be used to interpret former environments</td></tr>
<tr><td></td><td>(a) Fossil groups may be classified on the basis of morphology.</td><td rowspan="3">[a]. Maybe need suggested answers to questions? Perhaps classification could be developed so it is seen as more exciting!

[b]. Possible useful developments:
-Using photographs of fossils and line drawings to simply explain phrases like ‘Coiled in 3 dimensions (helically coiled)’.
(Perhaps produce interactive ‘pick and match’ exercises?)
-Produce a glossary of terms.</td></tr>
<tr><td></td><td>(b) Morphology is related to mode of life/function in representatives of all major groups of fossils.</td></tr>
<tr><td></td><td>(c) There are problems in relating morphology to function in extinct groups of organisms. Recognition of the value of exceptional preservation.</td></tr>
<tr><td></td><td>(d) The fossil record is:

(i) biased, in favour of marine organisms, with body parts resistant to decay, that lived in low energy environments, and suffered rapid burial;

(ii) incomplete, as natural processes can distort or destroy fossil evidence (predation, scavenging, diagenesis, bacterial decay, weathering, erosion).</td><td>1. Clear photographs of fossils needed to support work sheets and powerpoints.

2. Basic summary notes and fill-in-the-spaces-type worksheets giving a summary of factors that help (or limit) preservation. (Maybe develop suggested answers to these types of questions?) Would be helpful to have access to images showing the processes and environments operating.</td></tr>
</table>

Key Idea 2: Fossils provide evidence for the increasing diversity of life through geological time		
	(a) The fossil record provides evidence of changes in floras and faunas through geological time and the development of higher life forms: (i) Precambrian life: life possibly evolved early in Earth history (3.8 billion years ago). The Ediacaran fauna represents the oldest diverse set of multicellular, soft-bodied organisms (565 Ma) (ii) The Cambrian Explosion: the development of mineralised skeletons led to a wide variety of advanced marine invertebrates by the early Cambrian. (iii) Life in the ocean diversified in stages identified by separate fauna: a basic understanding of the difference between Cambrian, Palaeozoic and modern faunas. (iv) the Phanerozoic was marked by the migration of organisms on to the land during the Palaeozoic: Vertebrate development of amphibians from fish, reptiles from amphibians and mammals and birds from reptiles. Colonisation by land plants.	Visual resources and/or animations covering the topics listed would be very helpful. Indeed supporting illustrations and/or a more interactive way of learning about succession of life. (Time is one of the hardest topics to teach at all levels.) Illustrations of vertebrate fossils to link to worksheets/notes would be very useful.

	(b) Diversity increased through the Phanerozoic punctuated by many declines caused by mass extinction events. Mass extinctions may result from a variety of factors including: 1. asteroid impact (Alvarez); 2. increase in volcanicity (flood basalts); 3. changes in land/sea; 4. rapid climate change. Mass extinctions are exemplified by the end-Permian (P–Tr) and Cretaceous–Paleogene (K–Pg) boundary events.	Plenty of scope for development of more resources on evolution and mass extinctions.
	(c) There are alternative interpretations of evolutionary patterns based on the fossil record: Gradual change (gradualism) *vs*. stability interrupted by sudden change (punctuated equilibrium).	Scope for development of more resources on evolutionary patterns.
Key Idea 4: Evidence of global climate change is obtained from the fossil record, sedimentary rocks and ocean sediments.		
	(a) The fossil record provides evidence of different climatic zones, as exemplified by: (i) land plants (ii) corals	Scope for development of resources on these themes.
Theme 3: GEOLOGICAL EVOLUTION OF BRITAIN		
Key Idea 2: Changes in the latitude of the British area through geological time are interpreted from evidence of former climates and from inferred palaeomagnetic pole positions.		
	(a) (i) Sedimentary rocks and their contained fossils may be used to interpret environments of deposition: fluvial, deltaic, shallow and deep marine.	Useful summaries can be made, but needs photographs of fossils and photographs of the environments of deposition including modern-day analogues.

Table 3 WJEC GCSE Level Geology

WJEC GCSE Level Geology		
Key Idea 1: Rock exposures contain evidence of how the rocks were formed and subsequently deformed		
1.3 Sedimentary rocks are formed by a range of surface processes in a variety of environments		
	Fossils are indicators of past environments: • reef-building corals [marine, shallow, warm], • trilobite [marine], ammonite [marine], • plants [land, indicating past climate], • trace fossils [tracks indicating land, burrows indicating shallow water]	Clearly-labelled photographs of fossils needed to support introduction to fossils at this level.
1.7 Rock exposures contain evidence of the sequence of geological events that formed and deformed them		
	The following fossil groups have morphological changes with time that can be used in correlation: • cephalopods [goniatites, ceratites, ammonites – suture line] • graptolites [stipes, thecae]	[a]. Clearly-labelled photographs of fossils needed to support introduction to fossils at this level.
Key Idea 4: Major geological events fit into a timeline, beginning with the formation of the Earth		
This Key Idea enables candidates to fit the major geological events that have affected the Earth and the UK into a timeline		
	Life probably originated from the oceans, 3 5Ma (black smokers or hydrothermal pools) The diversity of life evolved through single cells, multicellular organisms, animals with hard parts, fish, amphibians, reptiles, mammals, birds and humans.	
	The development of the life on Earth was in stages punctuated by times of major extinction events (K/Pg mass extinction)	

Key Idea 5: Earth events occur frequently and are commonly reported in the media		
5.3 Great fossil finds		
	Major finds include: • rare and exceptional preservation [Burgess shale fauna] • fossils that have shown how different groups of organisms are linked through evolution [*Archaeopteryx*] • complex fossil skeletons that have to be interpreted from incomplete and disarticulated remains [dinosaurs] • early hominids ["Lucy"] • exceptional current discoveries	

James Mckay – Palaeo Artist

I have been working as an illustrator specialising in reconstructions of prehistoric life for over 15 years, and presently work for the comic magazine *2000AD* illustrating the seminal dinosaur series 'Flesh' written by Pat Mills[1] (collected volume 'Flesh: The Dino Files' available in all good bookstores – graphic novel section).

Fig 1: Coati and caiman skulls

Fig 2: Iguana and alligator skulls

My work runs from technical drawings of specimens to dramatic reconstructions of dinosaurs for children's books and magazines, comics and TV.

Fig 3: This colour picture of Giganotosaurus *and* Argentinosaurus *was produced for children's magazine 'DinoHunter' published by Hachette Ltd.*

[1] *Flesh: The Dino Files*, published by Rebellion UK Ltd 2011.

Fig 4: Ceratosaurus nasicornis, *the main character in a short story 'A Good Day' written by Steve White, editor at Titan Books and dinosaur aficionado. Published in the comics anthology 'Predators' by Accent UK (2011).*

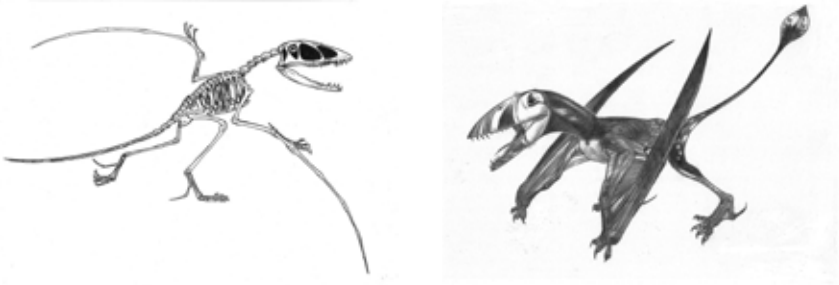


Fig 5: Dimorphodon macronyx *skeletal and flesh reconstruction exhibited at the Lyme Regis Fossil Festival 2012.*

Fig 7: Liopleurodon – *design for a playing card set for the publisher Hachette Ltd 2010.*

My comics work involving dinosaurs includes the science fiction story 'Marraquai' (set in the early Cretaceous Weald), and the two books of the 'City of Secrets' series (published in France by Mosquito Editions), which feature a lost valley filled with prehistoric life including mosasaurs and rauisuchians.

The series 'Flesh' for *2000AD* picks up where the classic 70s series left off: Time-travelling cowboys round up dinosaurs for their meat, which is then beamed up to the 23rd Century. Of course, things go horribly wrong and each episode is guaranteed to feature the gruesome death-by-dinosaur of at least one character!

Pat Mills is a writer (and founder of *2000AD*) well-known for including the most up-to-date representations of dinosaurs in the original 'Flesh' series in the 70s, and every effort has been made in our current story to keep the dinosaurs as realistic as possible (at least in their anatomy). As far as I know the new 'Flesh' comic series features the first reconstructions in a popular comic of *Gigantoraptor*, *Epidendrosaurus*, *Mononykus* and many others. More outlandish scenes include raptors gliding down from the treetops onto their human prey, and the 'sonic booms' of *Parasaurolophus* being using as offensive weapons.

For those interested in critiques of popular culture references to dinosaurs, the comic series 'Flesh' is studied at length by J. J. Liston in the paper "2000AD and the new 'Flesh': first to report the dinosaur renaissance in 'moving' pictures."[2]

My special interest is the Mesozoic of Britain, and I am presently working on a fully illustrated popular book evoking the environments of the Weald, Oxford Clay, Elgin *etc*. in the style of William Stout's 'The New Dinosaurs'; that is, an art book for dinosaur lovers rather than a scientific textbook. I would love to make contact with any palaeontologists interested in having an input into this project: please contact me at<**Jamesmckay76@hotmail.com**>.

I'm not just about reptiles and dinosaurs! Commissioned work has included technical drawings of, for example, invertebrates, and archaeological artefacts such as this Roman spoon:

Please contact me if you are interested in commissioning artwork:

- Technical drawings of specimens (anything from bivalves to dinosaurs to human ancestors)
- Skeletal reconstructions
- Flesh reconstructions
- Dioramas – from the scientifically accurate to wildly speculative

I'm grateful to Fiona Gill, James Witts and Crispin Little at the University of Leeds for promoting my work and suggesting this article.

James Mckay
< j.mckay@leeds.ac.uk> *07951 155 210* **<www.jamesmckay.info>**

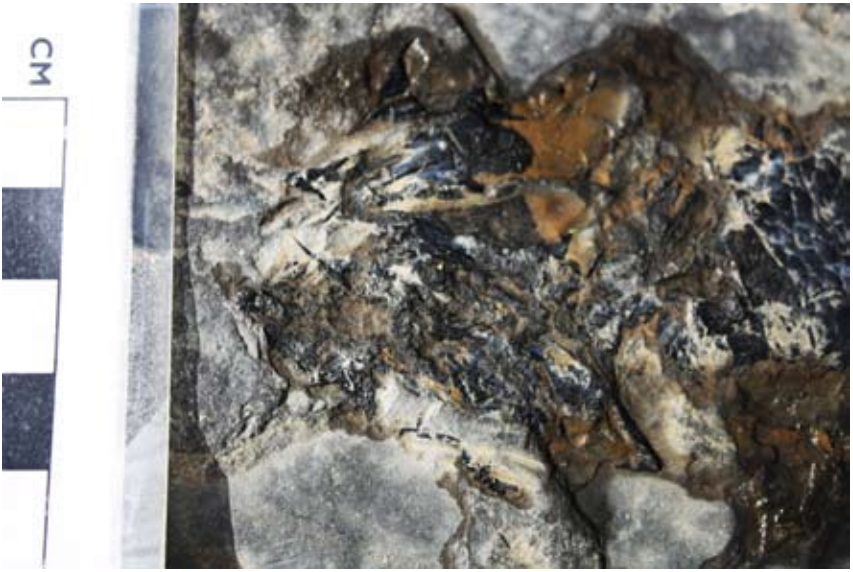
[2] *In:* MOODY, R. T. J., BUFFETAUT, E., NAISH, D. and MARTILL, D. M. (eds) *Dinosaurs and Other Extinct Saurians: A Historical Perspective*, Geological Society, London, Special Publications, **343**, 335–360. DOI: 10.1144/SP343.21

Caithness fish on Edinburgh Street

As well as my service with the Palaeontological Association, I am also involved in various activities with the Edinburgh Geological Society and Lothian and Borders Geoconservation. Voluntary work has always been an important means of repaying the investment made by my fellow citizens in funding my school and undergraduate education and some of my postdoctoral posts, but occasionally the circle of virtue does come back to your professional life.

About six weeks ago I got an email from Ken Shaw, who had come on an evening trip to the Early Carboniferous rocks on Wardie Shore that I had run in the Summer of 2011. He sent me a couple of photographs of a fossil fish he had found, rather aptly, on the way from Waverley train station to Dynamic Earth. As I routinely travel from Waverley Station to get to work in Glasgow, I knew that the street where Ken had taken the photograph was paved with flagstones from Caithness. The flagstones come from Devonian strata, when Orcadian Basin was a system of giant lakes, filled with a variety of fish. So I was unsurprised and gave him this information. I passed his photographs on to a few colleagues who carry out research on fish (thanks go to Drs Martin Brazeau and Jan den Blaauwen of Naturalis, Leiden and Dr Jeff Liston, Edinburgh) and got some comments back indicating that the specimen was probably worth retrieving for further study. City of Edinburgh Council has been very cooperative and we hope to have the specimen removed soon for safekeeping and further study in an appropriate place. We hope to have more news on developments for the next *Newsletter*.

Whole fish.



Close-up of head

I've been out with Ken to take the photographs featured and we also looked at the facing stones on the new City of Edinburgh Council building further down Market Street. These are highly fossiliferous, and we talked about the potential for developing a small fossil trail powered by a Makkamappa app around Waverley. The start would be the Scotsman Steps, which have been recently refurbished and now have some steps with excellent fossiliferous limestones, followed by the fish-bearing Caithness slabs and ending at the Council Building.

The most important part of the story for me is that a good deal of the speed with which we have been able to move on this has been contingent on my involvement in voluntary activities. In a time when we are under ever more pressure to devote our time to 'impactful research', we should not forget that impact outside of the academic sphere often starts with being visible, contactable and approachable to those outside of our professional circle maintaining a network of contacts with geodiversity groups, local scientific societies and public bodies.

Al McGowan

Ken Shaw

All photos by Al McGowan

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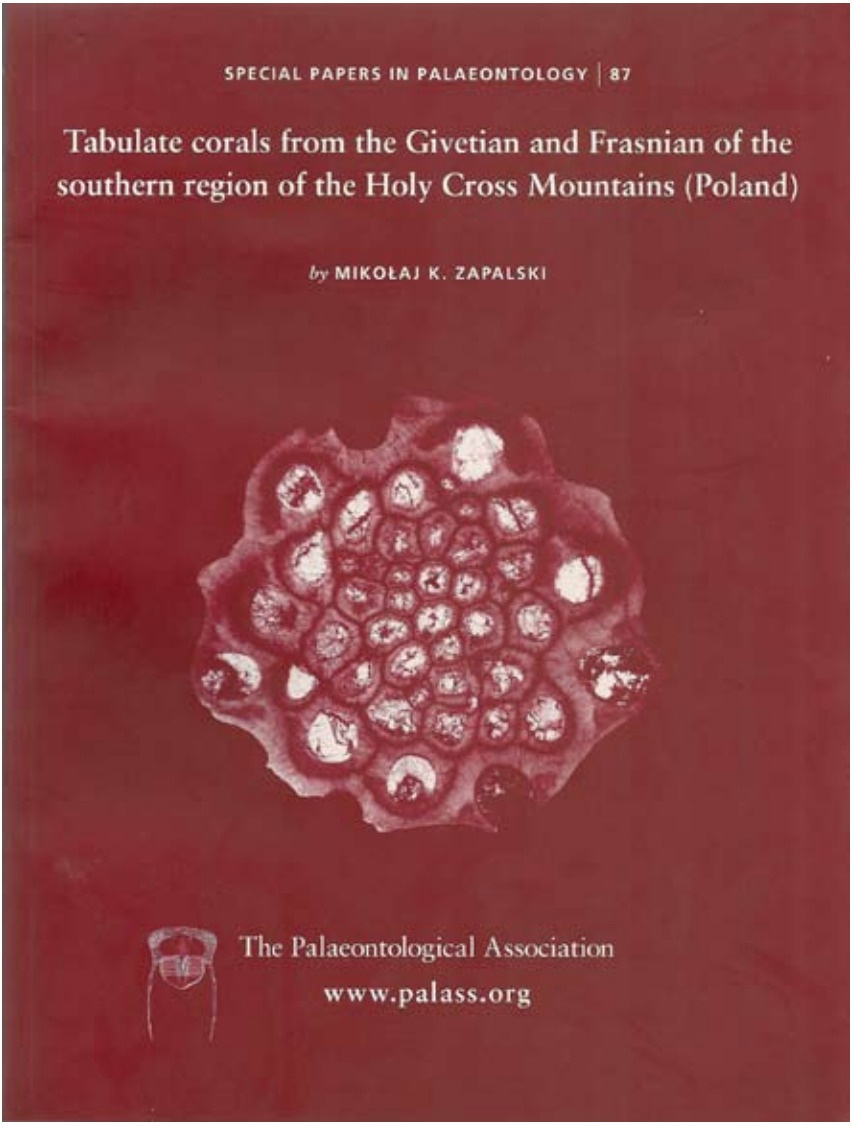
Special Papers in Palaeontology No. 87

Tabulate corals from the Givetian and Frasnian of the southern region of the Holy Cross Mountains (Poland)

Zapalinksi, M. K. April 2012. The Palaeontological Association, London. 100pp. 30 figs and 35 tables. £45.

Abstract: Givetian and Frasnian tabulate corals from the southern region of the Holy Cross Mountains, Poland, are described. Both Givetian and Frasnian tabulate faunas from the study region are dominated by alveolitids and comprise 52 species (Favositida: 40 species, Syringoporida: 6 species, Auloporida: 6 species). A new genus belonging to Syringoporida is proposed – *Sapounofouskilites* gen. nov. – and five new species are erected (Favositida: *Striatopora sciuricauda* sp. nov., *Alveolites? obtortiformis* sp. nov., *Crassialveolites oliveri* sp. nov., *Roseoporella heuvelmansi* sp. nov.; and Auloporida: *Aulopora slosarskii* sp. nov.). Study of the intracolonial variation in tabulates shows that minimal and maximal corallite lumen diameters and pore diameters are the best taxonomical discriminators for Alveolitidae and Coenitidae, while the double wall thickness and tabulae spacing are less useful characters. Moreover, alveolitids and coenitids show overall greater intracolonial variation than, for example, heliolitids. The tabulate endobiont *Chaetosalpinx? plusquelleci* isp. nov. is newly described. Study of tabulate endobionts – that is, *Chaetosalpinx? plusquelleci*, *Helicosalpinx* cf. *asturiana* Oekentorp and H. isp. – show that these were parasites of tabulate corals. Givetian and Frasnian tabulate faunas from the Kielce (southern) Region of the Holy Cross Mountains are dominated by Alveolitidae.

Key words: Tabulate corals, Devonian, intracolonial variability, palaeoecology, species definition.


SPECIAL PAPERS IN PALAEONTOLOGY | 87
Tabulate corals from the Givetian and Frasnian of the southern region of the Holy Cross Mountains (Poland)
by MIKOŁAJ K. ZAPALSKI
The Palaeontological Association
www.palass.org

Overseas Representatives

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

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Information – whether copy as such or Newsletter messages, review material, news, emergencies and advertising suggestions – can be sent to Dr Alistair McGowan, School of Geographical and Earth Sciences, Gregory Building, Lilybank Gardens, University of Glasgow, Glasgow G12 8QQ (tel +44 (0)141 330 5449, fax +44 (0)141 330 4817, e-mail <**newsletter@palass.org**>). The *Newsletter* is prepared by Nick Stroud, and printed by Y Lolfa, Talybont, Ceredigion.

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Palaeontological Association on the Internet

The Palaeontological Association has its own pages on the World Wide Web, including information about the Association, and copies of the *Newsletter*. Site-keeper Mark Sutton can be reached by email at <**webmaster@palass.org**>. The locator is <**http://www.palass.org/**>.

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