The Palaeontology Newsletter

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Contents

Reminder: The deadline for copy for Issue no 79 is 13th February 2012.

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

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Editorial

Time flies, as they say. Not only is it time for another Editorial, but it is time for a Valedictory Editorial as I will soon be relinquishing the reins of this great beast and passing the torch on to someone younger, more dynamic and (I hope for his sake!) more organised.

I see from the technicoloured array of newsletters lining the shelf by the door that the first one I had the privilege of editing was a suitable, youthful shade of green. Gradually through the years the heat and passion have built up as yellows made way to reds and finally – I see from the proof on my desktop – I will finish off my stint with a rather fetching shade of pink. This could be the pink of 'happiness', 'light-heartedness' or perhaps 'desire for the carefree days of childhood', depending on which website one chooses to believe. I do like the thought that being pink this current newsletter may 'stimulate energy … increase the blood pressure, respiration, heartbeat, and pulse rate … encourage action and confidence' and could be 'used in prison holding cells to effectively reduce erratic behaviour'. Instead of shelving, discarding or recycling this newsletter, perhaps you should consider donating it to the custody suite of your local police station?

Like many things concerning our beloved newsletter, the colour of front cover is something that is beyond the realm of the Editor's control or remit. The real power behind the throne, including the cover design, lies in the hands of Nick Stroud, who, three times a year, willingly accepts the random collection of (mostly) edited documents that I send his way and weaves them into the beautifully laid out item you have in your hands right now. Nick also has a beady eye for detail, and never fails to bring to the Editor's notice some obvious point that has been overlooked or forgotten in the maelstrom of emails that follows each copy deadline. You, me, we, owe him a great deal – so many thanks for all your efforts over the years, Nick!

While on the subject, I would like to thank the team of regular contributors to the newsletter for putting up with my nagging emails, questions, comments and nit-picking edits, as well as for the articles and other contributions they make. So, many thanks to Norm, Jan, Liam, Charlotte and Vanessa for all your efforts in supporting the newsletter over the past months and years!

The final vote of thanks goes to all of you who have contributed to the newsletter over the past few years. Whether you have sent in articles, reviews or reports for publication, pictures of mysterious fossils, notices of forthcoming meetings or emails pointing out my editorial oversights or shortcomings, without your contributions this newsletter would rapidly wither away. If you are one of those who still have to send in that overdue Sylvester-Bradley report, meeting report, or other article for inclusion in the newsletter (and you know who you are!) then please make it your New Year's Resolution to get it written up and sent in. The next copy deadline is in February so you have plenty of time…

Richard Twitchett
Retiring Newsletter Editor
<newsletter@palass.or g>

Association Business

Grants and Awards

Palaeontological Association research grants

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

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.

President's Medal

The Council has instigated a mid-career award for a palaeontologist in recognition of outstanding contributions in his/her earlier career, coupled with an expectation that they are not too old to contribute significantly to the subject in their further work.

Nominations are invited by **1st March**, supported by a single sheet of details on the candidate's career, and further supported by a brief statement from a seconder. 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**>.

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, for consideration by Council at the March and October Council Meetings each year. Enquiries may be made to <**secretary@palass.org**>. The deadlines are **1st March** and **1st October** each year.

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 using the online application form. Such requests will be considered by Council at the March and the October Council Meetings each year. Enquiries may be made to <**secretary@palass.org**>. The deadlines are **1st March** and **1st October**.

Travel grants to help student members attend the Association's Annual Meeting to present a talk or poster

The Palaeontological Association runs a programme of travel grants to assist student members (doctoral and earlier) presenting talks and posters at the Annual Meeting. For the Plymouth meeting, grants of up to £100 (or the Euro equivalent) will be available to student presenters who are travelling from outside the UK. The amount payable is dependent 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, by e-mail to <**secretary@palass.org**>, once the organisers have confirmed that their presentation is accepted, and before 8th December 2011. Entitle the e-mail 'Travel Grant Request'. No awards will be made to those who have not followed this procedure.

Annual Meeting 2011

Notification is given of the 55th Annual General Meeting and Annual Address.

This will be held at Plymouth University on 18th December 2011, following the scientific sessions. Please note that additional items may be added to the agenda following the December Council meeting.

AGENDA

1. Apologies for absence
2. Minutes of the 54th AGM, University of Ghent
3. Trustees Annual Report for 2010 (published in this Newsletter)
4. Accounts and Balance Sheet for 2010 (published in this Newsletter)
5. Election of Council and vote of thanks to retiring members
6. Palaeontological Association Awards
7. Annual address

H. A. Armstrong
Secretary

DRAFT AGM MINUTES 2010

Minutes of the Annual General Meeting held on Saturday, 18th December 2010 at the University of Ghent.

1 **Apologies for absence:** *Prof. J. C. W. Cope*

2 **Minutes:** *Agreed a correct record*

3 **Trustees Annual Report for 2009.** Proposed by Dr L. R. M. Cocks and seconded by Prof. G. D. Sevastopoulo, the report was agreed by unanimous vote of the meeting.

4 **Accounts and Balance Sheet for 2009** . Proposed by Prof. J. Francis and seconded by Prof. M. P. Smith, the accounts were agreed by unanimous vote of the meeting.

5 **Election of Council and vote of thanks to retiring members**

Prof. R. J. Aldridge extended a vote of thanks to the following members of Council who were retiring this year: Prof. J. C. W. Cope, Dr T. Servais, Dr M. A. Purnell, Dr M. Sutton, Dr P. Orr, Prof. Donovan, Mr W. Fone, Prof. D. A. T. Harper, Dr A. Rasmussen, Dr E. Rayfield and Dr G. Harrington. Dr L. Anderson was retiring as a scientific editor. The following members of Council were elected to serve on Council:

President:	Prof. J. Francis
Vice Presidents:	Dr P. Orr and Prof. J. W. Cope
Treasurer:	Mr P. Winrow
Secretary:	Dr H. A. Armstrong
Chair of Publications Board:	Prof. M. P. Smith
Editor Trustee:	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 (for a second term)
Ordinary Members:	Dr C. Klug Dr W. Renema Dr T. R. A. Vandenbroucke

Mr D. Ward was co-opted to assist with outreach and Dr M. A. Purnell was co-opted to complete outstanding projects. Dr Twitchett will organise the Annual Meeting in 2011 at the University of Plymouth.

6 **Association Awards:** The following awards were made:

- Lapworth Medal to Dr L. R. M. Cocks
- President's Medal to Dr N. Butterfield (University of Cambridge)
- Hodson Award to Dr T. R. Vandenbroucke (University of Ghent)
- Mary Anning award to Mr Daniel Vizcaino.

Honorary Life membership was awarded to Prof. Edwards, Prof. Bassett and Dr Skelton. Sylvester-Bradley Awards were made to Cotton, Halliday, Koot, O'Brien and Young. It was noted that a number of proposals this year were either incomplete or had not followed the guidelines and these could not be considered. The President's Award was made to Abigail Clifton (University of Leeds) and the Council Poster Prize was presented to Tom Harvey (University of Cambridge).

The Annual Address entitled "Ancient origin of the deep sea fauna: new evidence from the fossil record" was given by Prof. A. Gale (University of Portsmouth).

Trustees Annual Report 2010

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 21st December 2009: *President*: Prof. R. J. Aldridge; *Vice Presidents*: Dr T. Servais and Dr P. Orr; *Treasurer*: Prof. J. C. W. Cope; *Secretary*: Dr H. A. Armstrong; *Chair of Publications Board*: Prof. M. P. Smith; *Editor Trustee*: Dr P. Orr and Dr P. C. J. Donoghue; *Book Review Editor*: Dr C. Jeffrey-Abt; *Publicity*: Dr M. A. Purnell; *Newsletter Reporter*: Dr L. Herringshaw; *Newsletter Editor*: Dr R. J. Twitchett; *Web Officer*: Dr M. Sutton; *Ordinary Members*: Mr W. Fone, Prof. S. K. Donovan, Dr C. Underwood, Dr E. Rayfield, Dr C. Buttler and Dr D. Schmidt. Dr Harrington and Dr Vandenbroucke remained on Council as Annual Meeting organisers. *The Executive Officer*: Dr T. J. Palmer and *Editor-in-Chief*: Dr S. Stouge continued to serve Council but are not Trustees.

Membership. Membership on 31st December 2010 totalled 1,197 (1,184 at end 2009), and did not appear to have been significantly affected by the subscription increases that were introduced at the beginning of the year. Of these 745 were Ordinary Members, 162 Retired and Honorary Members and 290 Student Members. There were 78 Institutional Members and 89 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 (formerly Citi Quilter), St Helen's, The Undershaft, London EC3A 8BB.

Reserves. The Association holds reserves of £673,871, 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 £86,551 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 new Callomon and Whittington awards. Funds carried forward to 2011 totalled £760,422.

Finance. Total charitable expenditure in 2010, through grants to support research, scientific meetings and workshops, was £288,764. Governance costs were £13,107. Total resources expended were £325,745. The Association continues its membership of the International Palaeontological Association and remains a Tier 1 sponsor of *Palaeontologia Electronica,* and the *Treatise on Invertebrate Paleontology*. During the year the Association received bequests totalling £30,000.

Risk. The Association is in a sound financial position. Succession planning for executive officers remains a concern and will be considered as part of the Annual Review of Officers in 2011.

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 B. Lomax (University of Nottingham), "SporoMALDI-resolving terrestrial palaeoecosystem responses to perturbations in the global carbon cycle using isolated single sporomorphs"; Dr J. Wheeley (University of Birmingham), "Nitrogen and organic carbon isotopes of Ordovician conodonts"; Dr J. Antcliffe (University of Bristol) "Integrating the White Sea Ediacara into a global framework"; Dr J. Zalasiewicz (University of Leicester) "Exploring new stratotypes for Silurian (Llandovery) stages in Wales."

Grants–in-aid. The Association provided funds to support the following meetings: Siluria Revisited (IUGS); 8th International Symposium, Cephalopods present and past; 9th International Congress of Vertebrate Morphology (ICVM); 2nd International Sclerochronology Conference July 2010; PalaeoDbase course in Glasgow 2011. The Association provided a grant of £44,000 to the Third International Palaeontological Congress, held in London. This caused a substantial increase in the amount of money paid out in Grants, compared with 2009.

Sylvester Bradley Fund. A review of these awards was made in 2010. Application guidelines were changed and the amount per award increased. Fifteen proposals were received. Seven were recommended for funding. These included proposals from Brewer, Butler, Hopley, Lecuona, Nunn, Peralta-Medina and Sallan.

Online activities. The online activities of the Association continue to expand. During the year new server provision was made and a new system for advertising PhD studentships was developed. Funding was provided to develop palaeontological outreach through the website. The Association continues to host mirror sites for the PaleoDbase, *Palaeontologia Electronica*, the EDNA fossil insect database, the Palaeontographical Society website and a database of fossils from Kent produced by the Kent RIGS Group.

Public meetings. Three public meetings were held in 2010, and the Association extends its thanks to the organisers and host institutions of these meetings:

54th Annual General Meeting. This was held on 17–20 December at University of Ghent. Dr Vandenbroucke with much local support organised the meeting which included a symposium on "Biological proxies in climate modelling" and comprised a programme of internationally

recognised speakers. There were 221 attendees. The Annual Address entitled "Ancient origin of the deep sea fauna: new evidence from the fossil record" was given by Prof. A. S. Gale (University of Portsmouth). The President's Award for best oral presentation from a member under 35 was made to Abigail Clifton (University of Leeds). The Council Poster Prize was presented to Tom Harvey (University of Cambridge). Due to the severe weather the post-conference field trip was to the Royal Belgium Institute of Natural Science, Brussels.

British Science Festival, Palaeontological Association Symposium. This is an annual forum for presentations to the public and general scientists. The Symposium "Firsts for life: Different views on the origins of animals and plants" was organised by Dr Purnell (University of Leicester) 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 Aude Caromel, Roger Close, Alex Dunhill, Jenny Greenwood, Duncan Murdock and Rachel Warnock, and was held at the University of Bristol.

In addition to hosting public meetings the Association manages the Stuart Baldwin Lecture Series. This enables amateur societies to fund visiting speakers. Two awards were made in 2010.

Publications. Publication of *Palaeontology* and *Special Papers in Palaeontology* is managed by Wiley Blackwell. Volume 53 of *Palaeontology*, comprising six issues, was published. *Special Papers in Palaeontology 83*, "Silurian conodonts from the Yangtze Platform, south China," edited by Wang Cheng-Yuan and Richard J. Aldridge; and *Special Papers in Palaeontology 84*, "Evolution and Development of the Brachiopod Shell," edited by F. Alvarez and G.B. Curry, were also published during the year. Two field guides, on "Fossils from the Lower Lias of the Dorset Coast," edited by Alan R. Lord and Paul G. Davis, and "Fossils of the Gault Clay," edited by J. R. Young, A. S. Gale, R. I. Knight, and A. B. Smith, were 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 and distribution of *Palaeontology Newsletter*.

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

Awards. The Lapworth Medal, awarded to people who have made a significant contribution to the science by means of a substantial body of research, was presented to Dr L. R. M. Cocks (Natural History Museum). 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 N. Butterfield (University of Cambridge). 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 T. J. Vandenbroucke (University of Ghent). The Mary Anning Award, for an outstanding contribution by an amateur palaeontologist, was made to Mr Daniel Vizcaino. 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. Edwards, Prof. Bassett and Dr Skelton. The "Golden Trilobite Award" was made to <**www.bryozoa .net**>, a high-quality, information-rich amateur website which provides a wealth of carefully collated information.

Governance. The Association continues to improve its administration with further improvements to the *Newsletter* and website. Trustees were members of the Joint Committee for Palaeontology; Prof. Aldridge (Chair) and Dr Servais represented the Association. Dr Armstrong acted as the Association representative on the International Palaeontological Association. During the year the Association responded to requests for information from the HEFCE consultation on the Research Excellence Framework, 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. 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. A similar programme of public meetings and publications will be carried out in 2011. Funds will be made available to further develop the website aimed at encouraging outreach. It is intended that one new *Field Guide to Fossils* will be published within the year. The 55th Annual meeting will be held at the University of Plymouth. Progressive Palaeontology will be held at the University of Leicester. The Association will sponsor a symposium at the British Science Festival, "Paradise Lost? Strange environments and major events from the geological past," and provide travel grants for the Congress of the European Geosciences Union. The Association will host the Lyell Meeting in 2011 on the topic of "Island faunas, migration and evolution." During 2011 the Association will amalgamate the storage of back-stock and its archive to a new office in Aberystwyth.

Nominations for Council

Council nominations for the vacancies that will arise at the AGM are as follows:

President elect (*ex officio*): Prof. Mike Benton

Vice president: Dr Howard Armstrong

Chair of the Publications Board: Dr Paddy Orr

Secretary: Dr Richard Twitchett

Book Review Editor: Dr Charlotte Jeffrey Abt

Newsletter Editor: Dr Alistair McGowan

Meetings Coordinator: Dr Thijs Vandenbroucke

Ordinary Members: Dr Bob Owens, Prof. Paul Smith

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369
STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2010

		General Funds		Designated Funds	TOTAL 2010	TOTAL 2009
Incoming Resources						
Generated Funds						
Voluntary income	Subscriptions	66,913			66,913	68,202
	Legacies	30,000			30,000	0
	Donations	0		1,589	1,589	4,886
			96,913	1,589	98,502	73,088
Charitable activities						
Sales	Palaeontology	198,361				
	Special Papers	12,598				
	Offprints	1,581				
	Newsletters	0				
	Field Guides	12,671				
	Distribution	1,663				
			226,874		226,874	226,761
Investment income			12,069	94	12,163	15,230
TOTAL INCOMING RESOURCES			335,856	1,683	337,539	315,079
Resources expended						
Costs of generating funds						
for voluntary income	Administration	21,029				18,670
Investment management	Stockbroker fees	2,845				1,771
			23,874	0	23,874	20,441
Charitable activities						
Publications	Palaeontology	73,217				
	Special Papers	9,972				
	Offprints	1,230				
	Field Guides	20,831				
	Newsletters	13,795				
	Distribution	1,234				
	Marketing	2,974				
	Editorial costs	55,150				
	Total Publications	178,403			178,403	154,134
Scientific Meetings & Costs		70,931			70,931	18,939
Grants and Awards		7,525		7,260	14,785	14,877
Research Grants		5,619			5,619	6,637
Administration of charitable activities		26,286			26,286	23,337
			288,764		296,024	217,924
Governance costs	Examiner's fee	400				
	Trustee expenses	7,450				
	Administration	5,257				
			13,107	0	13,107	13,013
TOTAL RESOURCES EXPENDED			325,745	7,260	333,005	251,378
NET INCOMING RESOURCES			10,111	-5,577	4,534	63,701
INVESTMENT GAINS/LOSSES						
Realised gain		3,122				
Unrealised gain		43,127				
			46,249		46,249	44,838
NET MOVEMENT IN FUNDS			56,360	-5,577	50,783	108,539
TRANSFERS BETWEEN FUNDS			-50,000	50,000	0	0
SURPLUS/DEFICIT FOR THE YEAR			6,360	44,423	50,783	108,539
FUNDS BROUGHT FORWARD			667,511	42,128	709,639	601,100
FUNDS CARRIED FORWARD			673,871	86,551	760,422	709,639

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369

BALANCE SHEET as at 31st DECEMBER 2010

2009			Note			2010	
£						£	
		INVESTMENTS					
	454,924	At market value					534,720
		CURRENT ASSETS					
171,134		Cash at Banks		138,151			
147,424		Sundry Debtors	7	126,690			
318,558		Total Current Assets			264,841		
		CURRENT LIABILITIES					
24,244		Subscriptions in Advance		20,795			
39,599		Sundry Creditors	8	18,344			
63,843		Total Current Liabilities			39,139		
	254,715	NET CURRENT ASSETS					225,702
	709,639	TOTAL ASSETS					760,422
		Represented by:					
	667,511	GENERAL FUNDS					673,871
		DESIGNATED FUNDS	9				
4,656		Sylvester Bradley Fund			20,325		
23,064		Jones-Fenleigh Fund			22,805		
14,408		Hodson Fund			13,421		
0		Callomon Fund			10,000		
0		Whittington Fund			20,000		
	42,128						86,551
	709,639						760,422

Notes to the Financial Statements for the year ended 31st December 2010

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 2010 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 2010 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 Coumcil in furtherance of the general objectives of the charity and which have not been designated for other purposes.

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

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

During the year the Association received bequests from two former members totalling £30,000.

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. In view of the low rates of interest on cash balances, Council allocated an additional sum of £50,000 to the investment portfolio.

2. Analysis of Financial Resources Expended

	Staff costs	Other costs	Total 2010	Total 2009
Generating Funds	15,652	8,222	23,874	20,441
Charitable activities	19,565	271,759	291,324	217,924
Governance	3,913	9,194	13,107	13,013
	39,130	289,175	328,305	251,378

3. Staff Costs

	Salary	National Insurance	Pension Contributions	Total 2010	Total 2009
Publications: 1 employee (2009 – 1)	29,425	0	4,687	34,112	32,795
Administration: 1 employee (2009 – 1)	31,305	3,303	4,522	39,130	36,775
	60,730	3,303	9,209	73,242	69,570

4. Trustees Remuneration and Expenses

Members of Council neither received nor waived any emoluments during the year (2009 – nil).

The total travelling expenses reimbursed to 12 Members of Council was £7,450 (2009 – £7,746).

5. Costs of Independent Examiner

	2010	2009
Examination of the accounts	400	400
Accountancy and payroll services	1,400	1,350
	1,800	1,750

6. Transfers between Funds

Council has transferred £30,000 from General Funds representing the sums received under the bequests to Callomon Fund £10,000 and Whittington Fund £20,000 (see note 1.2). In view of the cumulative deficit in the Sylvester-Bradley Fund, Council has transferred £20,000 from General Reserves into this fund in order that these grants may continue to be supported.

7. Debtors

	2010	2009
Accrued income – receivable within one year	126,690	147,424

8. Creditors – falling due within one year

	2010	2009
Social Services costs	3,182	3,172
Accrued expenditure	10,462	36,427
	13,644	39,599

9. Designated Funds

See next page.

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No 276369

STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2010

DESIGNATED FUNDS

Note 9 to the Accounts:

	Sylvester-Bradley	Jones-Fenleigh	Hodson	Callomon	Whittington	TOTAL 2010	TOTAL 2009
Donations	400	1,189	0	0	0	1,589	3,886
Interest Received	10	51	32	0	0	94	285
TOTAL INCOMING RESOURCES:	410	1,241	32	0	0	1,683	4,171
Grants made	4,742	1,500	1,019	0	0	7,261	8,154
NET SURPLUS / (DEFICIT):	-4,331	-259	-987	0	0	-5,577	-3,983
Transfers in	20,000	0	0	10,000	20,000	50,000	0
SURPLUS / (DEFICIT) FOR THE YEAR:	15,669	-259	-987	10,000	20,000	44,423	-3,983
FUNDS BROUGHT FORWARD:	4,656	23,064	14,408	0	0	42,128	46,111
FUNDS CARRIED FORWARD:	20,325	22,805	13,421	10,000	20,000	86,551	42,128

	Sylvester-Bradley	Jones-Fenleigh	Hodson	Callomon	Whittington	TOTAL 2010	TOTAL 2009

Independent Examiner's Report on the Accounts of The Palaeontological Association for the year ended 31st December 2010

Respective responsibilities of trustees and examiner

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

It is my responsibility to:

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

Basis of independent examiner's statement

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

Independent examiner's statement

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

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

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

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

Dated: 1st May 2011

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

Nominal	Holding	Cost (bought pre 2010)	Value end 2009
35,300	M & G Securities Ltd Corporate Bond I GBP Inc	£10,061.14	£11,600.00
£18,000	UK 4.75% Stock 07/03/20 GBP 100	£18,145.87	£19,218.74
£7,000	UK 4.75% Stock 07/03/20 GBP 100	£7,056.73	£7,473.26
£20,000	UK 4.5% Gilt 07/03/19 GBP 0.01	£20,092.99	£21,028.00
£64,176.46	COIF Charities Fixed Interest Fund	£85,000.00	£81,048.45
804	Royal Dutch Shell B shares	£12,432.00	£14,564.00
1,425	BP Ord 25c shares		
600	BHP Billiton $0.5 shares	£4,341.48	£11,970.00
500	BG Group Ordinary 10p shares	£3,977.95	£5,610.00
1,825	HSBC Holdings Ordinary 0.5 US Dollar shares	£5,512.91	£12,936.00
6,800	Lloyds TSB Ordinary 25p shares	£10,169.91	£3,447.00
950	Barclays Ord 25p shares	£3,528.34	£2,622.00
875	BAE Systems Ord 2.5 P shares	£3,542.00	£3,146.00
1,000	3I Group Ordinary £0.738636 shares	£3,058.76	£2,830.00
1,150	Tesco Ord GBP 0.05		
1,550	Kingfisher Ord GBP 0.157142857		
175	Carnival Plc Ord USD 1.66		
650	Glaxo Smithkline Ordinary 25p shares	£10,232.42	£8,577.00
2,499	Bluecrest Allblue Ord Npv GBP shares	£3,020.28	£3,981.00
1,100	Wood Group (John) Ordinary 3.33p shares	£2,975.36	£3,397.00
7,000	Ing Global Real Estate Securities Ord NVP shares	£7,084.00	£4,883.00
4,175	Vodaphone Group Ord USD 0.11428571		
2,150	BT Group Ordinary 5p shares	£7,787.53	£2,903.00
225	Brit Amer Tobacco Ord GBP 0.25		
300	Unilever PLC Ord GBP 0.031111	£4,326.21	£5,982.00
150	Novo-Nordisk As DKK 1 Ser B	£6,200.64	£5,944.00
460	Pearson Ordinary 25p shares	£8,069.00	£4,099.00
490	Serco Group Ord 2P		
1,350	Prudential Ordinary 5P shares	£7,063.25	£8,640.00
700	National Grid Ord GBP 0.113953		
1,150	Misis Ord 1P		
420	Experian Ord 10C		
670	Blackrock World Mi Ord 5P		
315	Standard Chartered Ord USD 0.50		
650	RIT Capital Partners Ordinary £1 shares	£4,903.90	£6,793.00
1,000	Balfour Beatty 50P		
20	Schroder Alt Solut Agriculture C GBP Dis Hdg	£2,987.22	£2,166.00
1,500	British Empire Sec & Gen Trust Ordinary 10p shares	£5,005.61	£6,249.00
425	Findlay Park Partners US Smaller Companies	£6,158.47	£10,348.00
2,825	Ishares S&P 500 GBP		
900	JPMorgan Am UK Ltd Emerging Markets I Instl		
1,750	Cazenove Inv Fd Mt European Fund X Acc Nav	£6,107.82	£7,825.00
425	Fidelity EUR Value Ordinary 25P shares	£4,059.07	£4,892.00
3,900	Edinburgh Dragon Trust Ordinary £0.20 shares	£4,478.10	£7,547.00
3,100	Capita Morant Wright Japan B Inc Nav	£5,170.11	£5,477.00
5,200	Swip Fd Mgmt Property Trust Inc		
100	Bluebay Funds SA LI.FD-D GBP Base		
26	Veritas Asset Mgmt Veritas Asian A GBP		
13,750	Investec Fund Mgrs American I Acc		
1,320	Goldman Sachs Fund US Equity I GBP Inc Nav		
65	Roche Hldgs Ag Genusscheine Nvp		
6,600	Henderson Gbl Invs European Special Sits I Inc		
55	Fauchier Ptnrs Paragon Cap App Instl Stlg	£9,894.52	£9,906.00
1,283.80	COIF Charities Investment Fund Acc Units	£75,000.00	£91,316.44
5,270	M & G Charifund Units	£4,073.00	£56,505.00
	Total	£371,516.59	£454,923.89

Investment Portfolio 2010

Proceeds (sold in 2010)	Cost (bought in 2010)	Gain realised during 2010	Value end 2010	Gain unrealised during 2010
£11,624.30		£24.30		
			£20,072.00	£853.26
£7,988.60		£515.34		
			£22,030.00	£1,002.00
			£81,523.36	£474.91
			£17,005.00	£2,441.00
	£5,047.35		£6,634.00	£1,586.65
			£15,306.00	£3,336.00
			£6,480.00	£870.00
			£11,883.00	-£1,053.00
			£4,468.00	£1,021.00
£2,750.44		£128.44		
			£2,888.00	-£258.00
			£3,285.00	£455.00
	£4,583.22		£4,888.00	£304.78
	£3,554.45		£4,083.00	£528.55
	£3,996.49		£5,219.00	£1,222.51
			£8,060.00	-£517.00
			£4,248.00	£267.00
			£6,149.00	£2,752.00
			£6,003.00	£1,120.00
	£6,034.20		£6,922.00	£887.80
			£3,887.00	£984.00
	£4,991.81		£5,543.00	£551.19
			£5,889.00	-£93.00
£8,457.19		£2,513.19		
			£4,637.00	£538.00
	£3,005.01		£2,722.00	-£283.01
£7,471.32		-£1,168.68		
	£3,648.26		£3,871.00	£222.74
£3,417.67	£2,987.60	£430.07		
	£3,444.95		£3,352.00	-£92.95
	£4,019.09		£5,434.00	£1,414.91
	£5,514.48		£5,435.00	-£79.48
			£7,794.00	£1,001.00
	£2,913.17		£3,129.00	£215.83
			£2,790.00	£624.00
			£7,290.00	£1,041.00
			£13,130.00	£2,782.00
	£20,319.63		£22,819.00	£2,499.37
	£5,043.10		£5,620.00	£576.90
			£7,948.00	£123.00
			£4,730.00	-£162.00
			£9,965.00	£2,418.00
			£6,423.00	£946.00
	£4,669.49		£4,678.00	£8.51
	£11,581.33		£11,252.00	-£329.33
	£8,182.27		£8,462.00	£279.73
£14,537.31	£15,128.39	-£591.08		
	£14,640.81		£14,559.00	-£81.81
	£7,226.55		£6,104.00	-£1,122.55
	£7,037.91		£8,336.00	£1,298.09
			£9,927.00	£21.00
			£101,847.58	£10,531.14
£57,929.06		£1,424.06		
£114,175.89	£147,569.56	£3,275.64	£534,719.94	£43,126.74

news

New 'Field Guide to Fossils': English Wealden Fossils

The Lower Cretaceous Wealden rocks of south-east England, the Isle of Wight and Dorset contain a great range fossils belonging to many different groups of organisms. A few are quite common, but many are rare and require considerable searching. Nevertheless interesting and important finds continue to be made regularly. This new guide provides well-illustrated descriptions and discussions of all the fossil groups that may be encountered in the succession. It is the most comprehensive account of the Wealden fauna and flora so far published.

This is Number 14 in the acclaimed Palaeontological Association 'Field Guides to Fossils' series. This, and all other *Field Guides* still in print, can be ordered through the online shop at <**www.palass.org**>. Postage will be added. Enquiries should be e-mailed to <**palass@palass.org**>.

Contents of 'English Wealden Fossils':

The Lower Cretaceous Wealden rocks of south-east England, the Isle of Wight and Dorset contain a great range fossils belonging to many different groups of organisms. A few are quite common, but many are rare and require considerable searching. Nevertheless interesting and important finds continue to be made on a regular basis. This volume provides well-illustrated descriptions and discussions of all of the fossil groups that may be encountered in the succession. It is the most comprehensive account of the Wealden fauna and flora to have been published so far.

This is Number 14 in the acclaimed Palaeontological Association 'Field Guides to Fossils' series. All of the titles listed below that are still in print can be ordered through the online shop at www.palass.org. Postage will be added. Enquiries to palass@palass.org.

1. (1983) Fossil plants of the London Clay, *by* M. E. COLLINSON: 121 *pp*., 242 *text-figs*. List price £7.95.
2. (2002) Fossils of the Chalk. Second edition, revised and enlarged, *edited by* A. B. SMITH *and* D. J. BATTEN: ix + 374 *pp*., 33 *text-figs*, 66 *pls*. List price £14.
3. (1988) Zechstein reef fossils and their palaeoecology, *by* N. T. J. HOLLINGWORTH *and* T. H. PETTIGREW: iv + 75 *pp*., 17 *text-figs*. OUT OF PRINT.
4. (1991) Fossils of the Oxford Clay, *edited by* D. M. MARTILL *and* J. D. HUDSON: 286 *pp*., 40 *text-figs*, 44 *pls*. OUT OF PRINT.
5. (1993) Fossils of the Santana and Crato formations, Brazil, *by* D. M. MARTILL: 159 *pp*., 53 *text-figs*, 24 *pls*. List price £10.
6. (1994) Plant fossils of the British Coal Measures, *by* C. J. CLEAL *and* B. A. THOMAS: 222 *pp*., 94 *text-figs*, 29 *pls*. List price £12.
7. (1996) Fossils of the Upper Ordovician, *edited by* D. A. T. HARPER *and* A. W. OWEN: 312 *pp*., 34 *text-figs*, 52 *pls*. List price £16.
8. (1999) The Jurassic flora of Yorkshire, *by* J. H. A. VAN KONINJENBURG-VAN CITTERT *and* H. S. MORGANS: 134 *pp*., 43 *text-figs*, 20 *pls*. List price £12.
9. (1999) Fossils of the Rhaetian Penarth Group, *edited by* A. SWIFT *and* D. M. MARTILL: 312 *pp*., 32 *text-figs*, 32 *pls*. List price £16.
10. (2001) Dinosaurs of the Isle of Wight, *edited by* D. M. MARTILL *and* D. NAISH: 433 *pp*., 159 *text-figs*, 62 *pls* incl. 16 *in colour*. List price £16.
11. (2007) Silurian fossils of the Pentland Hills, Scotland, *edited by* E. N. K. CLARKSON, D. A. T. HARPER, C. M. TAYLOR *and* L. I. ANDERSON: 218 *pp*., 28 *text-figs*, 37 *pls* incl. 2 *in colour*. List price £15.00.
12. (2010) Fossils of the Gault Clay, *edited by* J. R. YOUNG., A. S. GALE, R. I. KNIGHT *and* A. B. SMITH: 342 *pp*., 14 *text-figs*, 57 *pls*. List price £18.00.
13. (2010) Fossils from the Lower Lias of the Dorset coast, *edited by* A. R. LORD *and* P. G. DAVIS: 436 *pp*., 39 *text-figs*, 78 *pls*. List price £18.00.

ISBN 978-1-4443-6711-9

Field Guide to Fossils No. 14
£24.00

English Wealden fossils

Edited by David J. Batten

The Palaeontological Association

ASSOCIATION MEETINGS

55th Annual Meeting of the Palaeontological Association
Plymouth University, UK *17 – 20 December 2011*

The 55th Annual Meeting of the Palaeontological Association will be held at Plymouth University, organised by Richard Twitchett and colleagues in the School of Geography, Earth and Environmental Sciences. As in previous years, this meeting will cover new and exciting developments in the fields of palaeontology and palaeobiology. Please check the Association's website <**www.palass.org**> for all details and updates.

The detailed programme and abstracts for the 55th Annual Meeting of the Palaeontological Association are included in the supplement on the coloured pages of this Newsletter.

Venue and travel

The conference will take place on the campus of Plymouth University (<**www.plymouth.ac.uk**>). Talks will be held in the Sherwell Centre, and posters will be on display in the nearby Main Hall.

Transport into Plymouth can be achieved via a variety of means. Travel by train from London Paddington to Plymouth takes between three and four hours depending on the time of day and the number of stops. The lowest fares are available by booking in advance, *e.g.* through the First Great Western website (<**www.firstgreatwestern.co.uk**>). Flights to and from Plymouth airport have, unfortunately, recently been suspended, but many national and international airlines fly into Exeter airport or Newquay airport. Of the two, Exeter has the best public transport links to Plymouth and is one hour away from Plymouth by train. Ferries link Plymouth to France (Roscoff), Spain (Santander), and Cornwall. National Express coaches link Plymouth with all major UK cities and London airports. Plymouth University is situated a few minutes' walk from the train station, coach/bus station, and a number of hotels, guesthouses and other accommodation. Delegates arriving by car are advised that the nearest public car parks are in Regent Street and in Drake Circus shopping centre. There will be limited free parking spaces on campus on Saturday and Sunday only. Blue badge holders will receive priority and should contact Sally Bishop-Hawes by e-mail to <**sally.bishop-hawes@plymouth.ac.uk**> to secure a place.

Plymouth is an historic and vibrant city that overlooks one of the world's great natural harbours. Best known for its rich maritime heritage, Plymouth is also home to the oldest gin distillery in the UK, which has been in operation since 1793 and is housed in a 15th century former monastery in the historic Barbican district. The Barbican is a short ten-minute walk downhill from the University campus and is famous for its Elizabethan buildings and for being the final departure point from which the Pilgrim Fathers set sail on the Mayflower to the New World in 1620. Its cobbled streets also house a number of restaurants and pubs, which are situated a stone's throw from the National Marine Aquarium. On the hill above the Barbican sits Plymouth Hoe, with its iconic lighthouse (Smeaton's Tower), the imposing Royal Citadel fort, and the Sir Francis Drake bowling lawn, amongst other attractions.

Meeting Format

The meeting will begin with a symposium on Saturday 17th December entitled 'Ancient and Modern Biotic Crises', to be followed by a drinks reception. Sunday 18th December will include a full day of talks and posters, the Association AGM and the Association Annual Address, which this year will be given by Prof. Paul Pearson of Cardiff University. In the evening there will be a drinks reception followed by the Annual Dinner. Monday 19th December will comprise another day of talks and a dedicated poster session. The meeting will conclude on Tuesday 20th December with a field excursion to the English Riviera Global Geopark, to take in local exposures of the marine Devonian and a visit to Kents Cavern.

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

Outline Programme

Saturday 17th December 2010:	• Symposium on 'Ancient and Modern Biotic Crises' • Reception in the Council Houses, Armada Way
Sunday 18th December 2010:	• Scientific sessions: talks and posters • AGM • Annual Address by Prof. Paul Pearson (Cardiff) on 'Climate and evolution in the Cenozoic oceans' • Reception and Annual Dinner
Monday 19th December 2010:	• Scientific sessions: talks and dedicated poster session • Presentations of awards.
Tuesday 20th December 2010	• Field excursion to the English Riviera Global Geopark.

Symposium

Entitled 'Ancient and modern biotic crises' this symposium aims to address a number of key themes surrounding recent advances in our understanding of ancient and modern crises. These will include comparative palaeoecological and palaeoenvironmental studies of ancient and modern events, to explore similarities in the responses of the biosphere to selected major crises in the past; studies that show how the ecology and evolutionary history of key groups of organisms were shaped by environmental changes of the past; and discussion of whether understanding ancient events may be useful in predicting biosphere response to present environmental changes, and whether techniques and approaches used in studying modern crises may be employed to better understand past crises.

Confirmed speakers are: David Bottjer (University of Southern California, USA)
Matt Friedman (Oxford, UK)
Mark Leckie (University of Massachusetts, USA)
Bas van de Schootbrugge (Frankfurt, Germany)
Martin Solan (Aberdeen, UK)
Peter Ward (University of Washington, USA)

Fieldtrip

The field excursion will leave from campus at 09.00 on the morning of Tuesday 20th December. The itinerary will include examination of some of the famous, fossiliferous marine Devonian localities of the Torquay area (the English Riviera Global Geopark; <**http://www.englishrivierageopark.org.uk /**>) in the morning, followed by lunch and an afternoon tour of Kents Cavern. At the end of the day, delegates will have the choice of returning to Plymouth or of being dropped off at Newton Abbott train station, which is on the main line to Exeter and all stations north and east.

Accommodation

Plymouth has a large number of hotels, guesthouses and hostels at a variety of prices, most of which are within ~1km of the University campus (hotels with PL1 or PL4 postcodes are closest). More information on these can be found through the usual channels, and a useful starting point is: <**http://www.visitplymouth.co.uk/site/where-to-sta y**>.

In addition, we have organised discount rates at the Jury's Inn, Exeter Street, which is located ~500m from the conference venue. A maximum of 100 rooms have been reserved, and will be allocated on a first-come-first-served basis. Rates per night are:

Room only rate	£52.00
Single occupancy with breakfast	£59.00
Double occupancy with breakfast	£66.00

To take advantage of these rates, reservations can be made by telephone or e-mail. Telephone the hotel on +44 (0)1752 631000 and select option '2' for group bookings, or e-mail Mr Richard Cambridge at <**richard_cambridge@jurysinns.co m**> with your requirements. In both cases, quote the code PALA161211. Please note, unfortunately it is not possible to use the group booking code through the Plymouth Jury's Inn website.

Registration and booking

The final registration deadline is Friday 18th November 2011. No refunds will be available after the final deadline. Registration and payment (by credit card) will be from online forms available on the Palaeontological Association website (<**http://www.palass.org /**>). Accommodation must be booked separately (see above).

The cost for registration is £110 for ordinary and retired members; £80 for students; and £135 for non-members. Registration costs are the same as last year, with a small reduction for students, and include sandwich lunches on Sunday and Monday, the reception on Saturday, full registration package and tea/coffee breaks. The field excursion costs £25 (this includes lunch). The cost of the Annual Dinner is £45.

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 Plymouth meeting, grants of less than £100 (or the € equivalent) will be available to student presenters who are travelling from outside the UK. The actual amount that will be payable is

dependent on the number of applicants and the distance travelled. Payment of these awards is given as a disbursement at the meeting, not as an advance payment. Students interested in applying for a PalAss travel grant should contact the Executive Officer, Dr Tim Palmer (e-mail <**palass@palass.org**>) once the organisers have confirmed that their presentation is accepted, and before 1st December 2011. Entitle the e-mail "Travel Grant Request". No awards can be made to those who have not followed this procedure.

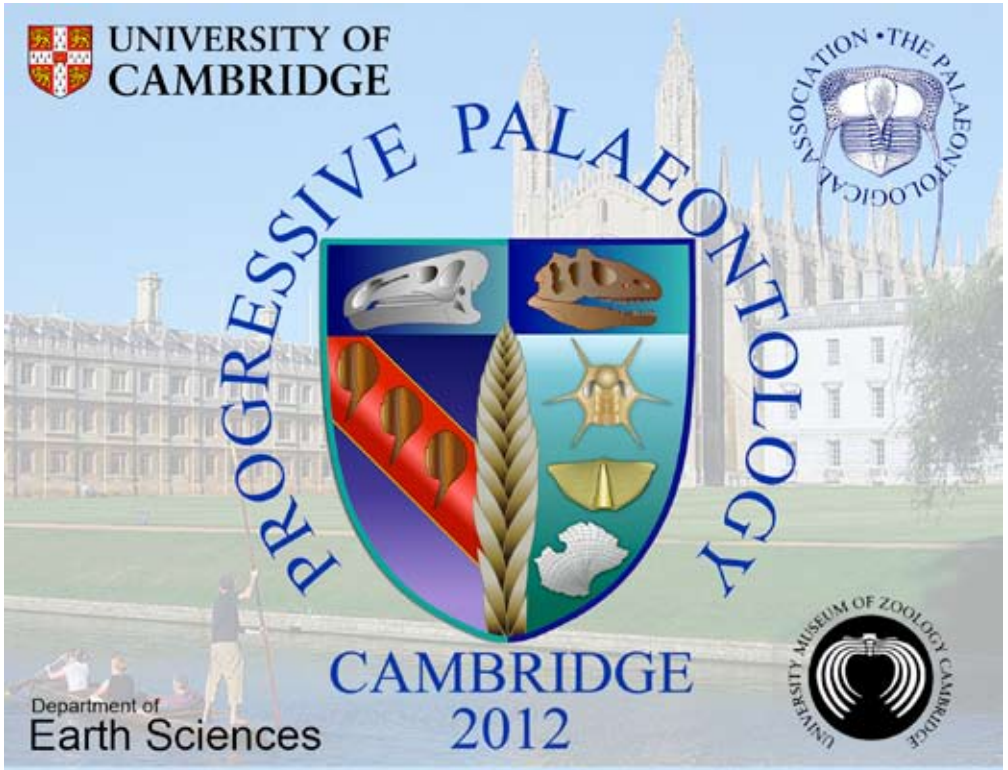
Acknowledgements

We express our appreciation to the following for providing financial assistance towards this meeting: Wiley-Blackwell, Taylor & Francis, The Geological Society of London, and the Paleontological Institute, University of Kansas.

Contact

To contact local organisers Richard Twitchett, Christopher Smart or Malcolm Hart please send an e-mail to <**annualmeeting@palass.org**>.

We look forward to welcoming you to Plymouth!



23rd - 25th May 2012

Progressive Palaeontology is an annual conference aimed specifically at postgraduate students. Here, freshers and senior grads can present the results of their palaeontological research to fellow peers in an informal and engaging atmosphere.

The programme will include an icebreaker reception at the **Sedgwick Museum**, a day of presentations (oral and poster) hosted by the **Department of Earth Sciences**, followed by the annual dinner, and finally a visit to a local fossiliferous outcrop.

More information, detailed programme and updates at **www.palass.org**

Email us at **progpal@palass.org**, or friend us in facebook **(Prog Pal Cam 2012)**

Organisers: *Caroline Sogot, Chloe Marquart, Emily Mitchell, Kelly Richards, Rick Thompson, Nick Crumpton and Javier Ortega Hernández*

From our Correspondents

The turnip that ate the pterodactyl

The smallest of them is a masterpiece, said Leonardo da Vinci. Albert Schweitzer thought that only music was their equal as a refuge from the miseries of life. None of them – affirmed Colette – are ordinary. To Jean Cocteau, they slowly became the visible soul of a home. Hemingway praised their emotional honesty, while W.H. Auden probably rued it in the case of Ruddimace, who used to pee in his shoe.

We speak here, of course, of cats. These creatures reign supreme as dividers of opinion. They have always been loved by some: by Raymond Chandler, for instance whose black cat, Taki ('his secretary'), used to sit on his manuscripts while he tried to write them. And hated by others. Napoleon was a true ailurophobe (yes, that was a new word for me too), both hating and fearing cats – perhaps because *they would not do what he ordered*[1]. The ancient Egyptians worshipped them. They fossilized them, too.

I had not realized the scale of this feline petrifaction, until peering into the world of William Buckland, that extraordinary man who beat Gideon Mantell, by a whisker, to the recognition of the dinosaurs[2]. Mummified cats, now, one was aware of, from those exotic if melancholy remains in museums, along with ibises, hawks, crocodiles and such; the more ambitious mummy-makers, I understand, occasionally tried their hand on a passing hippopotamus. With frankincense (a medium not unlike amber) and natron (sodium carbonate) to help the pickling, with those bandages for dramatic effect, and with a fine dry climate too, there were all the conditions to ensure survival of the mortal remains in both this world and, presumably, in the land of the dead too. This was not a case, though, of a few symbolic creatures set to grace the temple of the high priest or the grave of the king. There was a mass-market in eternity-bound cats.

Herodotus spoke of it. Dead cats, he said, were taken to Bubastis and placed in a cemetery there. Their remains, when found by the ever-resourceful Egyptologists of the modern age, amounted to some twenty cubic metres. I'm not sure of the specific gravity of a mummified cat, but this is probably of the same order as the 19 tons of animal mummies (mainly cats) that were unearthed in the temple of Bast, near Beni Hassan, over a century ago. Bast (or Bastet) was a goddess, associated with protection and fertility, while previously cats symbolized the more strictly inclined Mafdet, who held the justice and execution portfolio in the Egyptian firmament. Anybody who has kept a cat will know that both affiliations are entirely appropriate.

Visitors to the temple would take a mummified cat with them as a votive offering. In some cases this may have been the dearly departed house mog, finally succumbed to gout and a hardening of the arteries after many years of the good life. The really lucky cats here came complete with

[1] The conjecture of Eric Gurney, whose penetrating study *How to Live with a Calculating Cat* remains the definitive work on the subject.

[2] Delair & Sarjeant (1975) demonstrated that *Megalosaurus* was brought into the human sphere by Buckland a little before Mantell showed his contemporaries that such a thing as *Iguanodon* had once walked a landscape that was, much later, to become the English Weald.

jars of milk and a brace of mummified mice to chase in the after-life[3]. That the other side of human nature also comes through is depressingly predictable. Some cats also seem to have been purpose-bred and mummified by enterprising street vendors. You can bet your life that there were not many affectionate scritches under the ear in the lives of *those* kittens. Over time, the subfossil cats piled up at the temples (it was not the tradition to throw them away). A little later, they came in useful.

Early nineteenth century England was booming. Peace had broken out with the defeat of Napoleon, brought down by a combination of the Russian Winter, Wellington *et alii* and – one likes to fancy – by some intrepid guerrilla cat, waiting to pounce by the field headquarters. Population grew rapidly, and flocked to the growing towns and cities as the Industrial Revolution clanked and thundered along. The swelling ranks of people needed feeding, and farmers had long known that natural soil is all very well, but artificially improved soil delivers the goods.

Somewhere along the line, bone was found to be useful as a material that could lift a worn-out soil, apocryphally because graveyards were seen to grow larger flowers, while battlefields produced better vineyards. The knackers' yards provided a steady supply but, as human numbers grew, more bone was always needed. Here, the battlefields came into their own once more. Early representatives of the fertilizer industry scoured the killing fields of Leipzig, the Crimea, and of Waterloo too, to send back the bones of grenadiers and dragoons, hussars and cuirasseurs, to be ground into powder and used to feed the new generation. In the military language of today, it's what one might call a collateral benefit of war.

The great German chemist Justus von Liebig looked on, horrified. 'In her eagerness for bones … England is robbing all other countries of her fertility' he complained. 'Like a vampire she hangs from the neck of Europe'. The traffic grew to something over three million human skeletons a year, and extended into the catacombs of Sicily – and the more ancient feline graveyards of Egypt.

The discoverer of the cat cemetery at Bast, a local farmer, certainly took a practical view of matters. Most of the mummies (an estimated 180,000) were shipped en masse to Britain, and wound up in Liverpool docks, from there to be ground up and spread on English fields. The event didn't go unnoticed in those sensation-hungry times. A *Punch* cartoon of the day showed the bandage-bound cats returning to life, their baleful eyes glowing spectrally upon the terrified farmers.

The kittens' revenge, according to Punch.

[3] One has this on the authority of *The Cult of the Cat* by Patricia Dale-Green.

…and one of the ancient cats, rescued (after a fashion) and given to Wisbech Museum in 1872 (photo and information courtesy of David Wright).

In the middle of the century, the bone business received stiff competition from another, very distinct stratum: the guano fields of Peru, that comprised yet another discovery – for Europeans at least – made by Alexander von Humboldt on his great South American journey. A mixture of excrement and dead birds, this potent stuff was by far Peru's main export for the best part of half a century, largely to English fields. As well as the phosphorus, it was stuffed with nitrogen, and so was a more complete fertilizer. That, though, sowed the seeds of its own decline. And the dinosaurs were in the background, waiting to take over.

A great deal of Peruvian guano (and the recycled bones of bombadiers, and of the mummy-cats too) went into the production of the nineteenth century wonder-vegetable: the turnip. These days it's something of a joke vegetable, relegated to a minor tray in the supermarket shelves between the broccoli and the asparagus. Then, it then helped drive the Industrial Revolution by making farming more productive, so releasing labourers from the fields to work into the factories. Food for both man and overwintering beast, it could be planted in fields that were formerly fallow (for one could weed between the lines of growing turnips), and so the land could be used more intensively.

Turnips, though, generally needed a boost from phosphorus rather than from nitrogen. And, the Peruvian government, their economy dependent upon the guano trade, began to raise the price of the raw material[4]. This was a bad move, not least for them. Exports to Britain dropped sharply. A good deal of the demand for fertilizer – a demand that stayed no less insatiable – was

[4] All this is gone into in some detail by Mathew (1970), whose work, I was pleased to see, was made possible by 'the generous financial assistance … of the Research Board of Leicester University'. What enlightened times those were.

no longer met by what came out of the hindmost end of birds. It was supplied by the yet more impressive outpourings from their very distant ancestors. The coprolite trade was beginning.

That primordial geology professor of Oxford, William Buckland, coined the term. A character both energetic and unsqueamish, he seems to have first considered the concept in his exploration of the Kirkdale cave, where he famously deduced the animal remains represented an ancient living cave community, rather than corpses swept in by a Deluge. His vision of the living inhabitants of the cave – bears, bats hyaenas and such – extended to their toilet habits, and he showed that the irregular clasts he found were hyaena faeces simply by feeding bones and meat to hyaenas of his aquaintance, and then examining what emerged at the other end of the animal.

In 1829, he came across an ichthyosaur in Lyme Regis with gut contents preserved, and linked this with the irregular masses that could be found in those Lias strata to coin the term 'coprolite' for fossilized dung. He had, incidentally, a remarkably good intuition for that profound and unmeasurable mystery of those days: geological time. He thought that the ichthyosaur had lived, eaten and digested its prey more than 'ten thousand times ten thousand years ago'[5] – respectably close to a bullseye for the early Jurassic, as things have turned out. Not bad for a man of the cloth who was to become Dean of Westminster.

Similar kinds of things – dark lumpy objects – were found to be common in certain strata. John Henslow, Charles Darwin's celebrated and beloved mentor in his Cambridge days[6], found such things in the Red Crag of Suffolk and considered that fossil manure, like animal manure, could be a fertilizer. Analysing them, he found them to be rich in phosphate, and he is usually given the credit for encouraging local entrepreneurs to begin to use them to help increase food production.

The technology that made their use effective had been pioneered by the same Justus Liebig who so vividly commented on Britain's ghoul-like ways with foreign battlefields. In his youth he had lived through the last terrible European mass starvation – the year without a Summer, after Tambora had erupted in 1815 to fill the stratosphere with ash, sending temperatures plummeting and wiping out harvests throughout the northern hemisphere. Much of Liebig's life in science was directed towards keeping the people's food-baskets full. He discovered the significance of nitrogen and phosphorus to crop growth, and discovered that if mineral phosphate was treated with sulphuric acid, the nutrient is made readily accessible[7]. This was the key to producing superphosphate fertilizers, and Buckland's phosphates started to become big business.

Buckland himself realised the significance of the coprolites went well beyond scatological palaeontology. He helped organise, and accompanied, a lecture tour, aimed at agriculturalists, for Liebig across Britain in 1842. Their esteem was mutual, Liebig calling Buckland's discovery of the coprolites as representing 'the principal conditions of improving agriculture' in Britain. Buckland's enthusiasm for agriculture was as energetically expressed as that for geology. In 1844,

[5] This is in Buckland's biography, that his daughter, Elizabeth Gordon, later wrote. It is sympathetic to the man and good on the science, though draws a tactful veil over the hyper-omniverous eating habits of the good Dean

[6] Darwin said, on Henslow's death, that he fully believed that a better man never walked this earth.

[7] Liebig is also credited with the invention of Marmite after realizing that yeast could be made in concentrated form. A great man.

he exhibited, in the Ashmolean Museum, an enormous turnip, a yard in circumference, grown as a result of his experiments in land improvement[8].

The coprolite boom of the mid and late nineteenth century certainly helped fill the gap, as guano prices rose and battlefield bones grew thin on the ground. The scale and extent of this industry has been illuminated by the indefatigable Bernard O'Connor, whose 2001 summary, augmented by geological notes from the equally tireless Trevor Ford (currently some 58 years on from starting as one of the first lecturers at the University of Leicester's Geology Department, and still formidably productive in research) is both fascinating and revelatory.

The original raw materials came from the Pliocene Crag deposits of Suffolk, and here Henslow was both influential and selfless, advertising the phenomenon to local farmers but not, it seems, profiting from it personally. Others took a more entrepreneurial stance. The first off the blocks was a Hertfordshire landowner, John Bennett Lawes. He repeated Liebig's experiments with acid, patented the process as his own in 1842, and was soon producing 200 tons of superphosphate at a competitive £7 a ton. Even better, he got the lawyers into action to claim five shillings[9] a ton from anyone else who tried to produce and sell the same stuff. Others soon got into the act – including a certain Joseph Fison, whose family business prospers still.

Other coprolite deposits were soon found, too – foremost among them those that formed in the more distant times of the Early Cretaceous and that now lie beneath the Chalk escarpment of eastern England. There are quite a few of these, each not more, generally, than a metre or two thick: one marks the base of the Lower Greensand, and another that of the Gault, there is that thin but productive layer of the Cambridge Greensand, and yet others too. Blame it all on the greenhouse climate of those days, making the sea rise and then sweep around the pattern of islands that was then England. When that elevated sea level fell a little, or the land rose by a smidgeon, waves and currents winnowed the sea floor, concentrating the heavy phosphate-rich particles into layers.

The coprolite layers had to be found first, mind, and anyone who has tried to work out the geology of the flat and vegetated land of east-central England will know quite how difficult *that* task may be. It's geological mapping, pure and simple – the kind of thing that William Smith invented, but carried out, on a do-it-yourself basis, by local landowners, to fine levels of detail and sophistication, on ground that is outwardly unpromising and featureless. Once on the outcrop, the deposit had to be proved by trial pits or augering, for its thickness and persistence varies from place to place – and then the work started.

Gangs of labourers were hired to dig out the coprolites, and a multitude of small pits and quarries spread across Suffolk, Hertfordshire, Cambridgeshire, Norfolk. It was hard, dirty and dangerous work. The men (of all ages, including boys as young as eight) dug out the material with spades and crowbars, shovelling it on to wheel barrows or tracks that were then pushed across slippery, precariously placed planks, to the washmills where the soil and clay was cleaned off the precious phosphate material. Injuries and deaths resulted from frequent cave-ins of the pit faces, or accidents involving the coprolite trucks or the improvised steam-driven machinery that drove the washing process.

[8] It's all in Elizabeth Gordon's biography of Buckland, her father.
[9] That's 25p to those of you of tender years.

It was *very* profitable, though – a landowner might have a few hundred tons of coprolites below each acre where one of the phosphate-bearing formations outcropped, each ton fetching some £2.50 in the mid to late nineteenth century. That wasn't bad at all, considering that the average rent per acre then didn't usually get much above £2. The labourers were paid well for their pains, too, earning significantly higher wages than normal farm workers. With money to burn, they took those of life's pleasures that could easily be had, and the brewers opened up scores of new beerhouses to satisfy the migrant trade. There was competition for their leisure time, too, from such as the Cambridge University and District Coprolite Visiting Society, which organised lectures and magic lantern shows (sensibly holding these, though, by and large, in the pubs).

The boom years came in the mid-part of the century, with production of some 250,000 tons per year in the 1870s. After that, larger, cheaper sources of mineral phosphate began to find their way in from abroad once more, and production declined, falling off to a few tens of thousands of tons by the mid 1880s. There was a brief attempt at a revival in the First World War, a complex mechanical plant being set up at Trumpington, near Cambridge, constructed by some 3,000 prisoners-of-war (mainly Irish, from the 1916 uprising). The Armistice was signed, though, before production got going.

It was a quite an industry while it lasted, and drove more than just a good deal of Victorian agricultural output. From coprolite-digging on its lands alone, the Cambridge colleges had a total income not far short of £150,000 (worth some £10 million today). Bernard O'Connor's industry[10] has certainly cast a quite specific light on the varied uses of stratigraphy.

Coprolites, of course, aren't just about coprolites, so to speak, and the ambiguities of the English language here take us into realms that only the likes of Groucho Marx or Lewis Carroll could traverse with aplomb. The coprolites as defined by Buckland – fossilised animal droppings – were not quite synonymous with the coprolites that made up the phosphatic stuff of a major industry, as Trevor Ford makes clear in his geological notes in the 2001 paper. A few were, of course, genuine coprolites issued from the southern end of some marine reptile or other, with the spiral markings produced by the act of defecation. But a good deal of the phosphate formed as masses of calcium phosphate (apatite) that had grown chemically on or just below those winnowed Cretaceous seafloors, sometimes as irregular masses, and sometimes within, say, the chambers of ammonite shells, preserving their inner shape.

There were current-swept bones and teeth, too, in quantity. The mortal remains of marine reptiles – ichthyosaurs, plesiosaurs, pliosaurs – found a resting place in those layers. There were saurians, too, after their carcasses had been swept from the land – Buckland's *Megalosaurus*, Mantell's *Iguanodon*, *Craterosaurus*, *Dinatosaurus* and others. Some fell from the air – pterodactyls, smashed down into the waves in a storm or maybe even caught in the snapping jaws of pliosaurs, surging from the depths. A few of these specimens escaped the washing mills and crushers, as attractive fossil bones could command a good price from Victorian collectors, and found their way into collections (including those of Henslow and of Darwin), and some survive until today.

The place of the pterodactyl bones is one of the more unlikely parts of this unlikely story. It's given in H.G. Seeley's magnificent – and beautifully written – 1901 study of these extraordinary

[10] See his website for much more: <**http://bernardoconnor.org.uk/coprolites.htm** I>

reptiles, *Dragons of the Air*. They must have abounded in the air above those Cretaceous seas, in places as numerous, perhaps, as seagulls today. Almost a thousand bones from the Cambridge Greensand are still preserved in the Sedgwick Museum at Cambridge alone (with a few thousand elsewhere dispersed, too). Almost all are the result of the intelligent and discerning eye of a single labourer, one Mr. Pond, a washer of coprolites at one of the pits, who somehow learnt to distinguish the outwardly rather unspectacular pterodactyl[11] bone fragments from the others (and to name their anatomical parts, from studying those in the University museum). For just a couple of years, he put these slender bones to one side, as a matter of business, and these form the core of collections, still, from this source.

They are fragments only, of course – those that have survived being scavenged as they slowly fell through the water or rested on the sea floor. There are no articulated specimens such as the complete *Pterodactylus longirostris*, jaws open and bizarrely elongated head tilted back, found in the lithographic limestone of Solnhofen and described by Baron Cuvier in 1801, who then coined the term 'pterodactyle'; or the later specimen described by the naturalist Georg August Goldfuss in 1831. According to Seeley, it was Goldfuss who 'saw in this flying animal an indication of the course taken by Nature in changing the reptilian organisation to that of birds and mammals. It is the first flash of light on a dark problem, and its brilliance of inference has never been equalled'. The broken and battered fragments from the coprolite workings could not compete with such as these in overt magnificence. However, they did show 'the articular ends of bones in every aspect', something that is hard to see in rock-embedded specimens, so Mr. Pond's brief but productive rescue mission produced an enduring addition to the science.

Untold numbers of turnips in boomtime mid-Victorian Britain, therefore, were helped to grow to a healthy size by absorbing the minutely redistributed remains of those charismatic flying reptiles and their kin: a better diet, for a couple of decades, than the ground-up bones of cattle, soldiers and sacred cats.

However, the problem faced by those Victorian farmers – how to grow enough food to keep people alive – is both age-old and sharply contemporary. We are just as dependent on phosphate today as was the case then (when world population was one-fifth of what it is now). Phosphate today comes, mainly, from the sources identified by Buckland and Henslow – from rock strata – phosphorites – enriched in this mineral through, in effect, a concentration of apatite-rich fossils of one sort or another. It is the form of palaeontology that keeps us all alive. And it seems to be running out.

Phosphorites are unevenly distributed in time and space[12], being related not just to particular combinations of physical and chemical conditions, but also to what type of life was around at any time in Earth history. They are mostly in the Phanerozoic (those old bones are part of the story, in one way or another). Even here they are sporadic in time: lots in the early-mid Cambrian, not much from the Ordovician to the Carboniferous, a lot in the Permian – though much of that in one giant deposit in the western USA – then a lot from the Jurassic onwards (though the Oligocene seems somewhat bereft). Phosphate doesn't form much in cold waters – and in warm

[11] Yes, I know technically one should say 'pterosaurs' as the more correct and general term for this order of flying reptiles, rather than implying that we are dealing solely with members of the Suborder Pterodactyloidea. Just for now, though, the pull of Seeley's world – and that of Professor Challenger & co. in Maple White Land, is just too strong.

[12] The Cook & McElhinney 1979 global overview is a good, if now dated summary.

waters it particularly likes upwelling oceanic zones, where wind patterns force nutrients up from depth to feed organisms all the way from microplankton to the countless generations of seagulls that lived and died to support Peru's nineteenth-century guano-dependent economy.

Geographically, Morocco and China have between them a lot of the unused phosphorite resources. North America is not badly off – but Europe doesn't have much at all. The world as a whole has less than is comfortable. Recently, the possibility of 'peak phosphorus' – perhaps even attained this century – has been mooted (for example, Cordell *et al*. 2009) – a prospect that, with another two billion people soon to arrive on this Earth, seems even more troubling than peak oil.

It's yet another example of humanity's gigantic appetite for certain parts of the Earth's fossil record – and its Micawberish trust in some combination of providence and ingenuity to come up with some kind of answer once those fossils have gone.

Goodness knows how we will cope as human need rises and that supply, half a billion years in the making, declines. Part of the answer might be what Victor Hugo, in *Les Miserables*[13], praised about the Chinese farmers of those times, who he said never left from a visit to town without a couple of buckets of night soil. A great city, he said, is the most mighty of dung-makers, and our manure is gold. It's sustainable and recyclable and packed with goodness, and a solution earthy and practical enough to have the shade of Buckland nodding in agreement[14].

Our feline familiars – or nemeses – would be intuitively familiar with this strategy, too. The French literary historian Hippolyte Taine, writing around the time of the coprolite boom, commented on the superiority of cats to philosophers. The cats would certainly agree, as they pad out of the back door on their way to dig a hole in your flowerbed. But don't rush to hurl that half-brick in defence of the begonias. The wisdom of the most ancient of times is guiding those delicate paws.

Jan Zalasiewicz

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[13] In Cordell *et al*. 2009. It's nice to see a scientific paper remembering some of the older literature. They're good on the implications for modern times, too.

[14] As recommended this very week in *Nature*, no less, by James Elser and Elena Bennett.

PalaeoMath 101
The Centre Cannot Hold I: Z-R Fourier Analysis

Likely you were a bit dissatisfied with the *Sassia* example I closed the last column with. I know I was. At best, editing an image in order to prevent it from having double, triple, or multiple valued regions seems a last-ditch compromise born of necessity. At worst it's a kludge, fit only for those who haven't thought very deeply about the geometric problem and/or unaware of the other mathematically reasonable options. In either case this technique—which you still see covered in some textbooks (*e.g.*, Davis 2002)—is far from the elegant solution mathematicians constantly strive to attain. Worse still, it only works with a reasonably conservative subset of possible shapes. Consider the positively pathological shape characteristic of the calcareous benthic foraminifera *Ramulina globulifera* (Fig. 1). Obviously, for this shape there are no simple cut planes available for us to use to subdivide the image and then reconstruct it in a manner that would prevent the occurrence of multi-valued segments.

Figure 1. Shape of the spinose benthic foraminifer species Ramulina globulifera.

The fundamental problem in both the *Sassia* and *Ramulina* outlines is our reliance on some landmark at or near the outline's centroid to supply a fixed point from which to calculate its form or shape function. Actually, when you think about it, this whole idea of using a central point as the basis for form/shape function calculation has caused us nothing but problems. It's all well and good when we're dealing with simple, regular outlines. But even in those cases the centroid is a calculated point, of no special status in terms of the parts of the form we're really interested in from a biological point-of-view. Also, as we saw in the last column, we can't even rely upon the centroid staying put when it comes to interpolating the outline down to the level

where it can be described by a reasonable number of harmonic amplitudes and phase angles. If we could just get rid of having to find and then rely on the outline's centre all of this geometric analysis of outlines business would be much easier. Fortunately, some clever people down the (metaphorical) hall have worked up some procedures that allow us to do precisely that.

Think of the *Ramulina* outline as a path; a (admittedly tortuous) way of getting from a convenient starting point, round the outline and back to the start. This pathway is complicated when looked at in its entirety, but it can be simplified if broken into small pieces.

To draw a practical analogy, when someone stops you in the street and asks for directions, the route they need to take to arrive at their destination could well be geometrically complex when drawn on a map. Still, that complexity can be broken down into a set of very simple sequential directions. The set of instructions you'd likely provide would run something like this.

> Go north, down this street until you get to the second stoplight.
> Turn right onto Wabash.
> Go east on Wabash for three blocks.
> Turn left onto Cimarron.
> Go north on Cimarron until you come to a Stop sign, two blocks.
> Turn left onto Beaumont.
> Stay on Beaumont for four blocks and you're there—it's on the corner of Beaumont and Eastwood.

Assuming that each city block represents a unit distance—let's call it a 'step'—this set of directions is mathematically equivalent to the following.

> Take 2 steps.
> Turn 90° clockwise.
> Take 3 steps.
> Turn 90° anticlockwise.
> Take 2 steps.
> Turn 90° anticlockwise.
> Take 4 steps.

This type of street-direction procedure was used by Charles Zahn and Ralph Roskies (1972) to develop a way to transform any closed curve no matter how complex into a single-valued, periodic, mathematical function that could be decomposed using Fourier analysis.

The Zahn and Roskies procedure begins with the collection of a set of 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. 2A). These points need not be equally spaced at the time they are collected and, if you are using a digitizer that requires you to place the points on the outline by hand, they won't be evenly spaced. Regardless, provided the set of collected points provides sufficient resolution in the parts of the outline where the bend is tight, it is a simple matter to search out and estimate a set of equally spaced points along the sampled outline via linear interpolation (Fig. 2B, see the *PalaeoMath 101-2* spreadsheet for an example of these calculations).

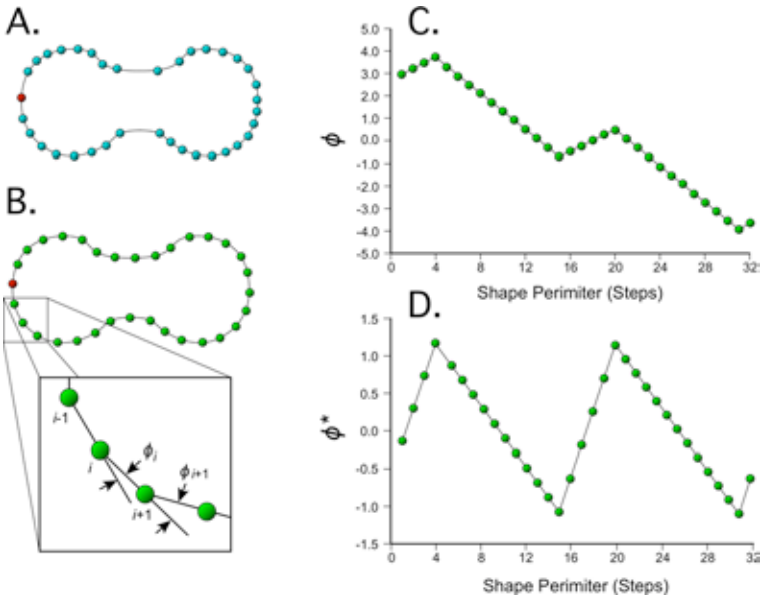

Figure 2. Steps in calculating the Zahn and Roskies (Z-R) shape function. A. Original set of semilandmark data points placed on the periphery of a hypothetical shape. The red landmark represents the starting point for digitization. Ideally this point should be placed on a topologically homologous landmark. Note also 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.

Once a set of equally spaced semi-landmark coordinates has been estimated, the outline can be regarded as an n-sided polygon where n is the number of semilandmark points. Since the distance between each point is the same we only need to 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 represent the length of the outline. This length will often be a convenient size metric.[1] Size may be removed from consideration (and display) by setting the steplength to a unit value (*e.g.*, 1.0) for all outlines in the dataset.

With size quantified and under our control, the shape of the outline can be represented in the 'street direction' manner alluded to above—as a series of angular turns that need to be executed in order to find the location of the next semi-landmark point, which is always exactly one steplength away. Mathematically this involves determining the angle between the adjacent sides of the polygon. There are many ways to calculate this set of angles, the most common of which is to regard adjacent polygon segments as vectors and use the vector dot product to find the angle.

[1] If the curve of interest is the outline of the entire specimen the steplength may be used as an index of size. However, if the curve of interest represents some spatially restricted feature of the specimen the steplength may represent a biased size index if interpreted in a naïve manner though it will still represent an unbiased measure of feature size.

The first step in this procedure is to calculate the displacements or distances between adjacent semilandmark points in the *x* and *y* directions. Since these segments are defined by sets of three semilandmark points, (x_{i-1},y_{i-1}), (x_i,y_i), and (x_{i+1},y_{i+1}) (see Fig. 2B, inset), the displacements in question are calculated as follows.

$$\begin{aligned} dx_1 &= x_i - x_{i-1} \\ dy_1 &= y_i - y_{i-1} \\ dx_2 &= x_{i+1} - x_i \\ dy_2 &= y_{i+1} - y_i \end{aligned} \tag{24.1}$$

Once these displacements have been obtained the dot product can be calculated.

$$c_i = ((dx_1 \cdot dx_2) + (dy_1 \cdot dy_2)) \Big/ \sqrt{ ((dx_1)^2 + (dy_1)^2) \cdot ((dx_2)^2 + (dy_2)^2) } \tag{24.2}$$

In order to get the orientation of this angle right the following rules must be applied.

$$\begin{aligned} &If\ c_i^2 \geq 1.0 \quad s_i = 0.0 \\ &If\ c_i^2 < 1.0 \quad s_i = \sqrt{1.0 - c_i^2} \end{aligned} \tag{24.3}$$

Once c_i and s_i have been calculated they can be used to calculate the angle between adjacent polygon segments using the arctangent function.

$$\phi_i = \tan^{-1}(s_i, c_2) \tag{24.4}$$

To ensure accuracy this value is estimated using high-precision numerical methods. Finally, in order to take advantage of the tangent function's ability to locate angles in any of the four Cartesian quadrants, the sign of the ϕ_i-value must be adjusted using a vector cross-product test.

$$If\ ((dx_1 \cdot dy_2) - (dx_2 \cdot dy_1)) < 0.0 \quad \phi_i = -\phi_i \tag{24.5}$$

These calculations result in a set of angles—expressed in radians—the cumulative sum of which quantifies the net angular change around the perimeter of a shape from the user-chosen sequence starting point. This shape function can be expressed in its raw form (ϕ, Fig. 2C) in which the cumulative radian values are used to represent the shape, or as a normalized shape function that expresses the degree and location of deviation from strict circularity (ϕ^*, Fig. 2D). In the case of the latter the negative ramp of the former is removed by subtracting a cumulative constant term corresponding to the radian-equivalent value of 360° (6.2832) divided by the number of steps used to subdivide the outline.

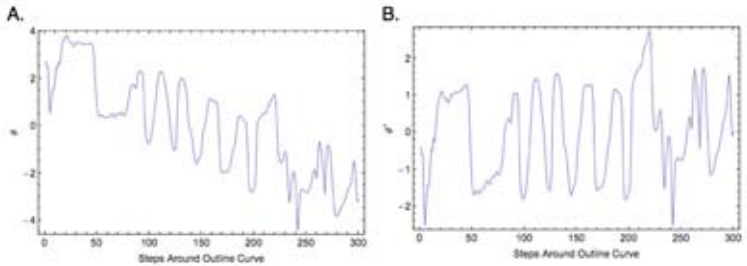

Figure 3. Zahn and Roskies shape functions for a 300-point interpolation of the Ramulina globulifera *outline data expressed in the ϕ (A) and ϕ^* (B) formats.*

Figure 3 shows the Zahn & Roskies shape functions for a 300-point interpolation of the *R. globulifera* outline semilandmarks. As with the example shown in Figure 2, the broad negative ramp in the raw (ϕ) form of these data (Fig. 3A), along with the near equivalence of the absolute value of the starting and ending points (ϕ and ϕ^*), identify this as the shape function of a closed outline. Local reversals in the trend of the shape function locate high-angle bends along the periphery of the shape (*e.g.*, base of tubular spines where they join the spherical test body). From the standpoint of shape characterization and analysis, however, by far the most important aspect of these shape functions is the simple fact that, despite the complexity of the *R. globulifera* outline, the equivalent Zahn & Roskies shape function is a true mathematical function, with a single ϕ value associated with every step along the entire outline. It is this property that allows Zahn & Roskies shape functions to be subjected to the Fourier (and other) data analysis procedure(s).

Before we move on to demonstrating the Fourier analysis part of Z-R Fourier analysis, I want to provide the equations that will allow you to transform any Z-R shape function back into its equivalent Cartesian form and say a word about spatial resolution. The back-transformation equations are trivially easy to apply.

$$x_i = x_{i-1} - (steplength \cdot \sin(\phi_i)) \qquad (24.6)$$
$$y_i = y_{i-1} - (steplength \cdot \cos(\phi_i))$$

Applying these equations to the *R. globulifera* data shown in Figure 3 results in production of the following reconstructions (Fig. 4).

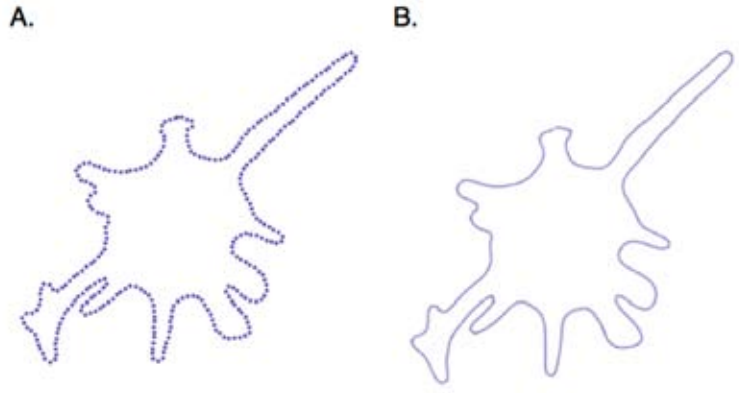

Figure 4. Reconstruction of the Ramulina globulifera *outline from the ϕ^* form of the Z-R function shown in Fig. 3B drawn as a series of 300 semilandmark points (A) and as a joined point series (B).*

Note that this outline is distinctly smoother in form than the raw outline (see Fig. 1), with many of the small spatial irregularities absent and sharp angular bends transformed into more even curves. This smoothing is a by-product of the interpolation procedure. If a larger number of interpolated semilandmark points are used to represent the outline the steplength will decrease and small-scale features will be captured with greater accuracy. If a lesser number are specified by the user, the degree of smoothing will increase, sometimes to the point where important aspects of the outline are represented in a distorted manner or, depending on their relative size, not represented at all.

When performing any analysis that involves interpolation of raw data, care must be taken to ensure that the spatial resolution selected captures those aspects of geometry that are important for shape characterization accurately and adequately across all specimens in the sample. Usually it's a good idea to reconstruct, plot, and inspect all the outlines you intend to use before you perform any subsequent analyses. That way any unanticipated sampling problems can be identified and corrected before time is spent attempting to interpret what may be artifactual results.

Once you have interpolated your outlines into a common number of equally-spaced semilandmark points, and transformed those into the angular-deviation format of their equivalent Z-R shape functions, you are ready to submit the set of outlines to Fourier analysis. Zahn and Roskies (1972) recommended use of the ϕ^* function for subsequent Fourier analysis as this 'rampless' function more closely approximates the form of a periodic function formed from radius vectors emanating from a central point. In principle either the ϕ or the ϕ^* functions can be used as the subject of a Fourier analysis. However, the large difference between the values of the two endpoints of the ϕ function usually means a larger Fourier harmonic spectrum must be used to accurately estimate the shape of a set of ϕ functions than is needed to accurately estimate the forms of a set of ϕ^* functions. Whichever form of the Z-R function is used, the Fourier part of the procedure is performed in a manner identical to the one we used to analyse the *Sassia* outline in the last column. Results of using 25 Fourier harmonics to model the *R. globulifera* Z-R (ϕ^*) shape function are shown in Figures 5.

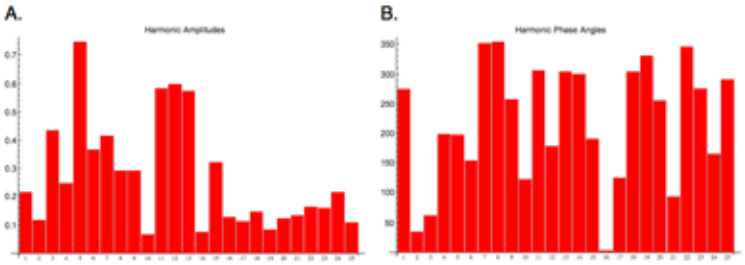

Figure 5. Fourier harmonic amplitudes (A) and phase angles (B) for a 25-term decomposition of the 300-point Z-R (ϕ^*) shape function of Ramulina globulifera.

The overall quality of this modelling result can be assessed by using the 25 harmonic amplitudes and phase angles to estimate the original (ϕ^*) shape function (Fig. 6).

Even using this relatively small number of harmonic descriptors, the form of the original 300-point shape function is represented to a remarkably high degree of accuracy. For a more direct assessment of shape variation the estimated shape function could be transformed into its Cartesian equivalent using equations 24.6 and compared to the original image. Of course, the level of accuracy could be improved further through expansion of the Fourier harmonic spectrum. Given a 300-point Z-R shape function the number of potential harmonics that could be used to describe the *R. globulifera* outline is 149.

We are now ready to review an example of how Z-R shape functions can be used to analyse real palaeontological data. Consider the set of benthic foraminifer shapes presented in Figure 7.

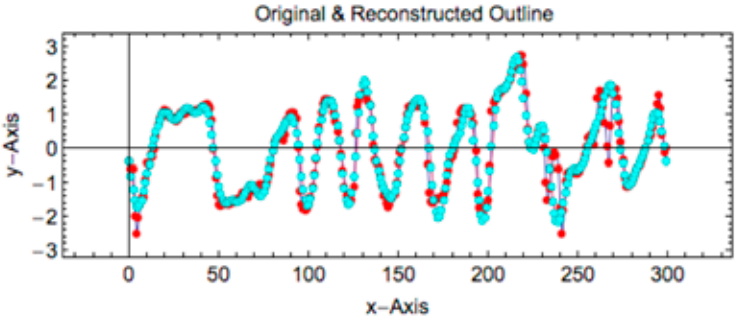

Figure 6. Overlay plot of estimates (red) and reconstructed versions of the Ramulina globulifera ϕ^* *shape function based on amplitude and phase angle data from a 25-term Fourier harmonic spectrum.*

Figure 7. Benthic foraminiferal shapes used in the example analysis. Note the preponderance of multi-valued object outlines.

Many of these species possess multi-valued outlines. Accordingly, this sample cannot be analysed using the radial Fourier method. But all of these shapes possess an outline that can be converted to a single-valued mathematical function using the Zahn and Roskies (1972) technique. Please note that the Zahn and Roskies procedure works as well for specimens with true single-valued outlines as it does for specimens whose outlines are multi-valued. As a result it is usually a good generalized choice for an outline shape-characterization strategy, useful for analysing samples consisting of known single-valued outlines, known multi-valued outlines, mixed single-valued and multi-valued outlines, or samples whose outline-value states you are either unsure of or can't be bothered to assess.

The complete set of ϕ^* shape functions for the set of 12 species shown in Figure 7 is plotted in Figure 8.

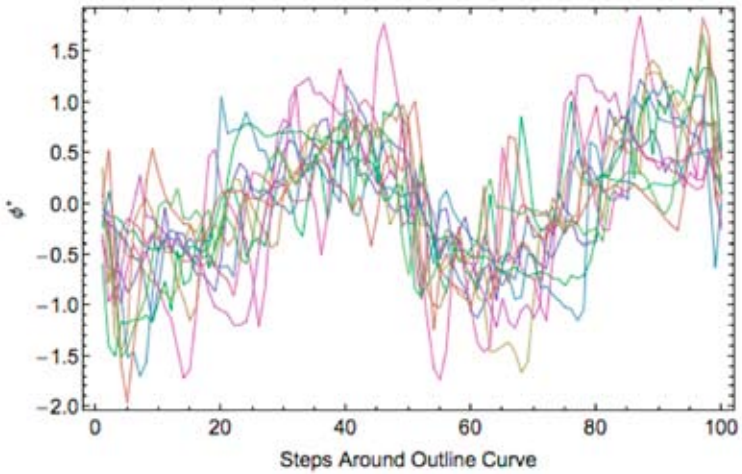

Figure 8. Swarm of 12 Z-R (ϕ^*) shape functions for the benthic foraminifer test outline shapes.

This type of overlay diagram is analogous to the plots of *Procrustes*-aligned landmark configurations I've shown you in previous columns (see MacLeod 2008a, 2009a-c). Just as with *Procrustes* alignment, the semilandmark data have been projected from a form space into a shape space in which translation, scaling, and rotational differences between specimens have all been removed from the system of observations. At each of the 100 interpolated steps around the outline of each specimen (*x*-Axis) 12 angular rotations specify the direction to the next semilandmark in the sequence that is equally distant from the preceding landmark on a per specimen basis. The mean shape can be calculated as the average of the angular values across all specimens in the sample at each step.

As you can see from Figure 8, all these outlines are broadly similar with angular deviations beginning just below the 0.0 value and descending to a diffusely defined nadir between steps 5 and 10. These deviations then increase to a local maximum in the vicinity of step 40. This trend reverses itself as we continue around the outline where the angular deviations descend the ϕ^* scale to a local minimum located between steps 55 and 80. Positive angular deviations then predominate, rising to a complexly structured peak between steps 75 and 97, after which they fall

sharply back to the origin of the ϕ^* axis. About this sample-level trend, exist a complex suite of interesting shape variation patterns. Recall also that Figure 8 presents us with a picture not of the geometries of the Figure 7 shapes themselves, but how those shapes differ from a circle.

As with radial Fourier analysis, we can use the Fourier expansion to define a set of geometrically comparable and mutually independent reference shapes (= the Fourier harmonic series) that can be used as a set of variables with which we can describe the complex patterns of shape variation we see in Figure 8. A set of example amplitude and phase angle spectra for a 25 harmonic solution is shown in Figure 9. Close comparison of barcharts for both the amplitude and phase angle descriptors shows that they are indeed picking up the similarities and the differences that exist between these shapes.

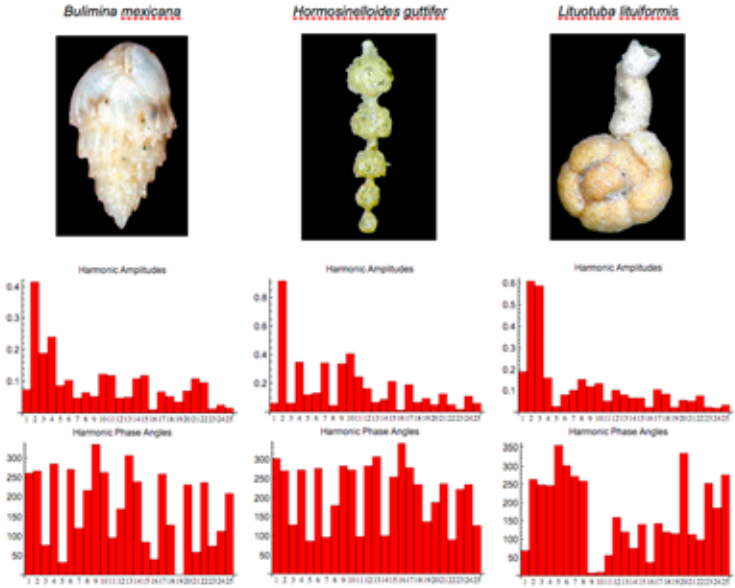

Figure 9. Images (upper row), harmonic amplitudes (middle row) and harmonic phase angles (lower row) for a 25-term Fourier description of a 100-point Z-R (ϕ^*) shape function for three example benthic foraminifer species. Note both similarities and differences in the harmonic amplitude and phase angle spectra, which reflect similarities and differences in the outline shapes of these species.

Once we have described the set of foraminifer test shapes in terms of their component Fourier harmonic shape variables we can compare and contrast the amplitude and/or phase angle data using an appropriate multivariate data analysis procedure. If we are interested in assessing the major patterns of variation in our shape data we can use principal components analysis (PCA, see MacLeod 2005). If we are interested in obtaining an image of shape similarities and differences among these species we could also use PCA, but an arguably better and certainly more interesting choice would be multi-dimensional scaling (MDS, see MacLeod 2008b). And if we have subsidiary groupings in our data and want to understand how this group-level structure is reflected in the shape data we have collected we can apply canonical variates analysis (CVA, see MacLeod 2007).

The important point to remember here is not simply to apply a procedure because you've seen someone else apply it to their data, or because you've heard that this procedure is 'accepted' by this or that school of thought. Take the time to understand how your problem, and how your data, match up to the capabilities and assumptions of the different data-analysis procedures, then go with the one you believe to be appropriate after researching the subject for yourself. If you haven't got time—or aren't interested—in doing this research yourself, the safest course of action is always to bring in an advisor or a collaborator who is interested in this aspect of the investigation and let them guide you.

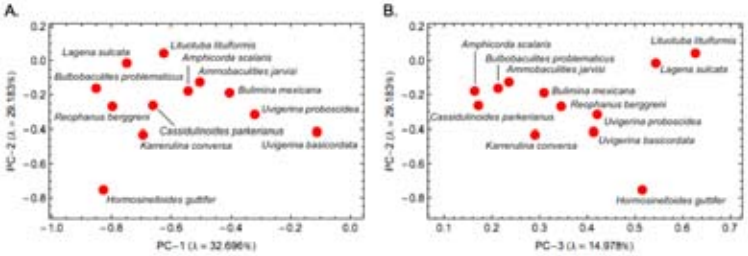

Figure 10. Ordinations of the 12 benthic foraminiferal outlines in the subspace formed by the first three principal components (covariance-based) of the 25-term Fourier amplitude characterization of the 100-point Z-R (ϕ^*) benthic foraminifer shape functions. See text for discussion.

For the purposes of this column let's take a look at the major trends in Fourier descriptor-based shape variation using PCA. Because there are only 12 specimens in the dataset there are only 12 principal components with positive eigenvalues, the first seven of which account for over 95% of the observed shape variation. Inspection of the ordinations of the first three of these axes (76.86% of shape variation represented, see Fig. 10) suggests that they are indeed reasonable. Along PC-1 species characterized by thin, uniserial tests (*e.g.*, *Hormosinelloides guttifer*, *Lagena sulcata*) are separated from species characterized by wide, flaring tests (*e.g.*, *Uvigerina basicordata*, *Uvigerina proboscidea*). The second PC axis separates forms with a large, ovate proximal and narrow distal shape (*e.g.*, *Lagena sulcata*, *Lituotuba lituiformis*) from species with a uniformly narrow shape throughout (*e.g.*, *Hormosinelloides guttifer*). The third axis separates species with the most pronounced body-neck form discrepancy (*e.g.*, *Lagena sulcata*, *Lituotuba lituiformis*) from those serial forms whose outline is either modestly flaring (*e.g.*, *Amphicorda scalaris*) or sub-uniform throughout (*e.g.*, *Cassidulinoides parkerianus*). Overall, this analysis is analogous to either a *Procrustes* PCA or a relative warps analysis performed on landmark data.

The Zahn and Roskies version of Fourier analysis has not been popular among either biologists or palaeontologists because it's been superseded by other approaches to outline characterization and analysis. I've presented it in its original guise in order to clarify the origins of the Z-R shape function and to provide space for a fairly detailed discussion of its two variants, ϕ and ϕ^*. Here we've been mostly concerned with the ϕ^* variant. I'll deal with the ϕ variant in detail in a future discussion of eigenshape analysis. Regardless, there's no reason not to use the Z-R version of Fourier analysis as a more generalized approach to the Fourier-based analysis of outlines than the traditional radial Fourier approach.

With respect to software, other than my own programs and software based on the algorithms I use (*e.g.*, Morpho-tools, <**http://www.morpho-tools.net /**>) the only public domain implementation of the Z-R shape function of which I'm aware is included in the PAST data analysis package (<**http://folk.uio.no/ohammer/past /**>, see also Hammer and Harper 2006). Claude (2008) includes a listing of R code to calculate interpolations and the Z-R shape function, but knowledge of R programming is required to implement this code. The *PalaeoMath 101-2* spreadsheet contains a simple example of the calculations involved. However the equal point-spacing interpolation algorithm is a bit tricky—involving successive approximation to the idealized configuration—and the Z-R transformation algorithm requires several passes through the data in order to adjust the geometric details appropriately. Irrespective of these complications, the pay-off for surmounting them is possession of a very generalized algorithm that, when employed properly, provides users with the ability to quantify a large number of comparisons systematists make on a routine basis, albeit qualitatively, imprecisely, and inconsistently.

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Don't forget the *PalaeoMath 101-2* web page, at:

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

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

World Conference on Paleontology and Stratigraphy
Nakhon Ratchasima, Thailand *28 November – 2 December 2011*

The World Conference on Paleontology and Stratigraphy (WCPS 2011) is an international conference to be held in order to celebrate His Majesty the King's 84th Anniversary on 5th December 2011.

The conference will be hosted by the Northeastern Research Institute of Petrified Wood and Mineral Resources (NRIP) and Nakhon Ratchasima Rajabhat University, with cooperation from international and domestic museums, universities, government agencies and the private sector.

Presentations on all aspects of palaeontology, ranging from tiny extinct creatures to large marine and terrestrial animals are welcome. The themes include vertebrates, invertebrates, microfossils, plant fossils and associated subjects, such as biostratigraphy, lithostratigraphy and chronostratigraphy. Contributions related to technological samples as well as fossil-site and museum management and fossil energy are also welcome.

Further details can be found on the conference website at <**http://www.wcps2011.com/wcps /**>.

Workshop on Palaeozoic Limestones of South- East Asia and South China
Petronas University of Technology, Malaysia *5 – 8 December 2011*

Spectacular and picturesque Palaeozoic Limestone outcrops are scattered around South-East Asia and southern China, in places such as Guilin (China), Halong Bay (Vietnam), Vang Vien (Loas), Kampot (Cambodia) and Phuket (Thailand), as well as the Kinta Valley (Malaysia). This workshop intends to try and understand the interrelation of these carbonate systems in a regional context.

This is the first of several workshops organised by the European Association of Geoscientists and Engineers (EAGE) on the regional geology of South East Asia. The workshop will cover all aspects of Upper Palaeozoic carbonate geology of the region, from sedimentology and hydrocarbon plays to tectonics and geohazards. The organisers intend to have a session devoted to palaeontology, stratigraphy and palaeogeography. Palaeontologists of all disciplines are very much encouraged to participate in this workshop.

The meeting will take place on the campus of the Petronas University of Technology (UTP) surrounded by tropical rainforest, while the delegates will be accommodated in the nearby city of Ipoh in the heart of the Kinta Valley. The workshop will comprise three days of presentations and discussions followed by a one-day optional field-trip to the limestone hills and cave temples of the Kinta Valley.

Further details can be found on the European Association of Geoscientists and Engineers (EAGE) website at <**http://www.eage.org /**> or by emailing <**asiapacific@eage.or g**> or <**aaron_hunter@petronas.com.m y**>.

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, with an (optional) excursion for participants on 5th July.

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 fifth 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, please e-mail <**b.vangeel@uva.n l**> 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 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.ph p**>. (Early-bird registration is until 30th April 2012; Abstract submission deadline: 17th February, 2012).

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/preregistratio n**>, 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 Glasgow.

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 /**>. (Early bird registration is until 1st April 2012; 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 on the conference website at <**http://wwwsoc.nii.ac.jp/psj3/jp /**>.

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 /**>.

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-201 2**>. (Early-bird registration and abstract submission deadline: 30th April 2012)

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

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

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.i t**>.

4th International Palaeontological Congress (IPC 2014)
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.

More details to follow.

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

Meeting REPORTS

Taphos 2011: 6th International Meeting on Taphonomy and Fossilization
Universität Tübingen *14 – 17 June 2011*

The Taphos meeting originated in Madrid in 1990 and up until this year has been held in a variety of locations in Spain; this was the first occasion that the meeting was held outside of Spain. The ancient University and city of Tübingen were selected and, given the pedigree of taphonomic and biostratinomic work that has been done in the University, this seemed an excellent choice of venue. The organizers (**Jimmy Nebelsick**, **Jan-Peter Friedrich** and **Janina F. Dynowski**) took full advantage of the venues within the University and city to host an excellent social programme to complement the academic elements.

A significant factor in the volume and quality of publications from Tübingen is the proximity of many fossiliferous deposits from the Triassic and Jurassic in proximity to the University and the fine collections in the university's Paläontologische Sammlung (Palaeontological Collections). This is Muschelkalk country, where Dolf Seilacher found the material for many of his famous taphonomic papers; the Jurassic lagerstätten of Holzmaden and Nusplingen lie nearby; and the renowned Solnhofen and Eichstätt lagoons are just over the border in Bavaria. Some of the spectacular material from the collections can be seen in the photos that illustrate this article.

The conference organizers took full advantage of the wealth of palaeontological sites close to Tübingen, organizing a pre-conference field trip to Holzmaden and Nusplingen and a post-conference trip to Solnhofen. I was personally unable to attend the trips but given the keen discussion of the Holzmaden/Nusplingen trip during the meeting and the anticipation of many of the delegates of the Solnhofen trip made one appreciate how valuable the chance of a secular pilgrimage to these sites was to many delegates. From the conversations about the field-based studies during the meeting, it was also obvious how vital the full range of skills of the field geologist remain in this area of research.

The indoor part of the meeting was held in the Institute of Geosciences, which handily occupies the same building as the Palaeontological Collections. Talks and posters were spread over the middle two days of the meeting, with a considerable amount of time available to view the posters, which were on display for the entirety of the meeting. The posters were of a high standard of production, with **A. Lukenender** and **S. Lukenender** winning the poster prize for their work *A Triassic ammonite mass-occurrence from the Taurus Mountains in Turkey*. As all delegates voted for the poster prize, by secret ballot, I think this enhanced the sweetness of victory for them. Perhaps an approach to consider for the Association's Annual Meeting Poster Prize in future?

The Wednesday morning session, *Taphonomic Processes and Palaeoecological Interpretation*, was started by a very engaging talk by **Yurena Yanes** (University of Granada) on her research that combines taphonomy, palaeoecology and stable isotope analyses to evaluate the effects of human disturbance and climate change on vulnerable populations of non-marine molluscs. This talk set

Fig. 1: A trio of marine reptiles on the wall of the Palaeontological Museum in Sigwartstraβe.

the scene for the breadth of topics and disciplines to be covered in the conference, as it took in archaeology, population biology, land snail systematics and geochemistry. If palaeontologists want an example of how palaeontology can work with allied disciplines to understand the fates of extant, but threatened taxa, Yanes' work is a fine illustration. The remainder of the morning session was filled with presentations that aimed to use taphonomy as a tool to interpret palaeonvironments in a range of settings spanning from the Triassic right up to historical sites.

Derek Briggs (Yale University) opened the afternoon session, *Exceptional Preservation and Mass Occurrences*, with an incisive overview of the shift in our understanding of the frequency of occurrence of certain types of exceptional preservation. New visualization and chemical techniques are finding that certain styles of exceptional preservation, previously thought to be rare, are in fact ubiquitous when searched for with the right tools. His talk proposed that some styles of Konservat-Lagerstätten are more limited by geological megabiases such as facies-dependence and the amount of exposed rock than by truly unusual circumstances. His discussion of the potential of macromolecules to provide substantive evidence for 'finger-printing' of precursor molecules was inspiring to me personally, and I was surprised by the potential for such studies to yield new characters that could be useful for phylogenetic analyses. The following afternoon session was a fascinating mixture of mass occurrences, the oft-overshadowed Konzentrat-Lagerstätten that can yield so much information on population structures and palaeoecology, and instances of the exquisite preservation of anatomical detail.

The post-coffee session in the afternoon focused on marine biostratinomy, and I must congratulate **Emmanuel Fara** (Dijon) and colleagues on a wonderfully methodical re-examination of the Grignon site in the Paris Basin with modern sedimentological and biodiversity approaches to this classic site.

Thomas Tütken (Universität Bonn) began Thursday with a detailed analysis of the Miocene Messel oil shale fauna and flora using an impressive battery of geochemical techniques to probe the abiotic and biotic elements of the ecosystem. His talk highlighted that the incredible preservation of the vertebrate fauna extends beyond the soft tissue and bone to the tooth enamel, which is yielding incredibly detailed information on the diet and behaviour of the fauna. The remaining talks in this session covered experimental taphonomy and new methods in taphonomy, ranging from the use of computed tomography to monitor a decay experiment to experiments on how to fossilize trees.

The second morning session covered a range of biostratinomic studies of terrestrial deposits, with a strong emphasis on cave deposits, although the talk by **Wuttke** and **Reisdorf** reminded us that there is more to the Solnhofen than flying vertebrates.

This left **Loic Villier** (Marseille) to begin the end of the talks. The final session was an innovative one, and explains my presence at the meeting. This session was concerned with the effects of taphonomy on estimation of biodiversity at a variety of spatio-temporal scales. Villier's talk was intriguing, as he ranged across multiple scales in his presentation on the fossil record of echinoderms. His presentation covered bias from sampling a single exposure to the Phanerozoic. After this introduction, the talks presented over the remainder of the afternoon examined individual elements of the sweep of space, time and taxa discussed during the meeting.

Fig. 2: Ammonoid pavement Konzentrat-Lagerstätte from the Muschelkalk.

The meeting abstracts are available at <**http://www.taphos-2011.uni-tuebingen.de/**>, where you can see the deteriorating echinoid that formed the meeting logo. Delegates were issued a set of five badges to wear with pride, or bribe their small children with, and the conference T-shirt featured the decay sequence. My T-shirt led to an informative exchange with my colleague, Nick Kamenos, who is a marine biologist with Cypriot connections. "Al, why does your T-shirt have the Greek word for 'grave' on it?" Where to begin!

Al McGowan

11th International Ichnofabric Workshop
Museo del Jurasico de Asturias, Colunga, Spain *30 June – 5 July 2011*

For the cider-loving trace fossil worker, there was only one place to be this Summer, and that was the northern Spanish principality of Asturias, for the 11th International Ichnofabric Workshop. Held in the wonderful cliff-top setting of the Jurassic Museum of Asturias (MUJA), the meeting brought together ichnologists from across the globe. Over a long weekend at the start of July, they enjoyed fine food, fabulous fossils, and, perhaps, a glass or two of *la sidra Asturiana*.

Flying into the regional airport, a small British contingent spent the first night in the nearby town of Avilés, birthplace of Don Pedro Menéndez, first governor of Florida, and now home to the space age curves of the Oscar Niemeyer Cultural Centre. The workshop began the following evening with an icebreaker in MUJA, 40 miles east along the coast of the Cantabrian Sea.

Shaped like a tridactylous dinosaur print, the museum opened near Colunga in 2004 and celebrates Asturias' Mesozoic heritage, not least the vertebrate trackways found in the cliffs above which it perches. There can't be many more dramatic locations to host a palaeoecological meeting, and the fact that it boasts the only museum reconstruction of a *T. rex* couple *in flagrante* was just a bonus.

The first session of talks got under way bright and early the next morning, with **Andrea Baucon** (Milano) making 'Ichnology' the I of GIS, mapping out spatial distributions of burrows in a modern lagoon. **Małgorzata Bednarz** (Memorial University of Newfoundland) modelled the 3D fluid flow generated by mudstone trace fossils, and **Margaret Bradshaw** (Canterbury, New Zealand) studied the lateral movement of a vertical burrow in the Devonian of Antarctica. In slightly warmer climes, **Al Curran** (Smith College, Massachusetts) compared modern and ancient thalassinid burrows in carbonates of the Bahamas.

Slightly confusingly, the opening ceremony came next, but perhaps we were too ichnologically eager for the local civic dignitaries. They were very pleased to welcome us, though, and it was noted by one of the organizers that Asturias was chosen because of the scenery, the geology and the museum. And the cider!

It was coffee first, though, and a chance to peruse the posters. Session Two then began with an invited talk from **Luis Buatois** (Saskatchewan), who reminded the audience of the need to consider evolutionary processes when studying trace fossils. For organisms burrowing into new environments, there are a limited repertoire of behaviours available. This leads to ichnological deja-vu, with the same morphologies occurring in different settings at different times. This is rarely considered when applying the ichnofacies concept, but is critical to its usefulness.

Museo del Jurasico de Asturias

Entertainingly and experimentally, **Tony Ekdale** (Utah) then looked at trace fossils as art. As the great painters provide a transformation of reality, so diagenesis does this to bioturbation, and Tony argued that both were an enhancement, enabling us to see things we might otherwise have overlooked.

The natural arts continued with a double-helix trace fossil described by **Jordi di Gibert** (Barcelona) from the Miocene of Mallorca. Then **Kentaro Izumi** (Tokyo) examined the ichnology of the Toarcian Ocean Anoxic Event, documenting high ichnofabric indices in north-west Panthalassa, and a diachronous development of anoxia.

Lunch came with a traditional Asturian stew in a beachside restaurant, near some sun-bathed sauropod tracks. **Dirk Knaust** (Statoil, Stavanger) then kicked off Session Three with some deep-sea ichnofabrics from well cores, and **Mary Leaman** (Memorial University of Newfoundland) demonstrated how pellet morphologies in *Ophiomorpha* can be misinterpreted if seen only in two dimensions. Subsequently, **Lars Löwemark** (Stockholm) studied *Zoophycos* in Arctic Ocean sediments, **Gabriela Mángano** (Saskatchewan) the diachroneity of infaunalization, and **Radek Mikuláš** (Czech Academy of Sciences) the insect ichnology of ancient Egypt. **Andreas Wetzel** (Basel) concluded the session with an invited talk on environmental conditions in the abyss, and using bioturbation to unravel the patterns.

After a caffeinated top-up, early evening brought the day's fourth session, and talks by **Masakazu Nara** (Kochi), who revealed *Protovirgularia* traces as a 'bivalvian highway', **Renata Netto** (Sao Leopoldo, Brazil), who interpreted clusters of Devonian *Rosselia* as made by early terebellids, and **Mike Romano** and **Martyn Whyte** (Sheffield), who talked of the ichnofabrics of Asturias' British equivalent, the dinosaur coast of Yorkshire.

Dinner was served in the nearby restaurant, El Mirador, with glorious views across the Bay of Biscay. With our marine appetite whetted, it was appropriate, therefore, that the next day's intra-meeting field-trip took us to the Bay itself, and a chance to examine the trace fossils of the El Tranqueru region.

The rocks exposed there are of Middle Devonian age, and preserve a siliciclastic marginal marine and shelfal succession. The thinly interbedded sandstones and mudstones include a wide array of ichnotaxa, most notably an abundance of well-preserved arthropod traces, including *Cruziana*, as well as *Chondrites*, *Nereites* and *Teichichnus* a-plenty.

Asturian history is not just about the tracemakers, though, and the afternoon saw delegates taking in some cultural highlights too. This began in Oviedo, and the Pre-Romanesque monument of Santa Maria del Naranco, a UNESCO World Heritage site completed in AD 848. It was followed by a trip to the almost equally ancient church of San Salvador de Valdedios.

Cruziana in the columns at Santa Maria del Naranco.

Taking in so much extraordinary history required a stiff drink, so it was lucky that the next stop on the itinerary was the El Gaitero cider factory in Villaviciosa. Their 'champagne cider' was especially refreshing, though the more traditional stuff (poured into a glass from a great height by a server who is deliberately looking the other way[1]) was hardly unpopular. Once we'd drunk that, then gorged on more local cheese, chorizo and rice pudding, it was time to waddle back to the bus and trundle home.

The Sunday session – number 5 – began at 8.45am, with **Zhifeng Xing** (Henan Polytechnic University) kicking things off with a study of Mesoproterozoic microbially induced sedimentary structures from China. **Jenni Scott** (Alberta) then presented a tiger beetle's view of *Skolithos*, showing that subaerially produced burrows can often be found in sediments that would be interpreted as having been deposited subaqueously.

A similar problem was examined by **Koji Seike** (PARI, Yokosuka), who compared land crab and ghost crab burrows in the Bahamas to enable their reliable identification as trace fossils. Using ichnofabric analysis to assess the evolution of the mixed layer was the focus of **Lidya Tarhan**'s (University of California, Riverside) talk, whilst **Nikki Tonkin** (Memorial University of Newfoundland) looked at the importance of different ichnotaxa to hydrocarbon reservoir characterization.

A final perusal of the excellent posters on display came in the coffee break, but there was a downside to the quality of the submissions. Come 11am and the start of the final session, and only the chairman, speaker and two audience members were in the lecture theatre.

[1] Type 'escanciar la sidra' into Google to see how it's done.

Bioturbation in the Middle Devonian rocks of El Tranqueru.

Once the stragglers had been rounded up, **Alfred Uchman** (Kraków) examined the orientations of nummulitic foraminiferans in Eocene burrows, **Andreas Wetzel** (Basel) the ichnology of upwelling intervals in the South China Sea, and **Jim Lehane** (Utah) exhorted delegates to work towards setting up a Universal Ichnological Database.

The final talk of the meeting was given by **Duncan McIlroy** (Memorial University of Newfoundland), who questioned one of the cornerstones of ichnology: the ethological classification system. Duncan argued that terms like 'domichnion' and 'fodinichnion' are being applied somewhat indiscriminately to structures that were almost certainly multi-functional, and that palaeoecological information is being overlooked as a consequence.

To end the workshop, **Luis Buatois** gave some closing remarks, noting the diversity of subjects discussed, and urging everyone present to spread the word about the International Ichnological Association. **Duncan McIlroy** then told the audience that, while '-ichnia' might be bad, Ichnia 2012 will be good, and that everyone with an interest in bioturbation or trace fossils should come to St John's, Newfoundland, next Summer (for details see the advert on page 69 herein).

Thence, the next major date on the ichnological calendar will be the 12th IIW, which will be held in the Canakkale region of Turkey. With fabulous geology and scenery, not to mention the sites of Troy and Gallipoli, it will surely be another great meeting.

First, however, there was an afternoon excursion, taking a bus to Ribadesella to see the extraordinary cave paintings of El Tito Bustillo. This was followed by a very relaxed, very enjoyable closing dinner back in Colunga.

The final two days were set aside for post-conference fieldtrips, either those arranged by the meeting convenors, or those by delegates themselves. On one of the latter, our small group went off in search of Ordovician turbidites and Celtic hill-forts, and happily found both. The only regret was that we couldn't stay in Asturias longer.

The workshop was a great success, and one of the friendliest and most exceptionally well-organized meetings I've ever attended. Tremendous credit should go to the convenors, particularly **Laura Piñuela**, whose scheduling skills were second to none and whose cheery demeanour never seemed to waver, as well as **Francisco Rodríguez-Tovar**, **José Carlos García-Ramos** and **José Ignacio Ruiz-Omeñaca**. And if you need a new part of Spain to explore, I can't recommend Asturias highly enough.

Liam Herringshaw
Memorial University of Newfoundland (<**http://www.ichnology.ca/**>*), and Durham University*

Second Open Congress of the Czech and Slovak Geological Societies
Monínec, Czech Republic *21 – 25 September 2011*

The second Open Congress of the Czech and Slovak Geological Societies was held in the Czech Republic from 21-25 September 2011. The venue was the pleasant mountain ski resort of Monínec, some distance south of Prague, and it was ideal for such an occasion. The Congress was superbly organised by **Petr Budil** and **Oldřich Fatka** and several other colleagues. There were over a hundred participants, mainly from the Czech and Slovak Republics, with the general theme of Geological Evolution of the Bohemian Massif and the Western Carpathians. Although a great range of geological topics was covered, there was plenty of palaeontology, appropriate to the fossil riches of the Czech and Slovak lands.

Following a pre-conference trip to a Geopark in Prague, the Wednesday was devoted to an excursion to the Barrandian, organised by Petr Budil and Oldřich Fatka, and with a fine guidebook, in English, specially prepared for the occasion[1]. An excellent feature of this guidebook is the many cartoons illustrating the various environments and their faunal associations. The incomparable light of late September, as we visited the various sites, was an added blessing. The Lower Cambrian in the Barrandian is largely unfossiliferous, with only the restricted marine Paseky Shale yielding the very rare arthropod Kodymirus, and acritarchs. This shale outcrops at the now classic roadside exposure at Medalův Mlýn, though we found no fossils. Passing through the village of Jince, and having seen the 400m long section so well explored by Oldřich Fatka in the distance, we were able to collect extensively from the Middle Cambrian Jince Formation, rich in trilobites and echinoderms, at Ostrý vrch hill, above the road from Reykovice to Felbabka. The various associations in this Formation have been established in detail and research is still intensively continuing. Here also the megafossil information has been tied to that provided by the primary producers, the acritarchs.

The next stop was at the ancient Točník Castle, set high on a crag and beautifully displaying the contact between the Proterozoic and the basal Tremadoc. The spectacular views provided a fine backdrop for lunch and coffee. On again to the Katian to Hirnantian Králův Dvůr Formation exposed on the hillside at Levin, with mainly deep water trilobite/brachiopod faunas. Then we were shown a tectonic puzzle – a complex fold and fault complex in the Lower Devonian which has been argued about for over a hundred years, illustrative of Barrandian tectonics. Penultimately we visited a section just above the railway, one of Barrande's localities, close to the Litohlavy Reservoir, yielding marvellous specimens of *Spirograptus turriculatus* and other graptolites. And finally, near Koněprusy, we were taken to an exceptionally fossiliferous quarry in the Lower Devonian in the distal reef flank of the Koněprusy reef complex. An excellent trip, magnificently instructive, and superbly organised.

The palaeontological lecture programme was held on Thursday. **Euan Clarkson** began with a keynote lecture on the life and times of the olenid trilobites, followed by **Stanislav Čech** and **Martin Košťák** on the Czech Cretaceous Basin – origin, facies development and faunal associations. The other, very good, lectures in the morning were on volcanism and structure, as well as tectonics, and finally of considerable general interest, a talk by **Vojtěch Ettler** (*et al.*) on contaminated geoenvironments.

[1] Fatka, O & Budil, P. 2011. Lower Palaeozoic of the Barrandian Area. 40 pp. *Exkurze Ceske geologicke spolecnosti* **29**/ PODZIM 2011. ISBN 978-80-87487-01-3.

The afternoon was devoted entirely to palaeontology. **Brigitte Schoenemann** spoke on the eyes of Bohemian trilobites and what they can tell us about the environments their bearers inhabited. **Oldřich Fatka** gave a magnificent review of Cambro–Ordovician fossil-lagerstätten in the Barrandian area, several discovered quite recently, some in relatively inshore facies. This was followed by **Petr Budil**'s eloquent analysis of the trilobite biostratigraphy of the Barrandian, and **Marika Steinová**'s fine talk on the Ordovician bivalves of the Barrandian. **Klement Fordinál** then gave an integrated interpretation of Miocene palaeoenvironments in Slovakia, **Martin Ivanov** presented a fascinating account of Miocene snake faunas, and **Martin Vlačiky** spoke on the fossil mammal fauna of a new Villafranchian locality in Slovakia. **Ivan Turnovec** then discussed fossilisation processes in wood in Tertiary volcanic environments, and finally **Daniel Pivko** on Neogene limestones and their use as building stone. Altogether, this was a satisfying and broad-ranging programme of palaeontological talks, and there were complementary poster sessions too. The speakers were kind enough to give their lectures in English, for our benefit.

The remaining lectures in the programme, which continued to Sunday morning, concerned igneous and metamorphic petrology, magmatism and volcanology, geochemistry, geodynamics, quaternary geology, popularisation of geology, tectonics, applied geology and information systems. This great range of topics testifies to the vigour of geological research in the Czech and Slovak Republics, and we can look forward to a great deal more first-rate geology from here.

But social events were also on the agenda. First there was a 'garden party' on the Thursday evening, with marvellous Czech cookery available for all and of course Czech beer (arguably the world's best) in the great hall of the ski centre. And then on the Saturday afternoon we had a late afternoon trip to Příbram, and the now defunct uranium mines, formerly the world's largest, which supplied great quantities of uranium to the USSR. Now it is a peaceful museum, with fine displays of ores and minerals, and the long history of the mine (and yes – there were the inescapable trilobites too). Finally we had a happy ride on a small train, formerly used by miners, and came back to a great table laden with copious and welcome beer and food. In the room behind there were fine trilobites and minerals for sale, at exceptionally good prices.

This was altogether a splendid conference, and really well organised by Petr Budil and Oldřch Fatka and their several colleagues – our profound thanks to them both, and to all their helpers. We were impressed also to meet so many young, keen palaeontologists, particularly from the Charles University in Prague. This augurs very well for the future of palaeontology in this part of central Europe. We can expect great things in the next years, building upon an ancient tradition, but at present, it is truly cutting-edge research.

Euan Clarkson
Edinburgh

Brigitte Schoenemann
Bonn

——OBITUARY——

Richard S. Boardman 1923 – 2011

Richard Stanton Boardman, who spent a lifetime researching stenolaemate bryozoans, sadly died this July in Florida, aged 87.

During World War II Rich was a weather man in the Army Air Corps and afterwards, as beneficiary of the American G. I. Bill, he attended the University of Illinois. His passion for bryozoans was developed during his PhD research on Devonian trepostome Bryozoa of the Hamilton Group of New York State. This dissertation was published as a US Geological Survey Professional Paper in 1960.

Rich was first employed as a geologist with the United States Geological Survey for six years and then as a curator in the Department of Paleobiology in the National Museum of Natural History in Washington, DC from 1958 to 1985. Rich spent his whole career at the Smithsonian, which housed one of the finest Palaeozoic bryozoan collections in the world built up by E. O. Ulrich and R. S. Bassler. Helen Duncan of the Geological Survey was his first mentor and he overlapped with Raymond Bassler for several years, about whom he loved to recant stories. Rich said of the Smithsonian that there was “not a grander place to be”.

Rich was part of an illustrious group of bryozoan workers at the Smithsonian. He developed a career-long interest in the evolution, mode of growth, functions, and classification of stenolaemate bryozoans. He realized that the study of living species was necessary in order to advance the understanding of the fossils. The soft parts of living species revealed much of how the animals grew and functioned, and their relationships with their skeletons. He compared the skeletons of living colonies with those of fossil species to reveal new details of their long evolutionary history. Rich introduced new techniques to examine bryozoans in collaboration with students and technicians at the Smithsonian. Living stenolaemate bryozoans were previously studied either as stained soft tissues after dissolution of the skeleton or as a clean skeleton with the soft tissue bleached away. In collaboration with Don Dean he demonstrated that epoxy could be driven into the tissues of modern bryozoans and the thin sections prepared with the tissues attached in life position. For the first time direct observation of the skeletal-soft tissue relationship could be made.

While he was Curator-in-Charge for the Division of Invertebrate Paleontology Rich led a major expansion of the Paleobiology Department. During his last five years in the Smithsonian he was in charge of the Museum's exhibits committee during the modernization of the Paleontology Halls. In addition to his research on bryozoans Rich also co-edited, and co-authored, a volume on animal colonies and a textbook on fossil invertebrates. He was the co-recipient, along with Paul Taylor and Ken McKinney, of the Golden Trilobite Award by the Paleontological Society for the best systematic palaeontology monograph of 1992. This is a beautifully illustrated work on the morphology, anatomy, and systematics of the new stenolaemate bryozoan family Cinctiporidae.

After a career in Washington, Rich moved to Sarasota in Florida for his retirement, but continued to regard bryozoan research as a full-time job until just lately when health issues prevented him from continuing. There he also indulged his other passion, for sport. I got to know Rich in his later, perhaps mellower, years but he was still intensely passionate about his subject and prepared to argue his point of view fully. There was a sense of achievement if he decided that you were perhaps right. Rich was supported throughout his career by his wife Phyllis, and they provided wonderful hospitality to visiting researchers.

In 1953 the first in the series of the *Treatise on Invertebrate Paleontology* was published. This was a slim volume on bryozoans authored by Ray Bassler that contained line drawings of all genera. Soon after publication it was realised a revision would be required. In 1983 the first part of the revised bryozoan treatise was published, which Rich co-ordinated and co-authored; it was a weighty volume dealing with just two orders and with a comprehensive introduction to bryozoans. Trepostome bryozoans, Rich's speciality, were not included in the new edition, and he returned to them for his final project. They were to be published together with the fenestrate bryozoans in a volume co-ordinated by Ken McKinney. Ken died just three months before Rich, two great losses to the bryozoan community, and it is particularly sad that they did not see the completion of the volume. In time it will be finished, and will be a fitting memorial to these eminent bryozoan workers.

Caroline Buttler

The Olympians of Siluria

In Ludlow, in July, the Silurians came home. A combined meeting of the International Subcommission on Silurian Stratigraphy and the new IGCP Project 591 brought together those with an interest in the mid-Palaeozoic, in the Marches of Murchison. At the same time, down the road in Wenlock, a different group re-united, one which could lay claim to just as much longevity, history and even, after a fashion, geology. And they too could boast they were coming home.

They weren't Silurians, however, but – by geography at least – a rather more incongruous-sounding group. They were the Olympians.

With London 2012 looming large on the horizon, crowbarring such words into reports becomes increasingly common, and the plans for next Summer become more complicated. Should one avoid the country like the plague, and head for palaeontological places well-away from hype and high jumps, or should one embrace the extravaganza of top-level sport and culture?

It never crossed my mind that there was somewhere that combined it all, a spot where one could try a dry run, a year in advance. And I certainly never thought I'd discover a rich geological seam within the Olympic movement. But then I'd never thought of attending the Wenlock Olympian Games.

Having written a PhD on fossils from the Much Wenlock Limestone Formation, I'd no excuse for my ignorance of an event that began in the Shropshire town 160 years ago. It's not as if the place is exactly large, yet I knew next to nothing of William Penny Brookes, and the extraordinary events he started in the mid-19th century.

Brookes was one of those Victorian figures who achieved so much you can't help wondering if he eschewed sleep entirely. Over a working life of more than 70 years, he served as the town's doctor, Justice of the Peace, Commissioner for Roads, Railway Company Director, Gas Company Chairman, School Director, Museum Curator, and manager of a new sewerage system. A dynamic, egalitarian figure, 'The King of Wenlock' turned his home town from a rural backwater into a modern centre of innovation and enlightenment. More than anything else, though, Brookes was a tireless promoter of education and health. In 1841, he founded the Wenlock Agricultural Reading Society, a library for the use and benefit of all, particularly local farm-workers and quarrymen. A few years later, this developed into the Wenlock Olympian Society, with Brookes promoting a revival of the Ancient Greek philosophy of moral, physical and intellectual improvement.

Geology played its part in the Society's establishment, as Brookes wished to keep the workers from the local limestone quarries out of the pubs. According to Catherine Beale's excellent book on the topic, *Born Out Of Wenlock*, the town had "an unenviable reputation for drunkenness." By offering athletic competition, Brookes hoped to encourage temperance. "The working man's only possession is his health," he noted, and heavy drinking ensured that many of his fellow townsmen died young.

With this in mind, he organized the first Wenlock Olympian Games in 1850, and if you think commercialism is a modern phenomenon, think again. Brookes got the mine companies to

sponsor his games, and put on specially arranged events exclusively for their employees. As a consequence, any quarrymen imagining the Games might be a doddle compared to a day's work were in for a surprise: Brookes' mine-endorsed version of the shot putt involved a 35lb lump of Wenlock limestone.

"The interesting thing," WOS archivist Chris Cannon told me, "is that they threw it, measured it, and then threw it again with the other hand, measuring that to give the total." The winner was the man whose combined left- and right-handed throws reached the greatest distance.

Limestone milestones and all, the Games were a success, and ran again the next year, competitors coming from all over the country to take part. By the 1860s, interest had bloomed so much that the National Olympian Association was formed, and a Games held in London's Crystal Palace. They didn't run every year, but Brookes never stopped the Wenlock Games, and nor did he cease his efforts to get physical education included in the state schools' curriculum.

Eventually, in the 1890s, as an old man, his petitions received parliamentary approval, and a French nobleman with similar interests came to speak to the wise Wenlockian. The visitor from across the Channel had no initial interest in the Olympian Games, only the promotion of physical education in schools, but when he saw what went on in Wenlock, a seed was sown. And shortly afterwards, Baron Pierre de Coubertin founded what became the international Olympic movement. The first Games, in Athens in 1896, came a year after Brookes had died, aged 86, and enabled de Coubertin to take rather more credit for the idea than he deserved.

Historians of sport and true Olympians, however, recognize this Shropshire lad's true place. 2011 saw the 125th Wenlock Olympian Games, with camera crews from across the globe descending on the town to find out more about the father of the modern Olympiad. All of which is why Wenlock is now not only a district of Shropshire and a geological epoch, but a 2012 Olympic mascot too.

Wenlock Olympian medals

Being an inveterate lover of Wenlock weirdos, I couldn't help but warm to this odd, grey, one-eyed creature. Without a mouth, its functional morphology was problematical, but I'm sure stranger things have turned up in the Herefordshire Lagerstätte a few miles down the road. And buying a cuddly Wenlock from the online shop meant I could amuse myself with a series of Olympian-Silurian juxtapositions:

Mascot on the edge of the conference town? Wenlock-Ludlow boundary.

Mascot in a Shropshire graveyard? Late Wenlock.

Mascot tripping over with an exclamation of "D'oh!"? Wenlock: Homerian stage.

Fellow delegates looked understandably bemused as I carried my new friend around the ISSS/IGCP conference, but forking out those few pounds had a tangible geological benefit. As part of the London 2012 Cultural Olympiad, the Much Wenlock Museum is undergoing a major overhaul. What's more, not only will William Penny Brookes be lauded there for his Philhellenic philosophy, but also for his love of natural history: his collections of local plants and fossils will take pride of place.

Palaeontology has made it into the cultural Olympiad elsewhere too. The 'Discovering Places' campaign of 2010 featured a couple of geological expeditions, whilst next May will see Lyme Regis launch the Jurassic Coast Earth Festival. Tapping into the fact that the Olympic sailing events will be in Weymouth and Portland, the Devon and Dorset World Heritage site will feature numerous cultural activities. Our very own Association will be involved, though I'm sad to say that support for a Palaeo-lympics hasn't been forthcoming. This is despite a fossiliferous 'Faster, Higher, Stronger' being a sure-fire crowd pleaser[1].

Talking of fire and crowds, keep an eye out for the Olympic flame, too. In 2010, the Vancouver Winter Olympic torch relay took the burning stick fully trans-Canada, and I had the pleasure of watching it sweep past the University Earth Sciences building in St John's. I'm not sure of the 2012 itinerary, but it must get within spitting distance of at least one geology department. If it doesn't, though, you can always become a geological Olympian yourself. Birmingham Earth Science alumnus Paul Manning took that very route, eschewing rocks and fossils for a bike, and pedalled to a series of Olympic medals. This culminated in gold in the team pursuit at the 2008 Beijing Games.

[1] Trilobite-racing was mentioned at the last Council meeting, but rejected.

Cycling seems like a perfectly palaeontological pursuit, one that might have seen Croll of Scotland or Milankovitch of Serbia take the laurel wreath, but maybe Manning is unique. I certainly don't know of any podium-placed palaeontologists. Perhaps the definition needs broadening, then. Maybe we can erect our own echinoderm pentathlon, or crustacean decathlon. And what are ammonoid and conodont biostratigraphy if not a form of synchronized swimming?

In the mean time, pay a visit to the Welsh Borderlands and immerse yourself in these amazing tracts of 19th century history, in the annals of an era when anything was possible, even in tiny Shropshire towns. And if you peer carefully into the shadows along the Olympian Trail, who knows? Perhaps you'll spot the philanthropic King of Wenlock in conversation with the self-centred King of Siluria? I know whose team I'm on.

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Palaeontology in — MADAGASCAR

The following is a short personal commentary on the state of Palaeontology in Madagascar written by Miky Lova Tantely Raveloson, a PhD candidate student from the Department of Palaeontology and Biological Anthropology, Science Faculty, University of Tananarive. This article will be the first in a series of essays examining the past, present and future of palaeontology in different countries around the world.

Madagascar has undergone an overwhelming advancement of palaeontological researches in the last two centuries. The first palaeontologists who began expeditions there were French scientists. Most of them were invertebrate palaeontologists such as Collignon whose work focused on ammonites. In addition, geologists and palaeontologists such as Besairie (1972), Deperet (1896), Lavocat (1955) and Pivetau (1926) have worked on the Cretaceous dinosaur-bearing sediments, and have surveyed the palaeoherpetological fauna. There were also Japanese scientists led by Ikuwo Obata and Yasumitsu Kanie, who in 1975 focused their survey on the Upper Cretaceous dinosaur-bearing sediments in Majunga.

Figure 1. Skull of the theropod dinosaur Majungatholus atopus *(Abelisauridae) from the Cretaceous Maevarano Formation.*

The arrival of American researchers in 1993 marked a spectacular expansion of research, related to palaeontological expeditions. There was collaboration first between the University of Majunga and Stony Brook University, New York, USA, and then between the University of Antananarivo and Stony Brook University. The field work was initially and subsequently guided by the famous palaeontologist David Krause, whose knowledge of the palaeofauna related to the fossils from the Cretaceous Maevarano Formation – located in the sedimentary basins of north-west Madagascar – is internationally recognized. In addition, John Flying from AMNH (American Museum of Natural History) has been working on mammal-like reptiles and the sauropod-like species *Azhendosaurus madagascariensis* from the Middle Triassic exposures located in the Morondava Basin.

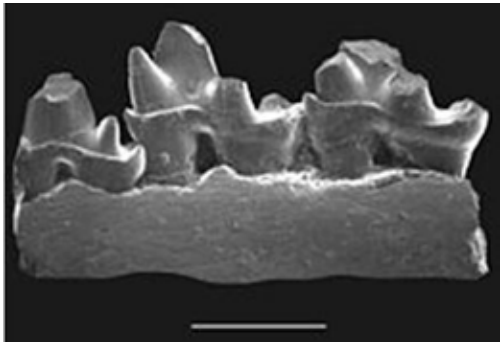

Figure 2. A fragment of a mandible from the mammal Ambondro mahabo *of the Middle Jurassic, Majunga Basin.*

Currently, the study of palaeontology in Madagascar is progressing, but it is dependent upon external funds and collaboration with foreign universities. Most of the research expeditions in the country were supported financially by foreign universities because the Malagasy Government does not have any funds to support expeditions, and all materials used for the field, transportation, accommodation *etc*. depend on the external grants of the foreign researchers. In addition, in the whole country there are only two universities which include expertise in palaeontology:

In Tananarive, there is a Department of Paleontological and Biological Anthropology included in the Faculty of Sciences, which was founded more than 30 years ago (the Science Faculty was founded 50 years ago). In this department, the professors number about 15 and study three specializations: Biological Anthropology, Primatology, Palaeontology and some sedimentary subjects. In Majunga University, located in North-West Madagascar, Palaeontology is included in the Department of Earth Sciences and Environment and there are five people in the professorial technical staff.

Figure 3. A complete skeleton of a fossil amphibian from the Isalo Group, Lower Triassic, Morondava Basin

The duration of student training is three years at the University of Tananarive after two years of studying different kinds of subjects related to the biological and earth sciences. The student graduates with a DEA (Diplômes d'Etudes Approfondies), which is considered equivalent to a Master's degree in US or UK universities. At Majunga University, the duration of study is four years but it is not really specialized, and the student graduates at Master level one. In Madagascar,

palaeontology is the least developed science because in our six universities, only these two (Tananarive and Majunga) include the study of palaeontology.

As mentioned above, the grants which are used to support every field trip always come from external funding through the research expeditions led by American, French, Polish or Japanese teams of researchers. However, it is quite difficult to make publications from field expeditions without the opportunities offered by the foreign researchers who are granted financial support from their home country. Each Malagasy researcher or graduate student cannot pursue his or her personal research unless there is a seasonal arrival of foreign researchers every two years or more during the Summer period.

The professionalization of palaeontological research as a job has been unthinkable until now; as proof of this, most graduate students from the University of Tananarive are jobless until they are recruited as professors of Earth and Life Sciences in High School. In addition, the subject of palaeontology is not specifically included in the syllabus offered by the Malagasy Government unless it is taught in the field of Human Evolution at K-12 class and Stratigraphy at K-11 class. And unfortunately, there are some schools which do not allow the teacher or professor to teach Human Evolution as revealed by fossils, because the history of life revealed by the fossils and palaeontology is always considered to be just anecdotal. That is one of the huge problems which limit the development of palaeontology in schools.

Although there is this barrier on the development of palaeontology in Madagascar, the country's richness in vertebrate and invertebrate fossils is still not wholly exploited. In my view, a Non-Governmental Organization specializing in supporting palaeontological research should be created, or an Applied Research Centre for Palaeontology, which will combine foreign research expertise and the national researcher know-how. Most Non-Governmental Organizations set up in Madagascar – like WWF (World Wide Fund for nature), CI (Conservation International), Durell Trust for Conservation – have been focusing their projects on biodiversity and conservation, *i.e.* on ecology and the conservation of living animals. The two museums located separately in Majunga (Mozea Ankiba) and in Tananarive (Museum of Tsimbazaza Park) are not able to develop their own palaeontological researches because the fossil collections need to be renovated and, in addition, there is a lack of a curator or specialist in fields such as palaeomammology, palaeoichthyology, palaeornithology or palaeoherpetology, or otherwise sedimentology or ichnology.

Finally, a Palaeontology Park should be created which can attract researchers and scientific tourists to discover the palaeobiodiversity of Madagascar and the endemic fossil faunas located there. The setting up of an Education Resource Center for Paleontology is also very helpful in order that fossils can be inculcated into the minds of the Malagasy people who are not aware of the preciousness of the fossils and the occurrence of dinosaurs.

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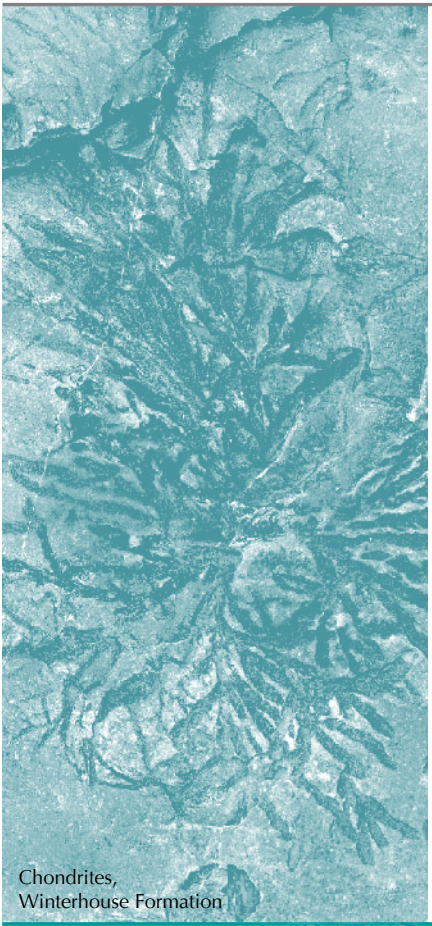
ICHNIA 2012

Memorial University of Newfoundland
St. John's, Canada

11 – 23 August, 2012



Chondrites,
Winterhouse Formation

SCHEDULE

August

11th – 13th:	Pre-conference fieldtrip:
	Ichnology of the Hawke Bay Quartzite and Winterhouse Formation
	Benthic ecology at the Bonne Bay Research Station
13th:	Registration and icebreaker
14th – 15th:	Scientific sessions
16th:	Intra-conference fieldtrip followed by banquet
17th – 18th:	Scientific sessions
19th – 21th:	Post-conference fieldtrip: Precambrian-Cambrian Boundary at Fortune, and Ediacara biota.
22st – 23nd:	Post-conference core workshop for graduate students.

ACCOMMODATION

Campus accommodation is available for the 13 – 18th August

$50.00per night (single occupancy room)

$37.50 per night (shared room).

There are also good hotels quite close to the University.

REGISTRATION

Pre-registration will be available at www.ichnology.ca

Payment by visa will be possible online through the Memorial University conference services office.

A thematic volume is proposed, manuscripts to be submitted ***before*** the 1st August 2012 (this is a hard deadline!).
The volume will be published by the Geological Association of Canada.

WWW.ICHNOLOGY.CA

Wiman's legacy: 100 years of palaeontology in Sweden

Fig. 1. Carl Wiman (1867–1944). The portrait was painted in 1931 by L. Sparre, and is part of the art collection of Uppsala University.

One hundred years ago palaeontology became a university subject in Sweden. In 1911 ***Carl Wiman*** *of Uppsala University was given a personal chair in palaeontology, the first ever in Sweden. There were, of course, earlier Swedish palaeontologists of note, including Angelin, Törnquist, Linnarsson, Holm, Lindström, Lundgren, Moberg and Nathorst. But Wiman was different, and his institute and collections became a leading force in the subject in Sweden. Even today his legacy is very much alive.*

In the collections of the Museum of Evolution in Uppsala there is a heart-shaped specimen of the sea urchin *Micraster*, from the Cretaceous of Aachen in Germany. It was collected by Lieutenant Ernst Wiman in the 1860s, and it is nice to think that he may have presented it to the love of his life, Julie Sommer. We can only speculate, but we do know that Ernst fought a duel against a Prussian officer over her, and that the pair eloped together. Her family did not approve of the match because he was Swedish and a Protestant, while they were Roman Catholic. Finally, they relented, and the couple eventually moved to Sweden and Märsta, south of Uppsala. Here Ernst became the station master on the new railway line between Uppsala and Stockholm. In 1867 the couple had their only son, Carl Johan Josef Ernst Wiman.

From an early age Carl joined his father on excursions. The Summers were often spent with the grandparents in Aachen or with a maternal uncle in Valkenburg. This uncle was a keen amateur geologist and palaeontologist who introduced Carl to the subject.

Carl Wiman was described by his contemporaries as a charismatic person, but with strong opinions which he was prepared to defend vigorously. His students loved him, and his lectures, full of anecdotes, were immensely popular and inspiring. His scientific profile was high, with a wide correspondence, election to membership of several geological societies, and participation in scientific congresses and meetings all over Europe.

All his formal education took place in Uppsala, where he earned his PhD in 1895 on studies of graptolites. The following year he became a docent (equivalent to an assistant professor in modern terms). However, by that time, he had taken charge of the palaeontological collections at the Institute of Geology and soon became responsible for teaching classes in palaeontology and pre-Quaternary historical geology. According to Wiman himself it was A.G. Högbom, professor of geology in Uppsala, who, during field work in Jämtland in 1891, prompted him to take up his own research. Wiman had produced about 30 papers on stratigraphy and invertebrate palaeontology, when his career took an unexpected turn.

Expeditions

In 1905 Wiman published his first work on fossil vertebrates, when he described fossil penguins collected during Otto Nordeskjöld's Antarctica expedition (1901–1903). In 1908 he joined a Swedish expedition to Svalbard and here he made the most important discovery of his career. In the Triassic beds he found the so-called Fish Horizon, rich in fossil fish and labyrinthodont tetrapods. He did not go to Spitsbergen himself, but during 1912 and 1918 six expeditions were organised, bringing back material, including ichthyosaurs, for Wiman to describe. The 1912 expedition was led by his student Erik Stensiö (1891–1984), who established his career describing the fish fauna.

Collecting

To enable comparative studies Wiman acquired a great number of vertebrate fossils. In 1919 he bought from the fossil hunter Charles Sternberg two mosasaurs (*Platycarpes* and *Eonanator*) and a fine *Pteranodon* specimen from the Cretaceous Niobrara chalk of the USA. Fish fossils, a plesiosaur and several exquisite ichthyosaurs came to Uppsala from Besano in Switzerland, Peterborough in England and Holzmaden in Germany. Over several years Wiman also collected remains of marine reptiles from the Cretaceous of Scania in southern Sweden. From the geologist Ivar Sefves (1886–1953) came South American mammals collected in Peru and Bolivia (1910, 1920).

Pterosaurs were a passion with Wiman, and he tried to get the best specimens money could buy. His main financial support and patron was a chamberlain to the King at Stockholm's Royal Palace, Axel Lagrelius (1863–1944). A successful businessman, Lagrelius had already arranged funding for several Swedish natural history expeditions, including the Antarctica expedition from which Wiman described the fossil penguins. Cape Lagrelius on Ross Island is named after Axel Lagrelius.

In his diary of 3rd August 1922, Lagrelius writes that he would try to persuade consul Aspgren to donate the wherewithal for Wiman to obtain his flying reptile. For this service Aspgren would receive the Order of the Vasa, which was an exclusive reward to citizens for service to the state and society in Sweden at that time. The pterosaur in question is perhaps the finest specimen in existence of *Dorygnathus*, from the Jurassic of Holzmaden in Germany. By November 1922 the contract was signed, and the specimen went to Wiman for 4,000 Swedish crowns. On 30th April 1924 Lagrelius brought the Archbishop of Uppsala and Crown Prince Gustav Adolf to admire the pterosaurs and other exhibited fossils.

With the help of Lagrelius, Wiman could also employ Charles Sternberg to collect dinosaurs, tortoises and crocodiles from the late Cretaceous beds in New Mexico. Expeditions during the Summers of 1921 and 1922 resulted in several exceptional specimens, of which a near complete specimen of *Pentaceratops* and the holotype skull of *Parasaurolophus tubicen* should be mentioned. Sternberg offered to continue his collecting efforts for Wiman, but resources were running low and something else had caught Wiman's attention.

The China adventure

In a letter to Wiman and Lagrelius in 1922 the Swedish geologist John Gunnar Andersson (1874–1960) writes "… it is hardly likely that we Swedes will ever again be in a more opportune situation…". He is referring to the extensive collections of Chinese fossil mammals, birds, fish and reptiles that, during the years 1918 to 1925, were sent to Wiman in Uppsala. The two men had known each other from student days, as well as through the Svalbard and Antarctica expeditions, when they had made friends with Lagrelius. Together, these three generated a lot of interest for the China adventure, and they founded a special China Committee which attracted funding for the

Fig. 2. Carl Wiman and some of the 300 boxes of Chinese vertebrate fossil that arrived in Uppsala during the Summer of 1923. This was the sixth consignment of boxes to arrive. Photographer unknown.

expeditions to China from the Swedish government and private patrons.

Andersson had arrived in China in 1914, as an advisor to the Chinese government on mining issues. A couple of years later, fossil plants and mammals along the banks of the Huang He River (Yellow River) attracted his interest. He was keen to use the fossils to date the sequences, and got both the Chinese Geological Survey and Wiman interested.

Andersson and Wiman were undoubtedly very well aware of the significance of these finds. The idea was that Andersson should collect during his many travels in China, and send fossils to Uppsala for Wiman to describe. An agreement was established with Dr Ding Wenjiang (known as V.K. Ting outside China) at the National Geological Survey, that described and referred material should stay in Uppsala, while as many duplicate specimens as possible should be repatriated to China after study.

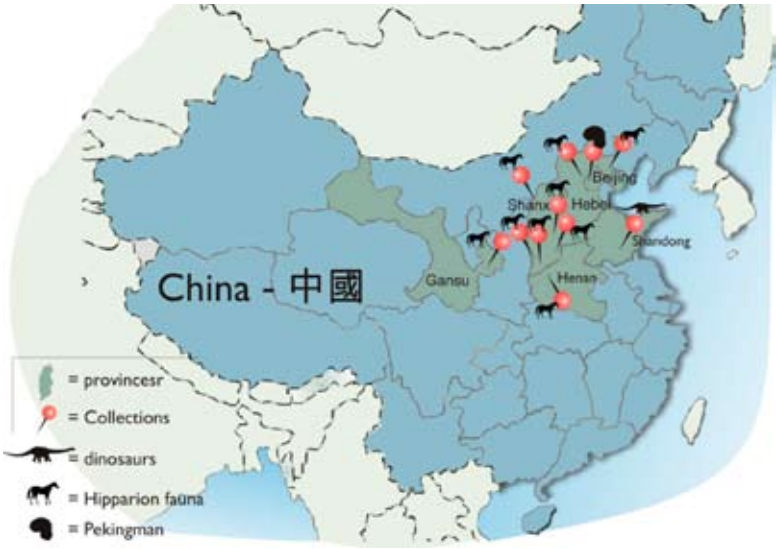


Fig. 3. Map of present day China, showing the areas in which Otto Zdansky and his Chinese colleagues collected fossils during 1921–1923. Most of the collection is comprised of fossils of mammals from the Hipparion *fauna (13–1.5 million years old), but includes remains from* Homo erectus *(ca. 500,000 years old), and dinosaurs (150–80 million years old). The entire collection bears the name Axel Lagrelius, after the main beneficiate.*

Otto Zdansky

Andersson had a contract to fulfil for the Chinese government, and by 1920 the task of handling this as well as collecting became overwhelming. He asked for a qualified scientist to come and lead the collecting, and Wiman sent the young Austrian palaeontologist Otto Zdansky (1894–1988). Zdansky would not receive any salary, but would have his expenses covered. He was also promised that he could research and publish his findings on material he collected. Zdansky quickly finished his thesis under the supervision of Othenio Able in Vienna, and set out for China. During three intensive years he and his Chinese co-workers managed to acquire the substantial collection which is today housed in Uppsala.

Perhaps the most significant find was made during the first month of field work. Zdansky was working at the Pleistocene cave fillings in Zhoukoudian, a short distance west of Beijing (today a World Heritage Site). Here he discovered a tooth of prehistoric man, and immediately understood its significance. But he did not tell anyone about this find, realizing that such a sensational discovery would probably jeopardise his position of being able to describe the material he was collecting. Zdansky left China just before Christmas 1923 and returned to Uppsala, where he wrote up several monographs on the mammals he had brought back. However, in 1926 Zdansky found another tooth amongst the material sent to Sweden from Zhoukoudian. This time Wiman was told about the two finds, and in 1927 Zdansky described the material as *Homo*? sp.

In 1927, Birger Bohlin (1898–1990), another of Wiman's students, arrived in China to continue the work at the caves in Zhoukoudian. On 16th October that year he found a third tooth, which came to be used to establish the new prehistoric man *Sinanthropus pekinensis* Black & Zdansky (now a junior synonym of *Homo erectus*). The find was announced at a meeting in Bejing in 1927 which the Swedish Crown Prince and Axel Lagrelius attended, together with Andersson, and which made headlines all over the world. With Chinese colleagues, Bohlin later found more material of Peking man, but in 1929 he joined with Sven Hedin in his explorations of Central Asia, so putting an end to the Swedish China adventure.

A temple for the fossils

A University Chair of Palaeontology and Historical Geology was established for Wiman in 1922, and on 16th October 1924 his research group became a separate Institute of Palaeontology. Space was a big problem, mainly due to the huge collection from China, which continued to arrive. During the Summer of 1923 for instance, about 300 wooden crates with fossils arrived in Uppsala.

Wiman's two preparation laboratories were lodged in the basement of the Geological Institute; on the floor above was his own study room and the offices of his assistant, another specialist and various fossils, among them the hip section of the sauropod *Euhelopus*. Modern facilities such as electric lights were absent. Preparation of the fossils took place under gaslight or the light from kerosene lamps. The invertebrate collections were in rooms on the top floor and the remaining vertebrate material scattered all over town in 11 different stores. The skull of *Euhelopus* was at Gustavianum (the former main building of the University), the vertebral column and other material were in rooms hired from the 'Student Nations'(student clubs) of Uppland and Stockholm, and in the basement of the University building and the corridors of the newly built Zoological Institute.

The solution was to build a museum, specially designed to house the collections. Wiman lobbied actively, with the help of his friends, and promoted his case in the newspapers, and in 1929 the

Fig. 4. Photographs from Wiman's research institute when it was housed in the 'Konsistoriehuset' next to the cathedral in Uppsala. (Photographer unknown)

A) The picture is labelled "The family". Wiman sitting. At the back, from left to right, Elsa Warburg, Märta Söderlund, Otto Zdansky, Nils Hjort (the latter in charge of preparing fossils and later caretaker in the new Museum). Taken early 1921.

B) Wiman preparing fossils from China.

C) In the light of a kerosene lamp, the sauropod Euhelopus *is being prepared by Wiman.*

Swedish government gave 791,000 Swedish crowns towards a museum building. By 1931 it was ready, and was hailed as "a temple for the fossils" in the newspapers. On the lower floors were offices and labs, with the second and third floors dedicated to exhibits.

Fig. 5. The Museum is being filled with specimens. A) A 1931 Chevrolet truck arrives with fossils at the new museum building, while the building process is still on-going. Wiman supervises. B) Wiman in the upper floor of the Museum during the construction. Large specimens are already mounted on the wall. C) A skeleton of the ichthyosaur Ophthalmosaurus *from Peterborough is transported across the snow to the new museum. Uppsala cathedral in seen in the background. (Photographer unknown)*

Historically important collections made by Bromell, Wahlenberg, Marklin and others were at this time donated to the new Museum from Uppsala Vetenskapssocietet (the Scientific Society in Uppsala – the oldest of its kind in Sweden, and still active). Wiman was supposed to retire in 1932, but the work of establishing the collections and exhibits in the Museum made it necessary for him to stay on for another year. He also ran into problems with the China Committee and the Chinese government. They argued that too few duplicate specimens had been returned, and although Wiman fought against it, he eventually had to relent. During the years up until 1936, a number of duplicate specimens and over 300 casts of described material were returned to China.

The Chair of Palaeontology in Uppsala

The day before he died Wiman was still working at the Museum. It was 1944, and he was 77 years old. Erik Stensiö had occupied the Chair of Palaeontology between 1933 and 1935, on Wiman's insistence, although Stensiö would rather have been working with his material in Stockholm. After a heated argument about the arrangement, Wiman refused ever to speak with Stensiö again. Stensiö's successor was Wiman's next student, the gifted Gunnar Säve-Söderbergh (1910–1948). He was only 27 years old, and got the position after a fierce academic debate. With Stensiö he had published research on early fish and tetrapods from Greenland, and he had named *Ichthyostega*. Stensiö and Säve-Söderbergh were among the pioneers of the so-called Stockholm School of studies in early vertebrate structure and evolution.

Shortly after his appointment, Gunnar Säve-Söderbergh was diagnosed with tuberculosis. While he was confined to his sick bed, Elsa Warburg (1886–1953) performed much of the daily work involved in running the institute. She was another of Wiman's students, having taken her PhD in 1925.

Fig. 6. Wiman's students. A) Erik Stensiö, B) Gunnar Säve-Söderbergh, C) Per Thorslund, D) Elsa Warburg. When Professor Säve-Söderbergh was ill, Warburg was running the Museum and Research Institute. (Photographer unknown)

Paradigm shift

When Gunnar Säve-Söderbergh passed away in 1948, a paradigm shift took place in Uppsala. Per Thorslund (1900–1981), yet another student of Wiman's, got the chair in 1950, after several years working at the Swedish Geological Survey. His research interest was with the Lower Palaeozoic successions, and not vertebrate fossils. Birger Bohlin worked at the Institute during that time, but although he had worked on vertebrate fossil from China, he now largely turned to invertebrates.

Valdar Jaanusson (1923–1999) was at the Institute from 1945 until 1961, when he moved to the Natural History Museum in Stockholm and eventually became the professor there. Jaanusson is widely known as one of Sweden's most brilliant palaeontologists.

Otto Zdansky could not get employment at the Museum during Wiman's time, and moved in 1927 to Cairo to take up a professorship there, but he returned to Sweden and Uppsala in 1950, and worked until 1978 as a curator at the Museum during Thorslund's time.

Anders Martinsson (1930–1983) started his career during Thorslund's time. He is well known for his work in micropalaeontology, but also made great efforts to modernize publication policies and traditions in Scandinavia. In 1970 Martinsson founded the Institute of Paleobiology, and moved from the Museum to other facilities. In 1978 he was awarded a personal chair through the Swedish Research Council.

When Thorslund retired in 1966 the attractive position went to Professor Richard Reyment. He is a prolific Australian–Swedish scientist, with a wide range of research interests, and has made important contributions, especially in the field of numerical palaeontology. During Reyment's time the old museum building saw much-needed renovation, such as new wiring for electricity, new storage facilities, and ventilation. During Reyment's time, too, Wiman's vertebrate collection was curated and studied by Dr Niall Mateer, who finished his PhD in Uppsala on the material.

The Museum of Evolution

The Institute of Paleontology was separated administratively from the Museum in 1978, with Professor Reyment as Chair of Palaeontology, as well as head of the Museum. In 1983 the Institute of Paleobiology moved back to the museum building, albeit without Professor Martinsson, who died of cancer briefly before the move.

When Professor Reyment retired in 1990, the chair went to Professor John S. Peel. He took up the position in 1992, and also became head of the Museum in 1993. Professor Peel is widely known for his work on early molluscan evolution, and came to Uppsala from a career at the Greenland Geological Survey in Copenhagen. In Peel's hands, the Museum administration, its collections and exhibits were reorganized and modernized. Major renovations took place and, in particular, the exhibits were made more attractive to visitors.

However, in 1999 Wiman's Museum ceased to exist as a separate entity. All natural history collections at Uppsala University were then amalgamated into the new Museum of Evolution, with Professor Peel as the head until 2008. The Museum of Evolution today encompasses Botany, Mineralogy, Zoology, and Palaeontology, with the two last collections still being exhibited in their original museum buildings.

Wiman's legacy

In 2007 even the research group moved out of Wiman's museum building, to join the rest of the geologists at the Institute of Geology. Thus ended an era in the history of the Museum. During the 100 years since Wiman became Professor of Palaeontology, many of the most renowned palaeontologists in Sweden have worked in the museum building, and Swedish palaeontology has in many ways been formed by Wiman's Museum and his many collections. This heritage from the past is carried forward by today's researchers who come from near and far to work on Wiman's legacy – a world class fossil collection in Uppsala.

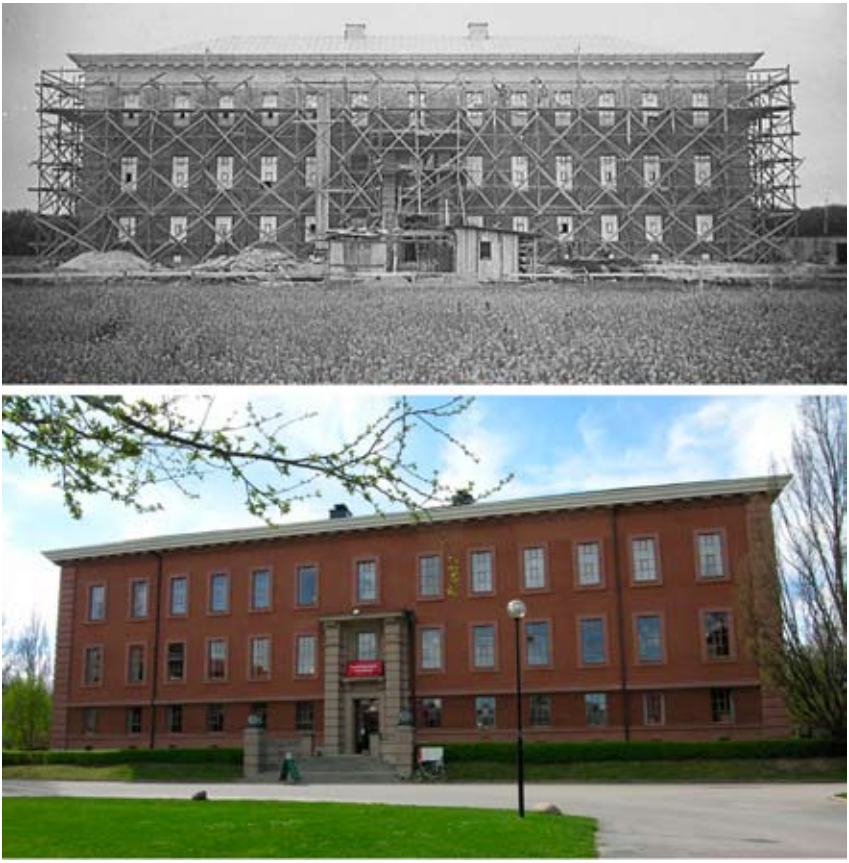


Fig. 7. A temple for the fossils. The Museum during the construction, and the museum building today, now a part of the Museum of Evolution.

Acknowledgements

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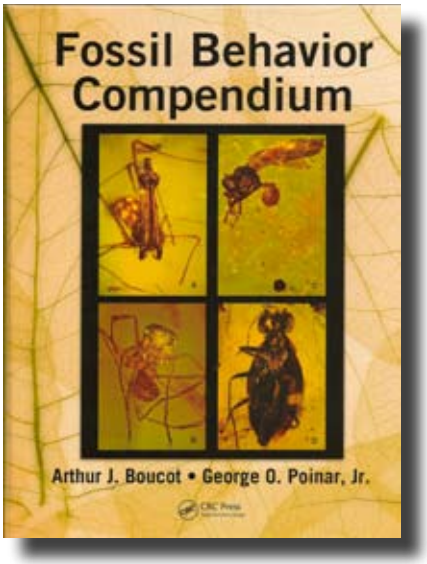
Book Reviews

Fossil Behavior Compendium

Arthur J. Boucot & George O. Poinar Jr., 2010. CRC Press, Boca Raton, 424 pp, £99.00. ISBN: 978-1-439-81058-3.



From the outside, this is a very appealing book, in terms of both look and feel. When I first held it, I had the immediate feeling that I was holding a quality work and eagerly sought to read through it to prepare this review. It should be mentioned at the outset that this book is not a stand-alone volume as the title might suggest. Rather, it would be better regarded as a supplement to Boucot's (1990) seminal work on the subject. However, it does include more than 250 new categories of data, such as chapters on disease, teratologies, genetic defects, seagrass communities and flying and gliding vertebrates to name a few, and as stated in the introduction, palaeontological evidence supporting the original data has more than doubled since the original volume.

The book begins with an extensive contents list occupying 15 pages. The numbering and lettering system used throughout this section is unpleasant to the eye, but as a result of cross-referencing throughout the text it definitely facilitates ease of navigation. There are a few instances where the listing order is a little misleading. For example, there is a section heading titled "Parasitic insects other than wasps and flies" followed 19 headings later by "Strepsipteran parasitism" (strepsipterans are parasitic insects). Sandwiched between these two entries are all manner of headings relating to a wide range of different parasite and disease conditions in a broad range of major taxa, particularly vertebrates.

The 37 major subject headings are as follows: Functional morphology; Specialized, potentially interacting biological substrates; Mutualism; Host-parasite and host-parasitoid relationships and disease; Density and spacing; Predation and feeding behaviors; Communication; Trace fossils and their formers; Specialized substrates; Sexual behavior; Parental care; Depth behavior; Phoresy; Defense; Carrier shells; Pollination ecology; Social insects; Long-range migration; Molting; Sensitive plants; Reptilian and mammalian burrows and dens; Vertebrate endocranial casts; Preening; Grain-size selectors; The seagrass community complex; Shelter; Flying and gliding vertebrates; Possible genetic-developmental defects; Teratologies; Disease; Marine molluscan larval types and their behavior; Competition involving bryozoans; 'Lost' behaviors and their vestigial evidence; Stunting; Oceanic vs neritic; Human behavior; Summary and conclusions.

Each entry is followed by a 'reliability classification', explained in the introduction, which rates the observed or suggested behaviours from very certain to highly speculative. This is useful for those who may not be familiar with a particular group of organisms, and the speculative categories provide clear avenues for potential future research. The book culminates with an extensive reference section of 83 pages and separate author, taxonomic and subject indices, although the taxonomic index is rather incomplete.

A 'compendium', as per the title of the book, can be defined as 'a collection of concise but detailed information about a particular subject'. I believe that on the whole this has been achieved, but it does not necessarily make for easy, pleasant reading as a result of short sentences and repeated phrases. However, in some cases where the authors have discussed the subject area in more depth then the prose reads very well. Indeed, some subjects are discussed at length and in depth, whereas others are only briefly mentioned in a single sentence with a supporting reference, and to my reasoning there seems to be no particular order to this. Hence, you may be lucky and find your subject area thoroughly discussed or you may simply be referred to the primary literature. One particularly frustrating aspect of this book is that regardless of which chapter you are reading you will almost certainly be referred back to Boucot (1990). Indeed, most of the tabulated data represent "additions" to various tables of Boucot. Hence, as inferred earlier, this work should be treated more as a supplement than as a comprehensive stand-alone volume.

There are a number of instances throughout the volume where it appears that sections have been written in the form of 'separate papers' by the second author, and it really becomes confusing as to how exactly this work has been co-authored. Examples include: Fossil flatus (p. 22); Gregarine infections of insects (p. 54); Notes on the origins and evolution of *Bacillus* in relation to insect parasitism (p. 68); Eggs, oviposition, and maternal care in amber (p. 152); Swinging springtails: phoretic behavior in fossil collembola (p. 183). In the 'paper' on page 54, a new genus and species of parasite from a cockroach in Burmese amber are described and named. This is a highly inappropriate forum for a new taxon, and it is hardly surprising that a Google search of the new genus name reveals only a single result … the website of the publisher.

Given the incredibly broad coverage of this volume it would be impossible for a single reviewer to comment authoritatively on the accuracy and completeness of all taxonomic groups and modes of preservation. Hence, I will comment primarily on arachnid and amber entries as exemplars. In some cases the text can be misleading. For example, page 39 cites a Dominican amber record as the oldest validated example of insect parasitism by a nematomorph. However, the specimen referred to is not an insect, but a spider, and is correctly identified and figured as such under a different section on page 50. Under "Ticks and mites as micropredators and potential disease vectors" there is no mention of the subfossil tick reported from the auditory canal of a Pliocene woolly rhinoceros by Schille (1916). The section concerning "spider webs, spinnerets and bundled prey" correctly cites Zschokke's description of araneoid spider silk in Lebanese amber, but omits a more important paper that actually quantifies and compares spider silk threads in different ambers (Zschokke 2004). This section also refers to *Attercopus* from the Devonian of New York as the producer of the earliest known spider silk, although this fossil taxon is no longer classified as a spider (Selden *et al*. 2008). Important palaeoarachnological omissions include the mass-moult-mate hypothesis in eurypterids (Braddy 2001) and although not strictly behavioural, it would have been worth noting the interesting study by McCoy & Brandt (2009) who determined how to differentiate between

scorpion moults and scorpion whole body fossils. This would have fitted rather nicely in the Molting section (Chapter 19). A fossil phoretic pseudoscorpion in Baltic amber described by Judson (2004) was also overlooked. Presumably specialists in other taxonomic groups will note omissions in their own areas of expertise.

As a result of constant new discoveries such works as this volume are usually out of date before, or shortly after, they run off the press. For example, the occurrence of a mantispid larva being carried by a spider in Baltic amber (Ohl 2011) can now be added to the short list of known fossil occurrences of hypermetamorphosis (p. 54, Table 5). An addendum at the end includes some of the more obvious last-minute inclusions of recently published material, but is also evidence of older papers omitted in the main text.

Throughout the volume I spotted 69 typos or inconsistencies (not including the reference list) and in some (but not many) places the wording is rather awkward. Some of the personal communications referred to date back a decade, and one must wonder whether there has been any advance in those areas since that time. Of the 335 figures only 19 are in colour (not including those on the cover). In many cases the image reproduction is poor while in others it is terrible (*e.g.* Fig. 120). Even the quality of the four colour plates leaves a lot to be desired. Most images have been reproduced from other works with permission and only a relatively small number of the images are new. However, some do represent the first published examples of specific behaviours, such as the pseudoscorpion carrying an egg sac (Fig. A27). Overall, the quality of production smacks of print-on-demand, but there is no indication of this on the publisher's website. More attention to copy editing and image reproduction, sharper photos (easy to do now with amber inclusions using automontage software) in colour and better quality paper would better justify the high price of this book.

Although on the whole this review may appear negative, these are only a few pages of minor quibbles relating to a work of 424 pages and taxonomic coverage across the board, throughout the entire fossil record. Of course there are going to be errors and omissions. Nonetheless, I found the book highly informative and often fascinating, and am much richer in knowledge for having read it. It is a book I will certainly refer to on many future occasions and it deserves a place in any comprehensive palaeontological library or palaeo research lab. However, the high cost may exclude it from many personal book collections. As stated in the preface to the book, it is apparent that many genetically determined behavioural characteristics are 'hard wired' and very conservative, implying that they can be used as taxonomic characters at both genus and family levels. The volume certainly provides ample evidence of this.

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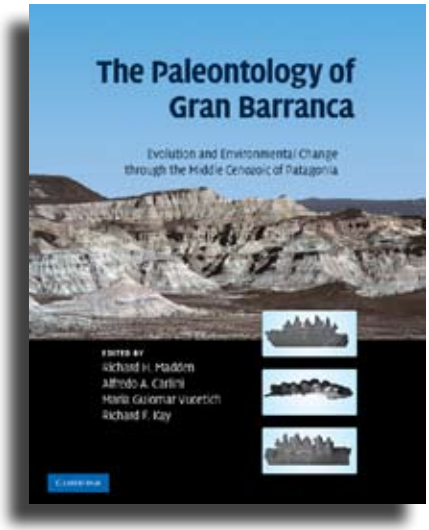
The Paleontology of Gran Barranca: Evolution and Environmental Change through the Middle Cenozoic of Patagonia

Edited by Richard H. Madden, Alfredo A. Carlini, Maria G. Vucetich and Richard F. Kay, 2010. Cambridge Univerity Press, Cambridge, 458 pp, £100. ISBN: 978-0-521-87241-6.



The Paleontology of Gran Barranca made me re-read George Gaylord Simpson's 1934 *Attending Marvels – A Patagonian Journal*, which has a wonderful opening line: "Intimate details about the molar teeth of the larger extinct rodents probably have their place in life, but they are a very poor prelude to events more immediate and more stirring." The authors of this 2010 book disagree; they update Simpson's work and cite him many times.

"Gran Barranca in Patagonia is important since it exposes the most complete sequence of middle Cenozoic paleofaunas in South America and the only continuous continental fossil record of the Southern Hemisphere 42 to 18 million years ago, when climates at high latitudes transitioned from warm humid to cold dry conditions." Fossils from Patagonia provided Charles Darwin with one of his first hints about evolution. Taken back to England, Richard Owen recognized them as the remains of extinct animals with completely unexpected characteristics, quite unlike any other found anywhere else on Earth. The present land connection between North and South America is of fairly recent geological origin, and when the Age of Mammals began, South America was separated from

the rest of the world and developed its own unique fauna. The Isthmus of Panama arose later as a land bridge allowing cats, dogs, bears, horses, mastodons, peccaries and others into South America, and armadillos, opossums *etc*. to invade the North.

The editors: Richard Madden (Duke University, North Carolina), Alfredo Carlini, Maria Vucetich (Universidad Nacional de La Plata, Argentina) and Richard Kay (Duke University, North Carolina) have done an admirable job. *Palaeontology of Gran Barranca* is an important contribution to South American vertebrate palaeontology; the first detailed treatment of Gran Barranca's impressive vertebrate faunal sequence. Not surprisingly, nearly 80% of contributing authors are Argentinian. Twenty-nine well-written papers are in English with Spanish abstracts; and the volume is separated into five parts: 1) Geology, II) Systematic Palaeontology, III) Patterns of Evolution and Environmental change, IV) Regional applications, V) A summary by the editors 'Gran Baranca: a 23 million year record of middle Cenozoic faunal evolution in Patagonia'.

The volume presents a geochronology of fossil mammal species and collates the latest studies of stratigraphy, sedimentology, vertebrate, invertebrate, plant and trace fossils. The new geochronology refines understanding of mammalian evolution during a period of major faunal revolution. The revised taxonomy allows re-evaluation of the origination and extinction of marsupials, herbivorous mammals and xenarthrans and the earliest occurrence of rodents and primates in southern latitudes. One improvement would be for the last paper, by Madden *et al.*, to have a superimposition on the panorama of figure 29.1 of the palaeontological succession. The volume also includes new information enriching understanding of climate variation during the middle Cenozoic. Based on over ten years of fieldwork and study, it provides new evidence about biotic diversity, evolution and change in native species. By presenting a new, more detailed analysis of the fossil record it yields information about diversity of Patagonian environments and an accurate measure of environmental change.

Illustrations are well captioned but would have been better if larger (particularly the locality maps and stratigraphic columns in some papers). For such an expensive volume, this is a slight (but recurring) detraction. Full-page photographic plates would be of more use, as detail is lost in smaller sizes. This is particularly apparent in the sixth paper on mid-Tertiary mammals (p. 69), although photography is clear. Paper 12 (p. 182) would be better illustrated by SEM instead of line drawings.

At 458 pages, 135 illustrations and 45 tables, this is a substantial volume for researchers and students in vertebrate palaeontology, geochronology, sedimentology and palaeoprimatology. However, the volume is unlikely to be accessible to non-specialists due to a £100 price tag.

While writing this review, I discussed the book with someone who had the good fortune to spend three years at the University of La Plata in the 1970s where he met many of the great men quoted in this volume; Rosendo Pasqual, Odreman Rivas, Chango Spalletti, Mario Terugi, Mario Mazzoni and many others. He was thrilled to see that the eminence of La Plata continues with the contributions to the volume of no less than 12 workers from that University. His comment was that the book is "brilliant in its conception, inspirational in its content and should become a template for such volumes in the future". He also said that he wished he had had this book on the two occasions that he visited Gran Barranca. It is a unique series of exposures that every palaeontologist should visit, but not without this volume.

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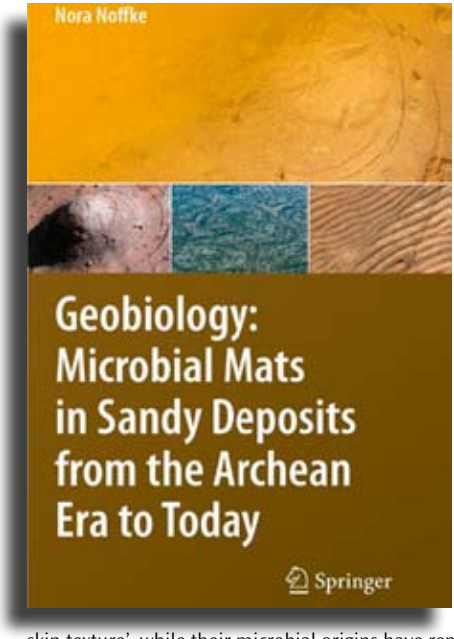
Geobiology: Microbial Mats in Sandy Deposits from the Archean Era to Today

Nora Noffke, 2010. Springer, Dordrecht, 194pp, £90. ISBN 978-3-642-12771-7.



This book is very timely. While the evolutionary potential of carbonate rocks together with stromatolites has been hinted at for a century or more, much careful and well-intended work now seems open to question – the macromorphology of stromatolites seemingly tells us rather little about microbiology. Instead it now seems, it is microfabrics that tells us more about either marine (Riding 2011) or non-marine carbonate microbiology (Brasier 2011) in the Precambrian. Stromatolites may be little better than any other kind of rock for decoding the early history of life.

But here comes a new search image to the rescue of early life studies: microbially induced sedimentary structures (MISS). This is the term devised by Nora Noffke and Gisela Gerdes for those textures of putative microbial origin within silicilastic rock. In the past, such things have been called 'wrinkle markings' or 'elephant skin texture', while their microbial origins have remained moot.

Happily, the promise of siliciclastic rocks for the earliest fossil record is now moving forward at a considerable pace. Nora Noffke and her coauthors (2006) have reported MISS within the 3.2Ga Moodies Group sandstones of South Africa. Emmanuelle Javaux and her colleagues (2010) have found surprisingly large organic vesicles of presumed bacterial origin in the same suite of rocks – the earliest acceptable palynomorphs in the fossil record. And more recently have come the discoveries by David Wacey and colleagues (2011) of rather well-preserved cellular microfossils in the 3.43Ga quartz arenites of the Strelley Pool Formation in Western Australia. Arguably, these are the earliest cells in the fossil record for which there are multiple lines of supporting evidence. And they also seem to provide evidence for the earliest biofilms within siliciclastic rocks.

Nora Noffke's book shows how some of these new lines of thinking about early siliciclastic sediments and the early fossil record are developing, with particular reference to her own field of research. Beginning with the formation and preservation of microbial mats in modern siliciclastic settings, she puts forward a classification, making use of 17 different features. From this it is argued that there are six strongly uniformitarian criteria that must be met for a structure to be accepted as a MISS. Some of these – such as lack of metamorphism, sea level setting, and use of modern analogues – will no doubt promote thoughtful debate. The author then goes on to outline five main kinds of MISS, making use of a wide range of examples from modern mats in the North Sea, via the Ordovician and through to the Proterozoic and the Archaean. The book then takes us on a field trip, moving through the Pleistocene of Tunisia to the 2.9Ga Pongola Subgroup of South Africa.

All of this is a very fine achievement. It is entirely reasonable, as well, that the author has largely confined herself to microbial mats constructed for the most part by oxygenic photoautotrophs such as cyanobacteria. That is the state of our current knowledge. But I beg to remind readers that a host of other microbes may also make cohesive biofilms with astrobiological potential. I refer here to anaerobic phototrophs, such as iron bacteria and sulphur bacteria, to aerobic heterotrophs such as *Pseudomonas*, and to dysaerobic to anaerobic heterotophs such as *Beggiatoa*, all of which can be cultivated with ease in the laboratory. And there is more to ponder here. There are many kinds of microbially induced textures, such as *Beltanelliformis* and *Arumberia*, which abound within Proterozoic sandstones and that are not reported from sediments today. And there are others which seem to have been made below the photic zone, such as those of the hypolimnion in the 1.0Ga Torridon lakes (see, for example, Callow *et al*. 2011).

Taking all these points together, we must wonder whether microbial mats, like biofilms, need be made by cyanobacteria alone. In fact, some early mats need not have been, or indeed could not have been, made by cyanobacterial cells at all. That is because the earliest microbial sediments may well have been anaerobic. In other words, we may need to open up the frame of reference here. What might such anaerobic biofilms look like when embedded within siliciclastic (or indeed, carbonate) sediments? And what might sulphur bacterial mats look like if they formed at the sediment surface? Can we find their like today? And how might they have been preserved in the remote past? As with all vibrant areas of research, the list of questions continues to bifurcate wonderfully.

There is clearly much exciting work to be done in this field. This book by Nora Noffke is a strong beginning. It should be thumbed hungrily by all those who are researching or teaching the evolution and ecology of microbial ecosystems through deep time. Like many books from this publisher, it does not come cheap, alas. But here stands a valuable key to help us unlock the mysteries of early life on Earth. The approaches in this book could even help with future astrobiological missions to the surface of Mars. Message to all future Mars explorers: tuck a copy of this volume in your pocket!

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Modeling Evolution: an Introduction to Numerical Methods

Derek A. Roff, 2009. Oxford University Press, Oxford. 451 pp. £37.50. ISBN 978-0-199-57114-7.

Roff is an extremely distinguished researcher in the field of life history and has already published an excellent book on computationally-intensive methods of data analysis (Roff 2006). The volume reviewed here is essentially a book about computer modelling of evolution at the gene, individual and population levels. The difficulty with writing a review of this work for the *Newsletter* is that I think that only a small fraction of the readership would put such a book at the top of their reading list. In this review I do not seek to persuade you to buy the book; OUP has marketing professionals for that. What I will attempt to do is convince you that the book is worth spending your time on.

The book opens with a discussion of the fact that computer modelling has become an integral part of being a researcher in most fields in evolutionary biology, but the transition to routinely implementing computer models as part of research projects routinely throws up two problems:

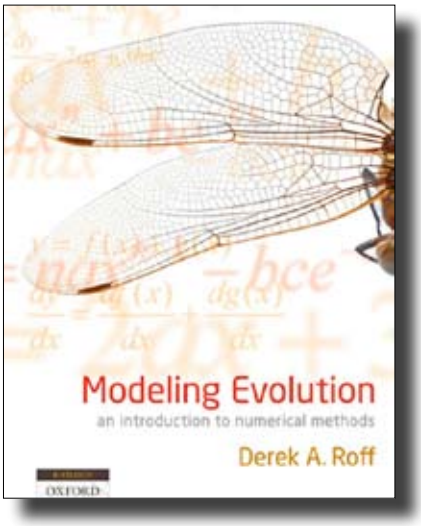
1) The problem of defining your hypothesis in such a way that you can express it as a computer model. This problem is not so different from designing physical experiments or statistical trials and is something that can be learnt by a combination of experience, support from supervisors or colleagues and trial-and-error;

2) The steep learning curve involved in learning computer programming languages, unless one has prior experience in programming.

The second point is something I would urge research supervisors and those readers serving on university teaching committees to address. We could give a huge boost to the employability, problem-solving and critical thinking abilities of students by requiring that they undertake a meaningful programming course or exercise during their university studies. And I mean *writing* computer programs that open files, perform calculations and write the output to another file: building websites or social media pages is not the same thing.

Roff tackles these problems in a structured and pragmatic way. The book provides copious examples of computer code in R and MATLAB throughout, and the code is also available from Roff's own website, which cuts down on the typing, and typos, when following his examples. For those who lack access to MATLAB due to its high cost, a freeware program called Octave is available (<**http://www.gnu.org/software/octave/download.html**>). Although Roff claims that no other texts exist that cover learning languages in a problem orientated-context, I would argue that *The Ecological Detective* (Hilborn and Magel, 1997), *Simulating Ecological and Evolutionary Systems in C* (Wilson, 2000) and *Ecological Data and Models In R* (Bolker 2008) all do this to a greater or lesser extent. However, Roff's book takes the high ground by avoiding being either a code cookbook, or

presenting useful equations but not explaining how to implement them as computer methods. Above all, the work never loses sight of its aim to help researchers implement models. It is not aimed at making them computer scientists.



The rest of the introductory section deals with general issues of categorizing the general parameters of the system the researcher is attempting to model. A critical part of the introductory chapter and all subsequent chapters is a clear discussion of the mathematical assumptions of the model. The book then goes on to explore the uses of five general classes of models: Fisherian optimality models; invasibility analysis; genetic analysis; game theoretic models; and dynamic programming.

Each of these classes of models requires the use of different areas of mathematics, which is one of the real strengths of the book. It introduces a tremendous range of useful mathematical tools. Fisherian analysis introduces the concept of finding the combination of parameters that will maximize the value of a function. Invasibility analysis introduces the use of matrix algebra, in the form of the Leslie matrix, to step through discrete-time population models. Chapter four examines genetic population level variance-covariance models for traits, individual-based models, and models of individual loci. The section on game theoretic models explores the role of frequency-dependent interactions in ecology and evolution via analysis of payoffs to locate evolutionarily stable strategies. The final approach discussed is dynamic programming to explore phenotypic plasticity. Dynamic programming takes the form of building a decision matrix.

Each chapter concludes with a selection of key papers in the field as a short annotated bibliography. Most of the papers are recent, even though many of the problems have a long history. Roff's annotation explains the problem(s) that the paper tackled and what class(es) of model presented in the chapter are relevant.

The book concludes with two useful appendices. The first provides a guide to translating code between R and MATLAB, which also serves as a set of quick reference tables for useful commands in both languages. The second appendix is a refresher on differentiation, which I found useful as my calculus is shaky.

Admittedly, the book does not cover many topics that are of immediate interest or utility to palaeontology and palaeobiology. No explicit models of phylogenetic or morphological evolution are discussed. However, the book could act as a self-teaching guide in ecology and evolution for those who want to explore the topics in the book by tinkering with parameters in the models and as an introduction to programming by working through Roff's models as he develops them from the simplest to the most complex cases. The text will also appeal to R and MATLAB users as a source of tips, tricks and shortcuts.

Such a book should also make palaeontologists reflect on the major advances that were made in the 1960s and 1970s when ecological models were applied to palaeontological data by Sepkoski to produce the dynamic models of Phanerozoic evolution using Macarthur and Wilson's models of Island Biogeography, Valentine's work on provinciality and diversification, and Simberloff's application of the species-area effect to the end-Permian event. With the availability of books such as this, those fruitful times can come again.

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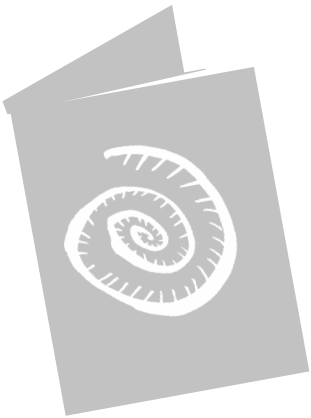

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Deadline for copy for Issue No. 79 is 13th February 2012.

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/**>.

Advertising in the Newsletter

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

£75 for half a page £130 for a full page

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

Rates for distribution of separate fliers with the Newsletter:

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

— — — **Newsletter design by Emma Davies, 31 Stafford Street, Edinburgh EH3 7BJ** — — —