The Palaeontology Newsletter

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Contents

Reminder: The deadline for copy for Issue no 69 is 6th October 2008.

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

ISSN: 0954-9900

Association Business

Annual Meeting

Notification is given of the 53rd Annual General Meeting and Annual Address

This will be held at the University of Glasgow, 20th December 2008, following the scientific sessions.

Agenda

1. Apologies for absence
2. Minutes of the 51st AGM, University of Uppsala
3. Annual Report for 2007 (published in Newsletter 68)
4. Accounts and Balance Sheet for 2007 (published in Newsletter 68)
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 2007

Minutes of the Annual General Meeting held on Monday, 17th December 2007 at the University of Uppsala.

1. **Apologies for absence:** Prof. Batten, Prof. J. C. W. Cope; Dr P. C. J. Donoghue; Prof. M. P. Smith (Secretary of the Publications Board), Dr P. D. Polly and Dr M. Sutton.
2. **Annual Report for 2006:** Agreed, proposed by Prof. Sevastopoulo and seconded by Mr W. Fone.
3. **Accounts and Balance Sheet for 2006:** Agreed, proposed by Prof. Edwards and seconded by Dr Sheldon.
4. **Vote of thanks to retiring members.** Prof. Bassett extended a vote of thanks to the retiring members of Council Dr Loydell (Vice-President), Dr Siveter (co-opted as Annual Meeting organiser), and Dr Harper (retires as a Trustee but will remain as handling editor). Dr Palmer (Executive Officer) and Prof. Batten (Editor in Chief) were thanked for their continuing service to the Association. Prof. Bassett extended a vote of thanks to Sir P. Crane, retiring President.

5. Election of Council: The following members were elected as trustees:

President:	Prof. M. G. Bassett
Vice-Presidents:	Dr N. Macleod Dr C. H. Wellman
Treasurer:	Prof. J. C. W. Cope
Secretary:	Dr H. A. Armstrong
Chairman of the Publications Board:	Prof. D. A. T. Harper
Newsletter Editor:	Dr R. J. Twitchett
Book Review Editor:	Dr P. J. Orr
Newsletter Reporter:	Dr A. McGowan
Internet Officer:	Dr M. Sutton
Publicity Officer:	Dr M. A. Purnell
Editors:	Dr P. C. J. Donoghue Prof. M. P. Smith (secretary of the Publications Board)
Other Members:	Dr G. Budd Prof. S. K. Donovan Mr W. Fone Dr C. Jeffery Dr J. A. Rasmussen Dr E. Rayfield Dr T. Servais
The Executive Officer:	Dr T. J. Palmer
Editor-in-Chief:	Prof. D. J. Batten

Dr Palmer and Prof. Batten will continue to serve Council but are not trustees.
Prof. R. J. Aldridge will attend Council meetings *ex officio*.

6. Association Awards

i. Lapworth Medal to Prof. A. Hallam (Univ. of Birmingham).

ii. Hodson Fund to Dr S. Peters (Univ. of Michigan).

iii. Sylvester-Bradley Awards to Herridge, Dunkley-Jones, Donovan, Challands, Joomun, Popov, Muir, Zanno, Allan and Ghobadi pour Mansoureh.

iv. Mary Anning Award to Mr J. Ahlgren (Mariestad, Sweden).

The Annual Address was presented by Prof. A. Lister (Natural History Museum), and was entitled "Evolution in an Ice age."

H. A. Armstrong
Secretary

Trustees Annual Report 2007 (Draft)

Nature of the Association. The Palaeontological Association is a Charity registered in England, 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 Wales, Aberystwyth, SY23 3DB, Wales, UK.

Trustees. The following members were elected to serve as trustees at the AGM on 17th December 2007: *President:* Prof. M. G. Bassett; *Vice-Presidents:* Prof. N. Macleod, Dr C. H. Wellman; *Treasurer:* Prof. J. C. W. Cope; *Secretary:* Dr H. A. Armstrong; *Chairman of the Publications Board:* Prof. D. A. T. Harper; *Newsletter Editor:* Dr R. J. Twitchett; *Book Review Editor:* Dr P. J. Orr; *Newsletter Reporter:* Dr A. McGowan; *Internet Officer:* Dr M. J. Sutton; *Publicity Officer:* Dr M. A. Purnell; *Editors:* Dr P. C. J. Donoghue, Prof. M. P. Smith (Secretary of the Publications Board); *Other Members:* Dr G. Budd, Prof. S. K. Donovan, Mr W. Fone, Dr C. Jeffery, Dr J. A. Rasmussen, Dr E. Rayfield, Dr T. Servais. Prof. M. Cusack will organize the Annual meeting in Glasgow, 2008 and was co-opted to serve on Council for two years. *The Executive Officer*: Dr T. J. Palmer and *Editor-in-Chief:* Prof. D. J. Batten will continue to serve Council but are not trustees. Prof. R. J. Aldridge will attend Council meetings *ex officio*.

Membership. Individual membership totalled 1,269 on 31st December 2007, an overall decrease of six over the 2006 figure. There were 754 Ordinary Members (unchanged); 168 Retired and Honorary Members (a decrease of three); and 347 Student Members (a decrease of three). There were 121 Institutional Members in 2007, and 101 institutional subscribers to *Special Papers in Palaeontology*.

Professional Services. The Association's Bankers are NatWest Bank, 42 High Street, Sheffield. The Association's Independent Examiner is G. R. Powell BSc FCA, Nether House, Great Bowden, Market Harborough, Leicestershire LE16 7HF. The Association's investment portfolio of Common Funds was managed by Citi Quilter, St Helen's, The Undershaft, London EC3A 8BB. During the year Morgan Stanley Quilter were taken over by Citi Smith Barney, Citigroup Centre, Canada Square, Canary Wharf, London E14 5LB.

Reserves. The Association holds reserves of £608,086 in General Funds. These reserves enable the Association to generate additional revenue through investments, and thus to keep subscriptions to individuals at a low level, whilst still permitting a full programme of meetings to be held, publications produced and the award of research grants and grants-in-aid. They also act as a buffer to enable the normal programme to be followed in years in which expenditure exceeds income, and new initiatives to be pursued, without increasing subscription costs. The Association holds £52,564 in Designated Funds which contribute interest towards the funding of grants-in-aid, the Sylvester-Bradley, Hodson Fund and Mary Anning awards. Funds carried forward to 2008 totalled £660,650. Following the recommendation of Citi Quilter it was agreed that the Association portfolio should contain up to 5% in hedge funds.

Finance. Subscriptions raised an income of £61,688. The Association gratefully acknowledges the donations from Members which amounted to £1,377. Incoming resources from charitable activities

included sales of £165,506 and investment income totalled £20,958. Total incoming resources were £249,529. Charitable activities resulted in publication costs of £154,632, sponsoring scientific meetings £14,752 and grants-in-aid £19,614. Administration costs were £23,550 and governance costs totalled £10,523. Administration and investment management costs totalled £21,072. Total charitable expenditure was £212,548. Total resources expended were £244,143. The Association continues its membership of the International Palaeontological Association and remains a Tier 1 sponsor of *Palaeontologia Electronica*.

Risk. As part of the annual review Trustees noted there were no new risks to the Association, beyond those reported in the Trustees Report 2006.

Council Activities. The Association continues to increase its range and investment in charitable activities, whilst continuing to keep individual membership subscriptions low. Of particular note this year was a major donation by Stuart Baldwin to support amateur activities. It was agreed the Association should supplement this initiative from General Funds to use the donation and any accrued interest to fund an annual programme of speakers for amateur groups.

Increased funds were allocated as "Grants–in-aid" to support workshops and meetings. These included: "Computer Aided Visualisation in Palaeontology;" Paleobiology Database Summer Course in Analytical Paleobiology; 8th International Symposium on the Cretaceous System; III Latin American Vertebrate Palaeontology Conference 2009; for palaeontological symposia within the 20th International Congress of Zoology; IGCP 503, "Ordovician Palaeogeography and Palaeoclimate" and the Charles Walcott Conference. Increased funds were also agreed to support the Lyell meeting in 2008. We have continued to provide funds to support student and speaker attendance at our own and international meetings.

The online activities of the Association continue to expand. Electronic versions of *Special Papers in Palaeontology* were produced and trustees agreed funds to scan abstracts from *Palaeontology* to allow online searching of back issues. The Association now hosts mirror sites for the PalaeoDatabase, *Palaeontologica Electronica* and the EDNA fossil insect database. A Members only area was developed and is now running well. A replacement online payment system has been purchased. The Association also provided start up funds for the "Ask a Biologist" website.

Trustees were members of the Joint Committee for Palaeontology: Prof. Bassett (Chair) and Dr Donoghue represented the Association. Dr Armstrong acted as the Association representative on the International Palaeontological Association.

Sir Peter Crane gave, on behalf of the Association, a lecture on the Life of Hooker at Kew Gardens as part of the "Local Heroes" series as part of the Geological Society of London bicentennial celebrations.

Association meetings. Three meetings were held in 2007, and the Association extends its thanks to the organisers and host institutions of these meetings.

The *51st Annual General Meeting* was held on 16–19 December at Uppsala University, Sweden, organised by Dr Budd with much local support. This meeting included a symposium on "The Origin of Major Groups" and comprised a programme of internationally recognised speakers. There were 270 attendees. The Annual Address, entitled "Evolution in the Ice Age," was given by Prof. A. Lister (Natural History Museum) and was attended by 250 people. The President's Award was

made to Laura Porro (University of Cambridge). The Council Poster Prize was presented to Martin Smith (University of Cambridge). On the final day field trips were undertaken to visit various sites in Uppsala linked to Linnaeus.

Progressive Palaeontology was held at the University of Bristol on 13th April. The annual open meeting for presentations by research students was organised by Graeme Lloyd.

British Association Festival of Science, Palaeontological Association Symposium: the annual forum for presentations to the public and general scientists was "Shotguns aimed at fossils: total molecular analysis of ancient samples" organised by Dr M. Collins (University of York).

Publications. Publication of *Palaeontology* and *Special Papers in Palaeontology* is managed by Blackwell, who also make sales and manage distribution on behalf of the Association. Volume 50 of *Palaeontology*, comprising six issues and 1,576 pages in total, was published at a cost of £116,440. *Special Papers in Palaeontology* 77, "Evolution and palaeobiology of early sauropodomorph dinosaurs (eds P. M. Barrett and D. J. Batten)", and *Special Papers in Palaeontology 78*, "Graptolites from the Upper Ordovician and Lower Silurian of Jordan" by D. K. Loydell were published during the year. The cost of publishing Special Papers was £4,512. A *Field Guide,* "Silurian fossils of the Pentland Hills, Scotland," edited by E. N. K. Clarkson, D. A. T. Harper, C. Taylor and L. I. Anderson, was published in June. The cost of publishing the *Field Guide* was £5,156.

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*.

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 made to Prof. A. Hallam (University of Birmingham). 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 S. Peters (University of Michigan). The Mary Anning award, for an outstanding contribution by an amateur palaeontologist, was made to Mr J. Ahlgren (Mariestad, Sweden). The Sylvester-Bradley Fund continues to attract a large number of high-quality international applications and awards totalling £8,702 were made to D. Allen, T. Challands, S. Donovan, T. Dunkley-Jones, V. Herridge, S. Jooman, L. Muir, E. Popov and L. Zanno. Council awards an undergraduate prize to each university department in which palaeontology is taught beyond Level 1.

Governance. The Association continues to improve its administration with further improvements to the *Newsletter* and website. The continuing series of primers on numerical analysis in the *Newsletter* has been widely acclaimed. The Association has continued online provision of *Palaeontology* and Special Papers in Palaeontology, made available free to the palaeontological community. During the year the Association website was re-designed. Trustees allocated resources to the Lapworth Museum (University of Birmingham) to sort and catalogue the archive. Significant items from the archive will be scanned and made available on the website. The Association continues to be proactive in generating publicity for palaeontology with major press initiatives and a continued high profile on television.

The Association is indebted to the Natural History Museum, London for providing meeting venues through the year.

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. In 2007, a similar programme of Association meetings and publications will be carried out. The Annual Meeting has continued to develop as one of the major international palaeontological meetings. The 52nd Annual meeting will be held at the University of Glasgow in December 2008. *Progressive Palaeontology* will be held at the University of Manchester in April 2008. The Association will again run a symposium at the annual meeting of the British Association for the Advancement of Science in Liverpool, entitled "Climate change in the past: the latest evidence from fossil plants and animals."

Resources will again be made available from General Funds to support Grants-in-Aid, provided to carry out research into palaeontological subjects, to disseminate findings in print and at conferences, and to support the provision of palaeontological workshops. A new Palaeontological Association Research Grant has been announced and will be instigated in 2008. This is to fund primary research up to the value of £15,000. In future there will be a single funding round per year. A new award, the "President's Medal," a mid-career award, was announced and would be implemented in the forthcoming year.

Funds will also be made available to further development of the website, aimed at encouraging outreach and improving the Governance of the Association. It is intended that one new *Field Guide to Fossils* will be published within the year.

It is recognised that the Association is now one of the premier international learned societies. During the forthcoming year mechanisms will be developed by which the Association can have a greater presence at international geological meetings.

Howard A. Armstrong
Secretary

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 organiser(s) of the meeting using the online application form (see **http://www.palass.org/**). Such requests will be considered by Council at the March and the October Council Meetings each year. Completed requests should be made at least six months in advance of the event in question and should be sent by 1st March or 1st October. Enquiries may be made to <**secretary@palass.org**>. If the application is successful, we will require that the support of the Association is acknowledged, preferably with reproduction of the Association's logo, in the Meeting literature.

Nominations For Council

At the AGM in December 2008, the following vacancies will occur on Council:

Vice-President
Newsletter Editor
four Ordinary members

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

All potential Council Members are asked to consider that:

> 'Each Council Member needs to be aware that, since the Palaeontological Association is a Registered Charity, in the eyes of the law he/she becomes a Trustee of that Charity. Under the terms of the Charities Act 1992, legal responsibility for the proper management of the Palaeontological Association lies with each Member of Council'.

Responsibilities of Trustees can be obtained from <**secretary@palass.org**>.

The closing date for nominations is **1st October 2008**. They should be sent to the Secretary: Dr Howard A. Armstrong, Department of Earth Sciences, Durham University, Durham DH1 3LE; email <**h.a.armstrong@durham.ac.uk**>or via <**secretary@palass.org**>.

The following nominations have already been received:

Vice President: Dr T. Servais (nominated by Council)

Newsletter Editor: Dr Richard Twitchett (nominated by Council)

Ordinary Members:

Dr T. Vandebrouche (University of Ghent): Council

Dr G. Harrington (University of Birmingham): Council

Dr C. Underwood (Royal Holloway and Bedford New College): Prof. S. Donovan and Dr F. E. Fearnhead

Dr D. Schmidt (University of Bristol): Dr J. Young (NHM) and Dr K. Johnson (NHM).

Dr C. Buttler (National Museum of Wales): Prof. M. Bassett and Prof. J. Cope

Awards and Prizes

Nominations are now being sought for the following awards.

Hodson Fund

Conferred on a palaeontologist who is under the age of 35 and who has made a notable early contribution to the science. Nominated by at least two members of the Association, the application must be supported by an appropriate academic case. The closing date for nominations is **1st September**. Nominations will be considered and a decision made at the October meeting of Council. The award will comprise a fund of £1,000, presented at the Annual Meeting.

Mary Anning Award

The award is open to all those who are not professionally employed within palaeontology but who have made an outstanding contribution to the subject. Such contributions may range from the compilation of fossil collections, and their care and conservation, to published studies in recognised journals. Nominations should comprise a short statement (up to one page of A4) outlining the candidate's principal achievements. Members putting forward candidates should also be prepared, if requested, to write an illustrated profile in support of their nominee. The deadline for nominations is **1st September**. The award comprises a cash prize plus a framed scroll, and is usually presented at the Annual meeting.

Sylvester-Bradley Award

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

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

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

Golden Trilobite Award

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

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369
STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2007

			General Funds	Designated Funds	TOTAL 2007	TOTAL 2006
Incoming Resources						
Incoming resources from generated funds						
Voluntary income	Subscriptions	61,688			61,688	66,149
	Donations	0		1,377	1,377	506
			61,688	1,377	63,065	66,655
Incoming resources from charitable activities						
Sales	Palaeontology	149,660				
	Special Papers	8,987				
	Offprints	1,986				
	Newsletters	0				
	Field Guides	4,015				
	Distribution	858				
			165,506	0	165,506	164,050
Investment income			18,617	2,341	20,958	19,171
TOTAL INCOMING RESOURCES			245,811	3,718	249,529	249,876
Resources expended						
Costs of generating funds						
voluntary income:	Administration	18,852				17371
Investment management	Broker fees	2,220				1924
			21,072	0	21,072	19,295
Charitable activities						
Publications	Palaeontology	73,208				
	Special Papers	2,837				
	Offprints	2,038				
	Newsletters	12,670				
	Field Guides	17,202				
	Distribution	828				
	Marketing	942				
	Management	44,907				
	Total	154,632			154,632	126,090
Scientific Meetings & Costs		14,752			14,752	24,931
Grants		8,232		11,382	19,614	30,187
Administration of charitable activities		23,550			23,550	22,660
			201,166	11,382	212,548	203,868
Governance costs	Examiner's fee	350				
	Trustee's expenses	5,601				
	Administration	4,572				
			10,523	0	10,523	7,901
TOTAL RESOURCES EXPENDED			232,761	11,382	244,143	231,064
NET INCOMING RESOURCES			13,050	-7,664	5,386	18,812
INVESTMENT GAINS:	Realised loss	-1,658				
	Unrealised gain	5,995				
			4,337		4,337	32,016
NET MOVEMENT IN FUNDS			17,387	-7,664	9,723	50,828
FUNDS BROUGHT			590,699	60,228	650,927	600,099
FUNDS CARRIED FORWARD			608,086	52,564	660,650	650,927

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369

BALANCE SHEET as at 31st DECEMBER 2007

2006			2007	
£				£
	INVESTMENTS			
489,537	At market value			477,438
	CURRENT ASSETS			
156,127	Cash at Banks	162,995		
11,541	Field Guide Stocks at valuation	0		
67,459	Sundry Debtors	62,842		
235,127				
	Total Current Assets		225,837	
	CURRENT LIABILITIES			
32,354	Subscriptions in Advance	23,036		
41,383	Sundry Creditors	19,589		
73,737				
	Total Current Liabilities		42,625	
161,390	NET CURRENT ASSETS			183,212
650,927	TOTAL ASSETS			660,650
	Represented by:			
590,699	GENERAL FUNDS			608,086
	DESIGNATED FUNDS			
21,543	Sylvester-Bradley Fund		14,421	
21,044	Jones-Fenleigh Fund		21,649	
17,641	Hodson Fund		16,494	
60,228				52,564
650,927				660,650

Notes to the Financial Statements for the year ended 31st December 2007

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 financial statements have been prepared in accordance with the revised Statement of Recommended Practice applicable from 2005 and include the results of all the charity's operations, all of which are continuing. The incoming resources and resources expended have been analysed under the headings laid down in the new SORP and the comparative figures from 2005 have also been analysed on the new basis.

The effect of events relating to the year ended 31st December 2006 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 2006 and the results for the year ended on that date.

1.2 Fund Accounting

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

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

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

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

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

1.3 Incoming Resources

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

1.4 Resources Expended

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

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

1.5 Investments

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

2. Analysis of Financial Resources Expended

	Staff costs	Other costs	Total 2007	Total 2006
Generating Funds	12,825	8,247	21,072	19,295
Charitable activities	48,081	153,085	201,166	203,868
Governance	3,206	7,317	10,523	7,901
	64,112	168,649	232,761	231,064

3. Staff Costs

	Salary	National Insurance	Pension Contrib's	Total 2007	Total 2006
Publications - 1 employee (2006 - 1)	25,596	2,614	3,838	32,048	29,524
Administration - 1 employee (2006 - 1)	25,596	2,614	3,854	32,064	29,509
	51,192	5,228	7,692	64,112	59,033

4. Trustees Remuneration and Expenses

Members of Council neither received nor waived any emoluments during the year (2006: nil).

The total of travelling expenses reimbursed to 12 Members of Council amounted to £5,600 (2006: £3,473).

5. Costs of Independent Examiner

	2007	2006
Examination of the accounts	350	350
Accountancy and payroll services	1,100	1,050
	1,450	1,400

6. Stocks

In view of the low number of "Field Guides to Fossils" that have been sold in recent years, Council has taken the decision to regard the net realisable value as nil.

7. Debtors

	2007	2006
Accrued income – receivable within one year	62,842	67,459

8. Creditors – falling due within one year

	2007	2006
Social Services costs	1,790	0
Accrued expenditure	17,799	39,770
	19,589	39,770

Independent Examiner's Report on the Accounts of The Palaeontological Association for the year ended 31st December 2007

Respective responsibilities of trustees and examiner

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

It is my responsibility to:

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

Basis of independent examiner's statement

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

Independent examiner's statement

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

(1) which gives me reasonable cause to believe that in any material respect the trustees have not met the requirements to ensure that:
    - proper accounting records are kept (in accordance with section 41 of the Act) and
    - accounts are prepared which agree with the accounting records and comply with the accounting requirements of the Act

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

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

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No 276369

DESIGNATED FUNDS

STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2007

	Sylvester-Bradley	Jones-Fenleigh	Hodson	TOTAL 2007	TOTAL 2006
Donations	743	634	0	1,377	507
Interest Received	838	818	685	2,341	2,882
TOTAL INCOMING RESOURCES	1,581	1,452	685	3,718	3,389
Grants made	8,702	847	1,832	11,381	13,116
NET SURPLUS / (DEFICIT)	-7,121	605	-1,147	-7,663	-9,727
FUNDS BROUGHT FORWARD	21,543	21,044	17,641	60,228	69,955
FUNDS CARRIED FORWARD	14,422	21,649	16,494	52,565	60,228

Nominal	Holding	Cost (bought pre 2007)	Value end 2006	Proceeds (sold 2007)	Cost (bought in 2007)	Gain realised during 2007	Value end 2007	Gain unrealised during 2007	Income in 2007
£19,000	6 1/4% Treasury 2010	£17,580.14	£19,904.82				£20,092.00	£187.18	£1,187.50
£4,700	Treasury 2.5% I/L Stock 2013	£10,145.15	£10,911.09				£11,361.00	£449.91	£264.24
£13,000	Treasury 2.5% I/L Stock 2011	£32,947.71	£35,443.14				£37,196.00	£1,752.86	£872.30
£64,176.46	COIF Charities Fixed Interest Fund	£85,000.00	£81,985.43				£81,196.06	-£789.37	£4,620.72
804	Royal Dutch Shell B shares	£12,432.00	£14,391.60				£16,802.00	£2,410.40	£561.50
600	BHP Billiton $0.5 shares	£4,341.48	£5,607.00				£9,276.00	£3,669.00	£142.82
500	BG Group Ordinary 10p shares				£3,977.95		£5,750.00	£1,772.05	£18.00
925	HSBC Holdings Ordinary 0.5 US Dollar shares	£8,138.45	£8,611.75				£7,789.00	-£822.75	£395.04
1750	Lloyds TSB Ordinary 25p shares				£10,169.91		£8,260.00	-£1,909.91	£196.00
900	HBOS Ordinary 25p shares	£7,913.49	£10,188.00	£8,928.10		-£1,259.90			£251.10
3,000	Premier Foods Ordinary 1p shares	£9,246.48	£9,052.50	£8,921.64		-£130.86			£285.00
550	Cadbury Schweppes Ordinary 12.5p shares				£3,971.34		£3,416.00	-£555.34	£27.50
1,055	Glaxo Smithkline Ordinary 25p shares	£16,608.00	£14,179.20				£13,493.00	-£686.20	£527.50
725	Smith & Nephew Ordinary £0.122 shares	£4,011.14	£3,864.25	£4,080.34		£216.09			£-
775	Imperial Chemical Industries Ordinary £1 shares	£3,045.45	£3,503.00	£4,777.97		£1,274.97			£36.81
1,100	Wood Group (John) Ordinary 3.33p shares				£2,975.36		£4,763.00	£1,787.64	£30.26
7,000	Ing Global Real Estate Securities Ordinary NVP shares	£7,084.00	£8,172.50				£5,810.00	-£2,362.50	£315.00
2150	BT Group Ordinary 5p shares	£7,787.53	£6,482.25				£5,864.00	-£618.25	£324.65
1,400	Inmarsat Ordinary €0.0005 shares	£4,958.80	£5,348.00				£7,602.00	£2,254.00	£192.35
1750	Centrica Ordinary £0.0617 shares	£4,027.44	£6,203.75	£6,181.48		-£22.27			£-
950	Biffa Ordinary 10p shares				£2,989.95		£3,135.00	£145.05	£39.90
460	Pearson Ordinary 25p shares	£8,069.00	£3,548.90				£3,367.00	-£181.90	£137.54
1350	Prudential Ordinary 5P shares	£7,063.25	£9,443.25				£9,612.00	£168.75	£235.17
650	RIT Capital Partners Ordinary £1 shares	£4,903.90	£6,347.25				£6,721.00	£373.75	£20.15
750	JP Morgan Fleming Merc. IT Ordinary 25p shares	£5,168.79	£9,367.50	£7,535.97		-£1,831.53			£202.50
1500	British Empire Sec & Gen Trust Ordinary 10p shares	£5,005.61	£6,791.25				£6,525.00	-£266.25	£84.00
425	Findlay Park Partners US Smaller Companies	£6,158.47	£7,949.95				£9,065.00	£1,115.05	£-
4450	New Star European Growth Instl Acc Nav	£6,079.59	£9,140.30				£9,625.00	£484.70	£127.99
3900	Edinburgh Dragon Trust Ordinary £0.20 shares	£4,478.10	£5,167.50				£6,367.00	£1,199.50	£42.90
3100	Capita Morant Wright Japan B Inc Nav	£5,170.11	£5,273.10				£4,793.00	-£480.10	£9.81
1283.8	COIF Charities Investment Fund Acc Units	£75,000.00	£97,749.94				£102,967.31	£5,217.37	£-
5,720	M & G Charifund Units	£4,073.00	£84,910.77				£76,591.00	-£8,319.77	£3,726.95
	Total	£366,437.08	£489,537.99	£40,425.50	£24,084.51	-£1,753.50	£477,438.37	£5,994.87	£14,875.20
	Total Investment Income								£14,875.20
	Interest Receivable								£6,572.87
	Total Investment Income & Interest								£21,448.07

ASSOCIATION MEETINGS

52nd Annual Meeting of the Palaeontological Association
Glasgow, Scotland *18 – 21 December 2008*

Registration and Call for Abstracts
The 52nd Annual Meeting of the Palaeontological Association will be held at the University of Glasgow (<**http://www.gla.ac.uk/**>), organised by members of the Department of Geographical & Earth Sciences and the Hunterian Museum.

Registration and abstract submission are now open on the Palaeontological Association website (<**http://www.palass.org/**>) where the Second Circular, which supersedes previous information, can be downloaded. For consideration for inclusion in the conference programme, abstracts must be received by **Friday 5th September**.

The conference lecture theatre has a capacity of 300 and the number of registrants will have to be capped at this figure, even within the registration deadlines if necessary, on a 'first come first served' basis.

Accommodation
Please note that accommodation is not included in the online registration form and must be booked separately. Rooms in a variety of hotels at a range of prices and within easy reach of the University have been reserved **up to 17th October** and can be booked through the University via the Annual Meeting pages on the Palaeontological Association website (<**http://www.palass.org/**>). Booking accommodation in these establishments cannot be guaranteed after this date. Links providing information on cheaper, hostel-style accommodation are also provided on the website and there are many other hotels and Bed & Breakfast establishments in the West End of Glasgow, where the University is situated, and in the city centre.

Meeting Format
The meeting will commence with a **field excursion** on Thursday 18th December to explore some of the fossiliferous Carboniferous rocks of the Midland Valley of Scotland. This will be followed by a **half-day symposium** on the afternoon of Friday 19th December starting at 2pm, entitled "**Biominerals – the hard part of palaeontology**". There will also be an **evening drinks reception** on Friday 19th December, hosted by Glasgow City Council in the City Chambers. The **conference** proper will commence on Saturday 20th December with a day of talks and posters, the **AGM** of the Association and the Association's **Annual Address**, which will be given this year by **Prof. Jenny Clack** of Cambridge University. In the evening there will be a **drinks reception** in the Hunterian Museum hosted by the Museum and the Geological Society of Glasgow, followed by the **Annual Dinner** in the Bute Hall, the main ceremonial hall of the University. Sunday 21st December will be a full day of **talks** and a dedicated **poster session**.

The time allocated to each talk will be 15 minutes including questions; there will be no parallel sessions. Oral presentations should be prepared in PowerPoint and posters should be prepared at A0 (portrait) size – *i.e.* 84cm wide, 119cm tall.

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

Symposium

The speakers and their general topics at the half-day symposium "**Biominerals – the hard part of palaeontology**" on the afternoon of Friday 19th December will be as follows:

Prof. Steve Weiner (Weizmann Institute of Science, Israel): *Evolution of biominerals across phyla*

Prof. Steven Stanley (University of Hawaii, USA): *Changes in seawater chemistry – influence on biomineral chemistry and mineralogy*

Dr Kazuyoshi Endo (University of University of Tsukuba, Japan): *Evolution of biomineral organic components*

Prof. Jan Veizer (University of Ottawa, Canada): *Brachiopod isotopes*

Prof. Peter Westbroek (University of Leiden, The Netherlands): *Long-term evolution of limestone*

Registration and costs

The cost for early registration is £40 (ordinary & retired members) and £30 for students; non-members pay £50. Early registration ends on **Friday 5th September** after which date all registration fees will increase by £15. Final registration is **Friday 21st November**. No refunds will be considered after that date.

The field excursion costs £15 which includes a packed lunch. The cost of the Annual Dinner is £42. Buffet lunches will be available on Saturday 20th and Sunday 21st December at a cost of £6 each day. There is a wide range of eateries close to the University.

Travel grants to help student members (doctoral and earlier) to attend the Glasgow meeting in order to present a talk or poster

The Palaeontological Association runs a programme of travel grants to assist student members presenting talks and posters at the Annual Meeting. For the Glasgow 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 depends on the number of applicants and the distance travelled. Payment of these awards is given as a disbursement at the meeting, not as an advance payment. Students interested in applying for a PalAss travel grant should contact the Executive Officer, Dr Tim Palmer (<**palass@palass.org**>) once the organisers have confirmed that their presentation is accepted, and before **8th December 2008**. Entitle the e-mail 'Travel Grant Request'. No awards will be made to those who have not followed this procedure.

Summary of dates and deadlines

23 May 2008	Start of registration
5 September 2008	**Abstract submission & early registration deadline**
17 October 2008	End of guaranteed reservation of rooms in selected hotels.
21 November 2008	**Late registration deadline**
18 December 2008	Field excursion
19 December 2008	Half-day symposium "Biominerals: the hard part of palaeontology"
	Civic Reception – Glasgow City Chambers
20 December 2008	Technical sessions
	AGM & Annual Address
	Reception hosted by The Hunterian Museum & Glasgow Geological Society
	Annual Dinner
21 December 2008	Technical sessions

Contact

The meeting organisers are Prof. Maggie Cusack and Dr Alan Owen of the Department of Geographical & Earth Sciences and Dr Neil Clark of the Hunterian Museum, University of Glasgow. We can be contacted at <**glasgow2008@palass.org**>.

We look forward to seeing you in Glasgow.

Annual Address: The emergence of tetrapods: how far have we come in the last twenty years and where can we go in the next?

Jenny Clack
Cambridge University

Twenty years ago, only three genera of Devonian tetrapod were known: one, *Ichthyostega*, was known from extensive specimens though incomplete descriptions, but carried the burden of being an icon for early tetrapods; another, *Acanthostega*, was known from two partial skull roofs; the third, *Tulerpeton* was known from a single partial skeleton and seemed anomalous in several ways.

From the 'fish' side of the spectrum, a single genus, *Eusthenopteron*, was available as the model from which tetrapods evolved. Many scenarios were postulated to explain the fish – tetrapod or water–land transition – including several 'hypothetical ancestors'. Today, the skeletal anatomy of *Acanthostega* is almost completely known; *Ichthyostega* is seen as radically different from its iconic image; and *Tulerpeton* is thought to fit the emerging picture of polydactylous Devonian tetrapods that lived in marginal marine conditions. We have much more detailed knowledge of tetrapodomorph fish with the discovery of *Tiktaalik* and reinterpretations of *Panderichthys*.

These have allowed us to construct consensus phylogenies from which we can infer sequences of character acquisition that then lead on to more testable hypotheses of when, where and howcome tetrapods evolved. We see that the 'hypothetical ancestors' have been proved incorrect in many respects, because they were based on preconceptions about evolutionary drives that are probably invalid.

Ecological information is now coming from many more sites for fossil stem tetrapods and tetrapodomorphs, resulting from the increasing range of taxa now available to represent the transition world wide. Studies of climate change and plant evolution in the Devonian link with morphological changes to the stem group.

We are increasingly able to exploit a range of new technologies to explore the fossils in greater and greater detail, allowing histological, microarchitectural, biomechanical and morphometric analyses. Studies of appropriate modern analogues point the way to inferences about how stem tetrapods adapted their physiology and sensory systems, that further suggest features of their skeletal anatomy to reexamine.

The interface with evolutionary developmental biology has recently been embraced by both sides, with more 'evolutionarily interesting' taxa being studied developmentally, with the input from fossils feeding into a more coherent picture. Probably most signficant of all, exploration of new geographical areas is uncovering potential sites for collecting more fossils.

27th – 29th May 2009

School of Geography, Earth and Environmental Sciences
University of Birmingham

Progressive Palaeontology is an annual conference for postgraduate students who wish to present their results at any stage of their research. Presentations on all aspects of palaeontology are welcome.

The itinerary will include an evening icebreaker reception in the Lapworth Museum of Geology, one day of oral and poster presentations, the annual dinner (venue to be confirmed), and a field trip to a local fossil locality.

Further information will be added to the website <**http://www.palass.org/**>.

If you have any specific questions, please email <**pej083@bham.ac.uk**>.

The Birmingham organising committee are:

Helen Hughes, Phil Jardine, Sarah King, Andy Rees, Lil Stevens, and Andrew Storey.

Geologists' Association and Geological Society of London launch Your Planet Earth Outreach Initiative

The UN declared 2008 as the International Year of Planet Earth (IYPE). To support education and outreach activities, the Geologists' Association and the Geological Society of London have launched a website – Your Planet Earth <**http://www.earth4567.com/**> – with five Powerpoint talks on earth science topics that are free to download. Dr Jess Trofimovs, a volcanologist, developed the talks with input from many colleagues at the University of Bristol. The images used in the talks are either in the public domain or were specially produced for the project, allowing the material to be freely used and edited for educational purposes.

Members of the Palaeontological Association may be particularly interested in the 'Dinosaurs' and 'Climate Change' talks. Three other talks in the series cover volcanoes, natural hazards and plate tectonics. In addition to the slideshows there are prepared exercises and discussion topics for use in outreach activities. Each talk also has accompanying notes to help deliver the lectures at an appropriate level of detail. All of the material has been peer-reviewed for scientific accuracy.

The talks are currently aimed at 14–15 year old audiences, but the team at Your Planet Earth plans to develop versions of the talks suitable for the 8–9 year age group as well. To help departments or student groups that want to build longer-term outreach links, the website also has a section that offers advice on assembling and running an outreach team, information on training available for student presenters in the delivery of talks to non-academic audiences, and another slideshow that can be used to train outreach teams to give science roadshows. The slideshows are also suitable for use as stand-alone resources by individual teachers and academics.

IYPE still has six months to run, so consider using these resources to put on an event or as a focus for starting up an earth sciences or palaeontological outreach group.

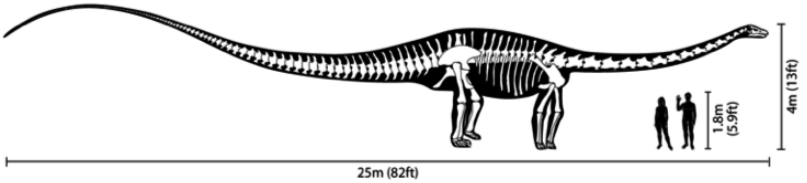

Illustration of a brachiosaurus, with humans for scale, from Your Planet Earth exercise about determining the upper limit of the mass of large sauropods.

From our Correspondents

Halfway there

Exopalaeontology! That – word on the street has it – is the new buzzword in the Martian community (that comprises Earthlings who journey to that planet in spirit via orbiter and lander, I hasten to add, rather than those beings for whom it is – or might be – home soil). It represents a new emphasis: an acceptance, perhaps, that on the red planet exobiology is functionally dead. James Lovelock pointed this out long ago, of course, on the sensible basis that Mars is in chemical equilibrium and thus quite unlike our own planet, where living organisms maintain an emphatically non-equilibrium surface environment in which such crazy stuff as free oxygen is now permanently present.

Yes, there might be a few hardy survivors out there, more or less in a state of suspended animation, like those terrestrial microbes – I can still scarce accept the possibility – reputed to live for a quarter of a billion years within fluid inclusions in salt strata. Or perhaps they are metabolizing *extremely* slowly underground, somewhere in that zone where the basal parts of the Martian permafrost are melted by that planet's residual geothermal heat. The occasional releases of methane at Mars's surface might (or there again, might not) be testament to such Rip van Winkle microbes. But essentially, life on Mars won't be alive, but dead. Its own Gaia-geist has given up the ghost, aeons past. It's Martian fossils that must be the prime target.

What kind of fossils? Well, it's unlikely to be the gigantic limb bone of an extinct *Galactosaurus* or some such (though, not so long ago, I did hear such a possibility expressed at a meeting by exobiologists who should have known better). Nor will they be petrifactions of the malevolent head-creatures of H.G. Wells's *War of the Worlds*[1]. Wells, of course, imagined a Mars with higher organisms but no bacteria. It did allow the denouement to his drama, in which human military might is brushed aside by the invaders, only the common cold to come to our rescue. But his scientific prescience had deserted him a little, for his Mars would have been unworkable. We now know that we humans (sort-of-higher-organisms) are approaching half microbe by weight, having, at the last count, some ten trillion or so of them as passengers and indispensable co-metabolizers (making us sort-of-higher-colonies, in that interpretation).

On a dying planet, the microbial world will die too, and decay. But what causes decay? – why, microbes. What will eat dead microbes? – why, other microbes. But once the last generation of microbes are dead, what will eat *them*? At the surface, the ultraviolet will blast them, but in a freeze-dried underground, their remains might linger virtually forever. And there's the time when they were – OK, might have been – in their pomp. For once such bugs have arrived anywhere, the growth of microbial mats should be pretty well an intergalactic standard. There should be chance, then, of the cross-planetary comparison of stromatolite structures, among the exopalaeontologists impatiently awaiting data from the latest lander mission.

[1] As in top of the food chain and as in disembodied too. HG was pretty well head of the class when it came to the dreaming up of aliens that could make one's flesh properly creep.

It's nice to gaze forwards and back, to look at history in the round, to get some sort of sense of context. Nicer even, if we can see ourselves as part of a developing context, as the unique present that links the actions of the past with the unfulfilled promise – or menace – of the future. We are always, of course, living on the cusp of an unfurling history, and the present, being of infinitesimally small duration (compared with which a nanosecond is an age), can scarcely be said to exist. The novelists who wrote those interminable trans-generational sagas, dancing to the *Music of Time* or discovering their *Roots*, had a point. Best to make any single present instant irrelevant by burying it within some large slab or other of time.

Now, historical contexts are well and good on the grand scale, as epic dramas of empire are recounted, stories of civilizations rising and falling on this Earth and on others, as Heinlein and Asimov and E.E. Doc Smith have demonstrated with some aplomb. They are also pretty good on the personal scale, as one can trace a family across the dustbowl of the mid-Western plains, say, or traversing the complex social strata of nineteenth century Europe. There is, though, a middle ground, of larger groups of people, supra-familial, certainly, but not yet nation-state (unless one stretches a point to envelop the Vatican City or Lichtenstein). Here there are conventions and gatherings and societies and … yes, and associations too. They range from whippet-fanciers to railway enthusiasts to devotees of postage stamps or gladioli. For the nefariously inclined, there are gangs and triads and mafias. And then, there are palaeontologists too, of course. A quite singular group of individuals. Quite how might history be unfurling for them? Take the present instant as mid-saga, say (yes, even as it arrows relentlessly on), and place it symmetrically within some suitably chosen time-span.

We can eschew the global reach, and stick with the familiar: the trans-generational lineage of British palaeontologists, once these had become numerous enough to become a recognised plurality. Where to start? With this august body, the Palaeontological Association itself, perhaps? Not really, alas, it being the youthful upstart that it is, having only just passed the half-century mark. The science was well advanced by the time of its birth. Its parent, body, then, the Palaeontographical Society? Now that goes back to a more respectably antique time, to 1847, and does give a picture of the development of the science. But, for our more dramatic purposes, its very rigour is dismaying: to produce full-scale monographs only – labours of love each, with a large fraction of any individual's lifetime work within just one volume, and then that being devoted to systematic description only of fossil material from the British Isles. It's magnificent – but a little too daunting for us, and too restrictive, regardless of such classics as Darwin's tome on barnacles or that of Richard Owen on dinosaurs.

No, it's the Geological Society of London that may be the best place to get a snapshot of the early days of the science within these shores, by perusing what one might find in its *Journal*. Today, of course, this publication is full of such weighty topics as the tectonics of far-flung parts of mountain belts, or the workings of magma chambers, with papers on fossils being something of a rarity. But in earlier days it was quite different.

Not in the very earliest days, mind. It was founded, as Gordon Herries recounts (2007), initially as a vehicle to publish a mineralogical monograph by Jacques-Louis, Comte de Bournon, Lieutenant de Maréchaux de France, devoted royalist and (hence, therefore) refugee from the Revolution of 1791. Not a hint of a fossil in there. And it's a little hard to get an idea of quite what was going on in the next few decades, as the fledgling Society struggled to publish intermittent *Transactions*

and *Proceedings*. That phase is a little like the Earth's Hadean Eon, that first phase of activity when one knows that a lot must have been going on, but direct evidence is a little hard to dig out. However, when the first edition of the *Journal* came off the presses in 1845, it produced a view of activity that provides a startling picture of the study of the Earth in those days. It was dominated, absolutely, by a focus on its organic remains. Fossils ruled the roost. Palaeontology had not so much the upper hand as a stranglehold, albeit one of the nicest sort.

It was a bumper issue, with 95 articles – including Miscellanea but not counting book reviews. Of those 95, 43 are specifically on the description and analysis of fossils *per se*, while a further 25 are stratigraphical studies underpinned by palaeontology: Brodie and Buckman on the 'Stonesfield Slate of the Cotteswold Hills', for instance, or Portlock on the White Limestone of Corfu and Vido. Igneous rocks receive shrift so short as to be almost invisible; the 'trap-rock' of Bleedon Hill is the one original description, though there is an essay by the considerable figure of Leopold Van Buch on granitic rocks. Metamorphism? – well, there's W.B. Clarke on marble dykes of Wollondilly, New South Wales. As for tectonics, it's down to Hannay with his 'Memoranda of Earthquakes in Upper Assam from 1839 to 1843'.

But otherwise geology then *was* palaeontology, and not just by sheer weight of manuscript numbers. The cast list was of a stellar quality that contemporary JGS editors can only drool over, and indeed surpassed anything in any recent year's worth of *Nature* and *Science* combined. There was Richard Owen on the ear-bones of fossil whales and on *Dicynodon* skulls, and Adam Sedgwick on the 'Protozoic' rocks of North Wales; Charles Darwin on coral reefs and his mentor, John Henslow, on concretions of the Red Crag of Suffolk; Charles Lyell on the Cretaceous strata of New Jersey, the Tertiary of Virginia and Carolina and, for good measure, on a bed of plumbago and anthracite in the mica-schist of Massachusetts. Edward Forbes may have died young, but in that year he surpassed them all – volumetrically at least – with no fewer than ten papers in that volume. A nonpareil jobbing palaeontologist, he tackled everything from Lyell's molluscs to a sea butterfly of Sedgwick's to fossils collected by one Lieutenant Spratt in the Gulf of Smyrna.

Much of the material is solidly descriptive, as one might imagine: Philip Malpas de Grey Egerton, for instance (P.G. Wodehouse could have dreamed up no better), on the 'Mouth of a *Hybodu*s found by Mr. Boscawen Ibbetson in the Isle of Wight'; or John Dawes' 'Remarks upon *Sternbergiae*'. But there's more intriguing stuff too. Take Charles Lyell's Virginian Miocene molluscs. There are faunal lists there, to be sure, but also palaeoclimatology of no mean order. Lyell compared the Virginia fossils with fossil assemblages in France and noted that "the isothermal lines in the climate of the Miocene period took a curve to the south when drawn from Europe to America, as they do now."

There's quantitative geochronology attempted on some of the fossils, too, quite ingeniously, half a century before Henri Bequerel had his little accident with the photographic plate and the uranium salt. One J. Middleton, Esq., late Principal of the College of Agra, set out to pin down the 'element of *time*, so interesting in all geological investigations', and devised an ingenious experiment based on the observation that fluorine accumulated in fossil bone. Could this therefore be used to establish absolute dates for pieces of bone, by extrapolating from the known to the unknown? J. Middleton set to work in true Indiana Jones-fashion, arming himself with, to wit: the bones of an Egyptian mummy from a sarcophagus with 'all the structure of recent bone'; the bones of a Greek 'from about the time of the second Peloponnesian war' – thus some 2,000

years old; and then the unknowns – a fossil bone from the Sewalik (*sic*) hills (affinity not given, but likely Plio-Pleistocene); and 'a bone of the *Anoplotherium*, given by Lassaigne'. The last of these is a strange beast, a proto-camel of sorts[2]. Stratigraphically, though – the only thing that should concern us here – it is a strange Oligocene beast.

Thus, a succession of bones through time. One imputed as recent by chemistry and taphonomic setting (that sarcophagus), if not in absolute years; one that was two millennia old in antiquity and process both; and the two fossil unknowns. J. Middleton retired to his laboratory and busied himself with reagents and test-tubes and titration columns, emerging with calcium fluoride levels of 2.97, 5.62, 10.65 and 15.00 respectively, the calcium phosphate levels concomitantly decreasing. So, a progression in the correct stratigraphic order! This allowed a computation, then, with the 2,000 year value pegged by the unfortunate Greek (and our hero Middleton – a geochemically subtle man – using not simply fluoride levels but the fluoride/phosphate ratios): *viz*. the Sewalik fossil at 7,700 years and the *Anoplotherium* at 24,200 years. Well, it is only out by a couple of orders of magnitude or so, but does demonstrate the perils of using a straight-line correlation rather than considering that the rate of fluoride uptake into bone might diminish with time. Nonetheless, it was a valiant attempt to chart a course across what were then unconstrained abysses of time.

Roderick Impey Murchison's contribution also gives food for thought. A minor paper? – well, he does set out the Permian System (albeit not quite for the first time, as he had brief accounts in the *Philosopical Magazine* and in the *Transactions* a couple of years previously). As a reminder of where we were then, he starts from the premise that he had thought that the Palaeozoic consisted of, not the six systems now hardwired into any geologists brain, but of just three: Silurian, Devonian and Carboniferous (notice that he has no truck with his rival Sedgwick's Cambrian System, still less with his 'Protozoic', the latter a name which sank without trace so effectively that I had been barely aware of it). However, he goes on to say that, while examining Russia and Germany (a field area somewhat larger than the five or so square kilometres that we recommend to our undergraduates) it transpired that a new division of time was needed.

How does one set about carving out a new unit of time, on the scale of the Permian? Well, in this case, by accident, really. He hadn't meant to. He had set out for Russia with another, slightly more prosaic objective, though one that denoted admirable rigour. He had previously established first the Silurian System and then (working, indeed, with Sedgwick as a collaborator) the Devonian System (it's good to have practice in this sort of thing). Could the units that he had already identified, the Silurian and Devonian, be recognized, via their fossils more widely? If they could be found far into the Asian continent, then that would suggest a global reach, rather than mere parochiality.

Murchison's two journeys are set out in considerable detail in his own diaries, as admirably collated and commented on by Michael Collie and John Diemer (2004). Together with a few colleagues, notably the French palaeontologist Verneuil, and sundry temporary travelling-companions as both help and hindrance, he completed these journeys with little thought of travelling light, taking with him a custom-built folding cast-iron bed, an ample supply of Madeira, a huge supply of cigars, a 'red box with stones', full scarlet dress uniform and much else.

[2] The *Anoplotherium*, of course, rather than Lassaigne, though you never know.

To enable this, he practised, magnificently, the black arts of the ultimate networker, taking in the likes of Alexander von Humboldt (something of a role model), Leopold von Buch, Count von Brunow, the Russian ambassador to Britain and then the Tsar of Russia himself, with whom he discussed matters where coal may and may not be sought. The Tsar, in fact, became his sponsor for his second journey, mandating him to map out the huge country's natural resources, as a second 'official' reason for his travels.

Murchison obviously enjoyed these contacts, and Collie and Diemer note that he had all of the class-consciousness of one who was born to high position and took such a position as his right. Maybe so, but while he described the meetings with the Tsar and with Humboldt in some detail, he also described many meetings with officials and minor aristocracy and with common people too. He obviously had a knack of getting on with all of these, while his commentaries on the social and political conditions of Russia seemed to me not altogether those of a knee-jerk reactionary. He certainly, also, had an eye for the ladies – and for human dynamics – and the pages are considerably enlivened by short digressions on the comparative charm and comeliness of the women who crossed his path. The Tsar's daughter, Alexandrina, for instance, was "exquisitely beautiful" while the Empress, her mother, was "animated but *epuisée*" – something that Murchison explicitly linked with the Tsar's unusually well-fitted breeches, cut, as was the manner of the court, "to delineate the virile member with great precision". Murchison also made light of – or simply didn't mention – the many practical difficulties that he must have encountered (though for the notorious steppe mosquitoes he made an exception).

Murchison was trying to encompass the globe. Well, a little under two centuries on, the trans-world dynasties he helped put in place have been infinitely refined, and subdivided a hundredfold, and there is a real prospect of taking palaeontology literally into new worlds. But what of farther in the future, trying to look as far from the present as we are distant from Murchison?

There's one aspect that might be picked up here. Palaeontology has a considerable amount of baggage, and baggage of a very material sort, at that. Murchison and Verneuil travelled around Russia, taking delight both in recognizing familiar fossils, and in coming across new ones. It was their skill in this that led them – quickly – to recognise that the Silurian and Devonian did indeed exist as real, verifiable entities in Russia and then, rather more haltingly, to recognise that above the Carboniferous the strata contained fossils that bore no resemblance at all to those of the succeeding Triassic. Thus was born their new system (the name variously ascribed by later authors as derived from Perm, the city, or from Permia, the ancient kingdom of that region) and the first real glimpse of the greatest catastrophe of the past half billion years.

Since that time, the number of fossil species has grown by much more than a hundredfold. These taxa and their descriptions are underpinned by enormous museum collections, growing more capacious by the year. It's a considerable and indispensable ballast to the science. Yes, one can take images and store a million of them on a few video discs, but that is simply not as good as the real thing. Those collections, though, need to be stored and labelled and catalogued and maintained and curated, and specimens sent to (then clawed back from, by the usual combination of threats, diplomacy and pleading) palaeontologists around the world. It's a considerable undertaking, and done because it is still regarded as part of something that is both an indispensable heritage and crucial to the science.

A couple of centuries on, though, those collections will have become much bigger still, and other circumstances may well have changed. If the Inter-Governmental Panel on Climate Change (current incarnation) is correct, this will be a very different world. The heat will be on, and the water will be rising. One now still hopes that, somehow, there will be some get-out clause; that the cavalry will sweep down the hill to the rescue, via some overlooked environmental feedback kicking in, or through the invention of some new technical trick, to keep the planetary thermostat at more or less its current setting.

But it is probably more reasonable to assume that the modellers have it about right, and that society's response to global warming will come too little, too late. Society, after all, has a respectable track record in this respect. What then?

Well, this need not necessarily mean a vindication of all those souls who have walked up and down the high street carrying an End-of-the-World-is-Nigh placard. But it will mean difficulties, and readjustments, and a bumpy ride for many. Societal priorities would – must – then shift towards, say, reconstructing coastal cities on to higher ground. Fanciful? Well, with no higher ground to go to, the Netherlands is already seriously talking about – and planning for – floating conurbations.

Priorities would, in such a scenario, focus upon homes, schools, hospitals, businesses, agriculture (part of which might have to morph into aquaculture). Science? – well, science would be regarded as important, of course, but one imagines a focus on those sciences with a perceived practical value and those in which less expensive readjustments may be made – just as it is easier to support a string quartet than to maintain an opera company. Now, palaeontology may still be useful, then, to milk the last dregs of oil out of the ground, and people may remember that it played a signal role in predicting how a world can change – but one should not expect gratitude for what might well appear old hat, if not ancient history. It would still have cultural value of course, but one that is predicated upon millions-strong specimen collections (with all that they entail) might be seen in some quarters as, well, a bit of a luxury.

Forecasts, schmorecasts. We are still some way from the time when museum fossil collections are bundled into a few lock-up garages, sold off to curio collectors in car boot (or open cart, by then) sales or converted into breeze blocks. Crystal balls almost always speak with forked tongue, to scramble rather than mix (as is more usual) a metaphor. Even if such a prospect was anywhere near the mark, then of all the consequences of global warming, a degradation of the ability to carry out taxonomic palaeontology surely counts as one of the minuscule – even poetically appropriate – knock-on effects of global warming. But who knows? Two centuries on, our successors might have secured our palaeontological heritage by dint of networking and schmoozing the powers-that-will-be and the new media giants (likely one and the same by then) in a manner worthy of Murchison, while simultaneously celebrating the inauguration of the first Solar System Stromatolite Theme Park, in the shadow of Olympus Mons.

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PalaeoMath 101
Distances, Landmarks and Allometry

This column marks a slight change in topic for the *PalaeoMath* series. Up to now we've been considering standard bivariate (regression) and multivariate data analysis procedures, techniques that can be applied to a broad range of data. While it is true that in all those essays I've used morphological examples as a basis for explaining the procedures, and while they all work well with morphological data, their use is by no means so restricted. At present you're more likely to see PCA, PCoord, MDS, *etc*. used to analyze non-morphological than morphological datasets.

This wasn't always the case. Through the mid-1980s these multivariate procedures were used routinely to analyze morphological data. They even formed a 'school' of morphological data analysis called 'multivariate morphometrics', coined by Robert Blackith and Richard Reyment (1971). So, what happened? As it turned out, the multivariate approach to morphometric analysis was synthesized with another prominent school of morphometric analysis—the deformational approach—in the mid-1980s, largely through the work of Fred Bookstein, but with important contributions by a number of others. This new approach to the analysis of morphological data crystallized into what is now termed 'geometric morphometrics' with the publication of Bookstein's (1991) treatise on the topic. Now most morphometric studies are undertaken using the methods of geometric morphometrics. Although it is by no means uncommon to see articles published using the older multivariate morphometric approaches, those are dwindling as more researchers become aware of the power of geometric morphometrics and learn how to use the software that has been developed to implement the various geometric approaches. Accordingly, we will now turn our attention to this important group of methods for handling the analysis of morphological data.

The geometric morphometric approach is bound up with the concept of the *landmark*. In the context of geometric morphometrics a landmark is defined as 'a specific point on a biological form or image of a form located according to some rule. Landmarks with the same name, homologues in the purely semantic sense, are presumed to correspond in some sensible way over the forms of a data set.' (Slice *et al.*, 2008). There are a number of alternative definitions of the term (*e.g.*, Bookstein *et al.* 1985; Bookstein 1991; Dryden and Mardia 1998; Zelditch *et al.* 2004), but this one seems the most general to me.

Note the careful use of the term 'homology'. Landmarks are always assumed to represent corresponding parts of locations on the body, but they do not always—nor always need to—represent formal homologues in the biological sense of that term. Indeed, in the vast majority of cases landmarks can't be demonstrated to represent formal biological homologues. The concept of a homologue refers to a biological structure in its entirety (*e.g.*, the eye of a fish, amphibian, reptile, bird, and mammal), not an isolated mathematical point defined on the basis of that structure's geometry (*e.g.*, centre of the iris opening), however convenient that point may be for making quantitative comparisons. This centre of the iris is a good example of the logical complications one can get into by (needlessly) becoming embroiled in assertions about landmark homology insofar as this point has been used routinely in fish morphometric studies, but in fact corresponds to … nothing. There is no structure at the centre of the iris opening to argue the homology of.

It is simply an abstract point that is as good as any other for representing the position of the eye relative to other morphological structures. It is the eye that is homologous across vertebrate taxa, not a constructed point in the centre of an opening within that structure (see MacLeod 1999 for additional examples). Landmark points are used to locate the positions of structures relative to other structures whose positions are themselves represented by other landmark points. This more generic view of what landmarks are, aside from being logically defensible, also has the virtue of being consistent with the specification of different types of landmarks (*e.g.*, semilandmarks, constructed landmarks) as well as with both historical and contemporary practice.

The representation of morphology by landmarks has both trivial and profound implications (Fig. 1).

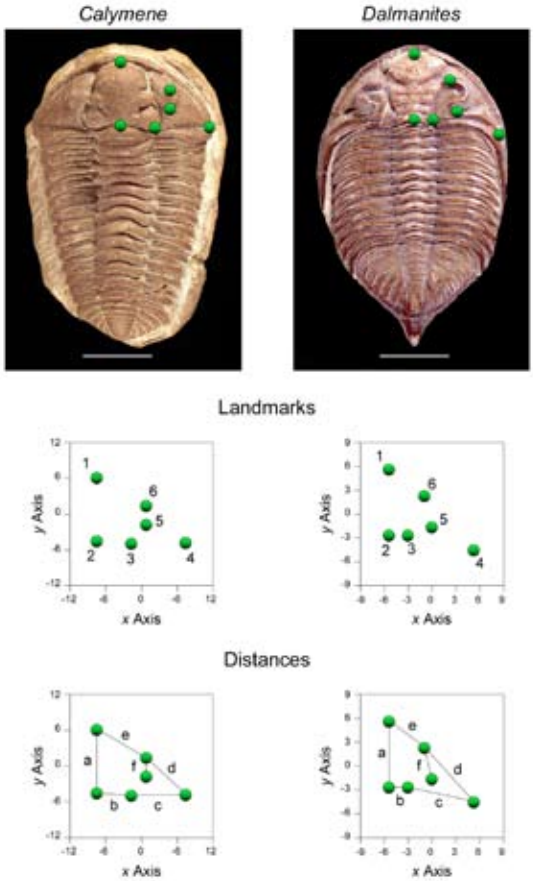

Figure 1. Alternative schemes for measuring size and shape differences between the cranidia of two trilobites. Upper row: images of Calymene *and* Dalmanites *specimens with six cranidial landmarks indicated (see text for definition). Scale bars: 11.87 and 8.20 mm, respectively. Middle row: geometry of landmark distributions in a scaled, mean-centred coordinate system. Lower row: selected inter-landmark distances linking the landmarks.*

Note that in previous essays we represented morphology by the simple device of measuring linear distances on the specimen, as we would with a set of callipers or using a ruler on a photograph. This resulted in a table of values, with sets of distances for different specimens typically organized into a matrix in which the rows represent specimens and the columns represent variables: the set of corresponding distances collected from each specimen. Of course the irony of this procedure with respect to landmarks is that, in order to know what distances to measure we needed to define the end-points of the distances which are — landmarks. Thus, we've actually been working with landmark data throughout these essays; we've just been focusing on the distances between landmarks, not the landmarks themselves.

Figure 1 illustrates the difference this makes. Here, aspects of trilobite cranidial shape have been represented by the six landmarks: 1: anterior central glabellar margin, 2: posterior central glabellar margin, 3: right posterior glabellar margin, 4: right lateral posterior fixigena terminus, 5: posterior eye margin, 6: anterior eye margin.[1] In the middle row of the diagram locations of these six landmarks have been placed into a scaled, mean-centred coordinate system. Note the obvious shape differences. In the lower row the landmarks have been joined by a series of chords the lengths of which represent inter-landmark distances. However, spatial relations between these chords are able to be appreciated only because we have retained the information encoded in the landmarks. These distances, as distances, are more accurately depicted as a simple table of values (Table 1).

Table 1. Scaled inter-landmark distance values for the trilobite cranidia. All values in mm.

Distance	*Calymene*	*Dalmanites*
a	11.675	8.985
b	6.239	2.346
c	10.343	8.683
d	11.421	10.036
e	9.753	5.450
f	3.551	4.116

As you can see, if all we had was the information included in Table 1 it would be very difficult to infer the correct relative positions of the landmarks. Each landmark is located relative to others by only two distances, with the exception of landmark 5, which is located by only one. The distance values obtained from each trilobite image are consistent with a wide variety of landmark configurations, only one of which is correct.

[1] Because trilobites are bilaterally symmetrical only the right half of the cranidium has been measured.

Contrast this with the situation for the landmark coordinate locations (Table 2).

Table 2. Scaled, mean-centred landmark coordinate point data for the trilobite cranidia. All coordinates in mm.

	Calymene		*Dalmanites*	
Landmark	x	y	x	y
1	-6.746	8.238	-3.926	6.595
2	-6.746	-3.438	-3.666	-2.386
3	-0.519	-3.827	-1.323	-2.256
4	9.794	-4.605	7.137	-4.208
5	2.400	0.065	1.540	-0.824
6	1.816	3.567	0.239	3.080

Because the coordinate point locations are referenced to linear distances along independent *x* and *y* axes, they record the position of each landmark relative to every other landmark precisely and succinctly. The data in Table 2 are geometrically equivalent to having a table of all possible inter-landmark distances (15 distances in all for six landmarks, see Fig. 2). But in terms of reconstructing the geometry of the landmark points they are even better, as all the coordinates are uniquely referenced to a single location—the origin of the coordinate system—thus obviating the need for inferential landmark reconstruction procedures. The coordinate-point representation is also far better from an analytic point of view in that many of the possible inter-landmark distances are redundant owing to their similarity in length and orientation. The penalty paid for this increased specificity, however, is an increase in the number of variables necessary to represent the forms fully. Once we have our data in landmark form we can easily compare the results of distance and landmark-based morphometric analyses to assess the advantages of using landmarks to measure morphology.

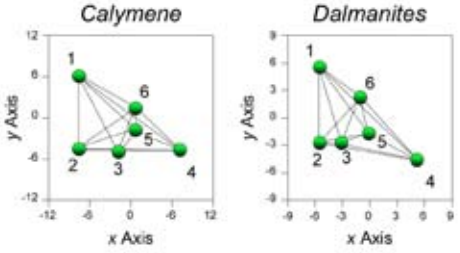

Figure 2. All pairs of distances between the six trilobite landmarks. See text for discussion.

To make use of landmarks, the first issues we need to tackle are position and orientation. Because inter-landmark distances represent simple magnitude, or scalar, variables, so long as we don't make a mistake assembling our data matrix (*e.g.*, by putting different measurements in the same column or the same measurements in different columns) it doesn't matter where the specimen was or how it was oriented when we took the measurements. The distance values will be the same regardless. Not so for landmark variables. Since landmarks encode the fundamental geometry of forms, differences in specimen position and orientation are part of landmark data. If we are interested in analyzing differences in specimen position or orientation, that's great.

For example, if we wanted to analyse the distribution of trilobites across a bedding plane and/or their orientation relative to the prevailing current direction, raw landmark data would be fine. But if we're not interested in differences between specimens that have to do with their positions and/or orientations during measurement, we need to correct for these factors in order to bring the distribution of landmarks into positional and orientational conformity. Fortunately, there are a couple of easy equations we can use to do this.

The first step in this procedure is to decide on a reference orientation: some standard configuration of landmarks that all specimens could be brought to. For the trilobite data an obvious reference orientation would be landmark data that are mean-centred with the mid-line chord (between landmarks 1 and 2 in the middle part of Fig. 1) perpendicular to the *x*-axis and parallel to the *y*-axis. This is more-or-less the standard orientation for trilobite illustrations and is shown for the example *Calymene* and *Dalmanites* landmarks in Figure 1. But even these data are slightly out of alignment (note the difference in the *Dalmanites x*-coordinate values for landmarks 1 and 2). Strict conformity can be gained by (1) reversing the x and y columns of the data[2], (2) centring the landmark distribution on landmark 2, (3) calculating the slope of the mid-line chord, (4) calculating the angle between the mid-line chord and the *x*-axis (= 0°), and (5) rigidly rotating the entire landmark distribution so that landmark 1 lies on the *x*-axis, and landmark 2 lies at the origin, of the coordinate system. The procedure for making these calculations is detailed in the *PalaeoMath 101*-2 spreadsheet. The equations needed for implementing steps 4 and 5 are listed below.

Step 4

$$\tan^{-1}\theta = \frac{m_2 - m_1}{1 + m_1 m_{21}} \qquad (14.1)$$

Step 5

$$\begin{aligned} v_1 &= x\cos(\theta) + y\sin(\theta) \\ v_2 &= -x\sin(\theta) + y\cos(\theta) \end{aligned} \qquad (14.2)$$

In equation 14.1 m_1 and m_2 represent the slopes of the *x*-axis (= 0°), and the mid-line chord.[3] Once the correct rotated values have been obtained the x and y columns can be re-transposed and the entire landmark dataset re-centred about the new mean x and mean y values (= centroid).

[2] This step rotates the landmarks by 90° and is needed with these data to avoid complications arising with the calculation of an infinite mid-line slope for some specimens.

[3] See the first essay in this series (*Newsletter* **55**) for instructions on how to calculate a slope.

Table 3 shows the results of these calculations for the two example trilobite genera.

Table 3. Scaled, rotated, and mean-centred landmark coordinate point data for trilobite cranidia. All coordinates in mm.

	Calymene		*Dalmanites*	
Landmark	x-rotated	y -rotated	x -rotated	y -rotated
1	-6.746	8.238	-3.734	6.706
2	-6.746	-3.438	-3.734	-2.279
3	-0.519	-3.827	-1.388	-2.217
4	9.794	-4.605	7.012	-4.413
5	2.400	0.065	1.516	-0.869
6	1.816	3.567	0.328	3.072

Now that we have our landmark data in a form suitable for comparison we can perform a PCA analysis on these data and compare the results of that with a PCA of the inter-landmark distance data as shown in Figure 1 and Table 1. Eighteen of our 20 trilobite images are suitable for the collection of these data (names shown in Fig. 3).

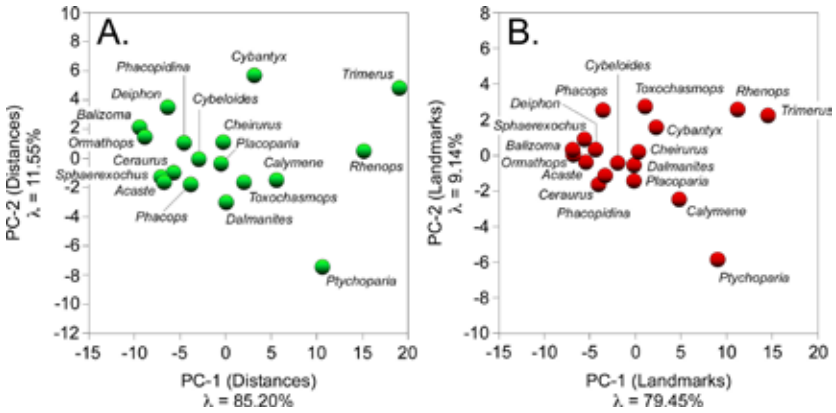

Figure 3. Ordination of trilobite cranidia inter-landmark scaled distances (A) and scaled, rotated landmark positions (B) in the space of the first two principal components of the respective datasets' covariance matrices.

Ordinations of the two datasets using the first two principal component axes (Fig. 3) are broadly similar, as would be expected. The amount of variation represented by PC-1 and PC-2 relative to the total variation is slightly lower in the case of the landmark-based analysis. This is also expected as that dataset contains twice as many variables as the inter-landmark distance dataset.

In both cases the PC-1 axis appears to ordinate taxa by size, with small individuals (*e.g.*, *Balizoma*, *Ormathops*) projecting to positions low on the axis and large individuals (*e.g.*, *Rhenops, Trimerus*) projecting to positions high on the axis. Close inspection of the diagrams shows the taxa are all in precisely the same rank order along PC-1, confirming the interpretation of this axis as a size index. However, the two analyses differ strongly in terms of the PC-2 ordination. Since the landmark-based dataset has the higher geometric information content, this result suggests the

distance data are masking both similarities and differences among taxa and so presenting a somewhat biased picture of the true state of morphological affairs. In other words, the switch to representation of the same geometries by landmarks made a difference not in terms of the assessment of size similarity, but in the assessment of shape similarity. This difference is most readily appreciated by inspecting the orientation of the principal component axes relative to the original variables (Table 4).

Table 4. Principal component loadings for distance-based (left) and landmark-based (right) covariance matrices.

Distance[a]	PC-1	PC-2	Landmark	PC-1	PC-2
a (1-2)	0.646	0.453	1x	-0.315	0.191
			1y	0.600	0.610
b (2-3)	0.222	0.105	2x	-0.315	0.191
			2y	-0.240	0.124
c (3-4)	0.323	-0.516	3x	-0.020	0.141
			3y	-0.248	0.104
d (4-6)	0.444	-0.568	4x	0.419	-0.468
			4y	-0.288	-0.300
e (6-1)	0.454	0.329	5x	0.175	-0.185
			5y	0.002	-0.237
f (5-6)	0.160	-0.292	6x	0.055	0.131
			6y	0.174	-0.302

[a] Numbers in parentheses refer to distance-defining landmarks.

The distance-based results (Table 4, left side) are highly reminiscent of the example given previously in the column on principal component analysis (see *Newsletter* 59). All loadings on PC-1 are positive but unequal, indicating that this axis represents allometric size change.[4] The theoretical value of a six-variable isometric axis is 0.408. Accordingly, distance *a* shows strong positive allometry, distances *d* and *e* weak positive allometry, and the remainder weak negative allometry. The orientation of these distances (see Fig. 1) suggests the glabellar mid-line is disproportionately longer in large-sized specimens with the overall cranidial length slightly greater than would be expected under a model of strictly isometric size change. The fact that distances located in the posterior portion of the structure are negatively allometric also suggests a slight narrowing of the cranidial shield accompanied by a strong reduction in eye size.

Whereas the PC-1 axis represents mixed size and shape variation, the PC-2 axis represents pure shape variation as indicated by its mix of positive and negative loadings. Here, taxa scoring high on PC-2 exhibit large values for the glabellar mid-line and anterior cranidial shield distances and

[4] Readers who recall the previous essay on the analysis of univariate and multivariate allometry will note—possibly with some surprise—that I have not log-transformed the original distance data. The purpose of the log-transform in allometric studies is to enable linear regression methods to estimate non-linear regression models (*e.g.*, logistic growth curves). While this is the classic procedure for allometric analyses, the analysis of non-transformed data is also appropriate for allometric investigations insofar as (1) most morphological data are not demonstrably non-linear and (2) the principle of allometry pertains to any comparison between size and shape data, not just comparisons between log-transformed variables. In the end the decision to employ a log-transformation should be dictated by the purpose of the analysis, the data, and characteristics of the data analysis method. Allometric theory is equivocal with respect to this issue. See Klingenberg (1996) for additional discussion.

small values for distances attached to landmark 4 in the posterio-lateral region. Eye size is also negatively correlated with an increase in PC-2 score.

While this might appear to be a lot of information, note that, for the most part, each distance must be interpreted in isolation from every other. High scores on PC-1 and PC-2 mean small eyes, low scores large eyes. But how is the position of the eye changing with respect to the position of the glabella? Is the glabella pushing out anteriorly, pushing back posteriorly, or both as size increases across these taxa? These questions are very difficult to answer from the distance-based results because each distance confounds two distinct sources of shape-change data—change in the *x*-axis direction and change in the *y*-axis direction—despite the fact that *information about these directions of shape change was collected in order to calculate the inter-landmark distance values*.

Contrast this with the much more complex and information-rich summary provided by the landmark data (Table 4, right side). The first thing to notice here is that the simple multivariate allometric interpretation of PC-1 doesn't necessarily apply to landmark data. This is indicated by the mixture of positive and negative loading values on the PC-1 axis. A mixed PC-1 loading pattern is characteristic of many landmark datasets and is a reflection of the fact that scalar distances between landmark points can increase at the same time as either *x* or *y* coordinate values *decrease* (*e.g.*, as the orientation of the distance becomes either more or less aligned with the *x* or *y* axis).

As we noted in interpreting the distance and landmark data ordinations along PC-1, the major axis of variation for the landmark dataset appears to reflect size differences among the taxa despite the fact that the loading pattern does not identify it as an allometric size axis. This somewhat counter-intuitive result has occurred in the example analysis because the two landmark variables that load most strongly onto PC-1 (1y and 4x) are also the variables with the largest mean values (as well as the largest variances) by a considerable margin. Also note that these positive loadings are much higher than any of the negative loadings for the other variables on PC-1. Geometrically, this means that, for these specimens, the glabellar mid-line length and lateral width in the region of posterior extra-glabellar cranidial shield exhibit both large displacements from other landmarks and increase with increasing overall size at disproportionately higher rates than those of any other variables. These two particular aspects of the morphological variation are dominantly responsible for the perceived size increase among the taxa in our sample. But how can this be, when the distance-based results clearly identified distances *a*, *d*, and *e* as being the most positively allometric? A moment's reflection reveals the reason and, along with it, the power of the landmark approach.

The disproportionately high loading on landmark 1y indicates that migration of landmark 1 in the anterior direction is the shape change most responsible for size differences among taxa. This is reflected perfectly in the distance results by the high loadings assigned to distances *a* and *e*, both of which share landmark 1. In the distance-based results it was ambiguous whether the cranidial mid-line was getting longer because of a change in the relative positions of landmarks 1, 2 or both. The landmark-based results neatly resolve this ambiguity. The focus of change is landmark 1 and the direction of change is along the *y*-axis (anterior-ward). Similarly, distance *e* has a high loading on the distance-based PC-1 because that distance is being dragged out by the anterior-ward migration of landmark 1. To be fair, there is a slight anterior-ward migration in landmark 6 as well, but its rate is far outstripped by that of landmark 1. As for landmark 2, the

distance between it and the origin is actually decreasing with increasing cranidial size. Thus, the whole glabellar mid-line is shifting anterior-ward relative to the other landmarks.

Along the *x*-axis, it's more-or-less the same story. Landmark 4 is shifting its position strongly in a lateral direction, away from the mid-line and migrating anteriorly at a slightly higher rate than landmark 2. This shift accounts for the high positive loading on distance *d* in the distance-based results. Moreover, inspection of loadings for landmark 2 also explains the negative allometry shown for distances *b* and *c* as that landmark (along with landmark 1) is migrating toward the *y*-axis (= line containing the form centroid) as size increases. In other words, within this sample the cranidia are becoming disproportionately longer (via anterior-ward migration of landmark 1) and narrower via migration of landmarks 1 and 2 inboard in the lateral direction), and the lateral portion of the cranidial shield getting disproportionately wider (via outboard lateral migration of landmark 4) with increasing cranidial size.

Now let's have a look at the eye. The distance-based results tell us only that the eye is getting smaller with increasing cranidial size. The landmark-based results confirm it's getting relatively smaller (difference between loadings on both 5y-6y *vs*. 1y, and 5x-6x, *vs*. 4x), but also that it's shifting to a position farther back on the cranidial shield (difference between 6y and 1y loadings) with a posterior margin placed closer to the glabella (difference between 5x and 4x loadings). In addition, differences in the eye landmark loadings themselves indicate its orientation is changing such that the chord joining the anterior and posterior landmarks is rotating anti-clockwise with increasing cranidial size. And all this is just the interpretation of landmark PC-1!

With respect to landmark PC-2 we note the broad regional distinctions among the landmarks with 1, 2, and 3 all migrating away from the origin in both x and y dimensions (1y very strongly so), and landmarks 4 and 5 migrating toward the origin. This represents a subdominant pattern of cranidial lengthening—differentially focused in the anterior region of the form—and lateral compression, accompanied with strong reduction in eye width and further rotation of the eye landmarks.

Admittedly the previous three paragraphs are a bit dense and abstract. But I hope the take-home message is clear. Analysis of landmark coordinate positions enables far more geometric information to be incorporated into an analysis—and supports far less ambiguous interpretation of the results—than the analysis of inter-landmark distances. In fact, the amount of information that can be gained from an analysis of landmarks is so large that much of the effort in developing geometric morphometric techniques has been spent developing mathematical tools to enable interpretations like those above to be made not by inspecting tables of numbers (as we have done here and as must be done with all standard multivariate data-analysis techniques), but by inspecting new types of ordination diagrams that summarize the complex and subtle geometric information in an easy-to-interpret graphical manner. It is to these methods with their accompanying graphics that we will turn our attention in future essays.

Most presentations of geometric morphometrics begin simply by defining landmarks and then diving into the subject of shape coordinates. Here I've tried to focus a bit more on the link between distance-based morphometrics and landmark-based morphometrics so that, when we get to shape coordinates (next column), the distinction between old-style multivariate morphometrics and new style geometric morphometrics won't seem so abrupt. Although

the transition between multivariate and geometric morphometrics occurred in a sufficiently short space of time that those of us who lived through it often speak of it as a 'revolution', the revolution actually had quite deep roots. Nevertheless, the translation and rotation methods I've outlined in this essay are based on equations that were developed for general geometric purposes, not specifically for morphometrics. These are not considered part of the established corpus of geometric morphometrics methods as they have been superseded by methods that allow greater control of size and shape aspects of the data. Instead, they represent precursor concepts and tools that form the (largely unacknowledged) background against which the discussion of more mainstream geometric morphometric techniques should be viewed. As such, there are no 'canned' programs for performing the standardizing rotations I have illustrated in this essay other than the *Palaeo-Math 101-2* spreadsheet.

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

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

Meeting REPORTS

SPCC/SVPCA
Glasgow, Scotland *27 August – 1 September 2007*

SPPC and SVPCA 2007 were organised in unequivocally the most expert of ways by the illustrious **Jeff Liston** at the University of Glasgow.

Monday
Arriving at the hub of incomprehensible British accents my colleague and I made our way on foot (the only true student method of travel) across the city to our accommodation. We stopped on the way to ask in our most polite of English accents whether the kind gentleman behind the bar would allow us to order food even though they would cease serving in two minutes and thirty seven seconds. A brief almost visible mental struggle between the wanting of profit and the botheration of having to take an order at this late hour resulted in cold chips, little salad and, I'm fairly certain, a small amount of saliva in the dressing that was needless to say left on the plate before a swift exit was made. Within minutes of arriving at the accommodation we had encountered more than one species of large arachnid, much to my excitement, and settled in nicely to the more than comfortable en suite rooms. I cannot do justice to the excitement of the *daily* free muffins, so shall not try – only here to note their presence. Many kisses on the cheek later many old friends had been greeted and reacquainted in the lobby of the informal folder-giving gathering before we all headed to the pub, of course, to catch up properly.

Tuesday
The first day of the conference period brought with it the delights of the 16th Symposium of Palaeontological Preparation and Conservation, though not before a guided tour around the new Hunterian and Kelvingrove Museums' vertebrate fossil displays. Surrounded by stuffed animals and fossil specimens we were introduced to the delights of the newly refurbished vertebrate fossil collections by **John-Paul Summer**, and received a thoroughly informative, not to mention amusing, explanation of why the *Ceratosaurus* dinosaur cast was indeed Scottish despite being found in North America. In the realm of the 'non-palaeontological though nevertheless still extremely interesting' was Salvador Dali's painting of 'The Christ of St John on The Cross', a victim of stabbing by some maniacal activist. It has been beautifully restored, though retains just enough scar tissue to be visible under close examination by those with an anthropomorphic demeanour and morbid interests. Sadly the no doubt exquisite demonstration of the fine arts of ancient glue making by **Leslie Noè** (University of Cambridge) was missed by myself on account of unforeseen 'essential items left at the accommodation' issues. I have heard it was a marvel though.

The SPPC was brief yet important (as always) and filled with monoscopic photographs, fake rock and mammoths. As only a day in the life of a palaeontologist can be. **Richard Forrest** (University of Leicester, and the brains behind the online infrastructure that made the electronic part of the conference organisation possible) took to the floor as the first chairman of the event, and introduced **Steve Etches** ('Ashfield') who delivered the one pro and many cons of building a Museum

on the Jurassic coast. I am always pleased to see a presentation by **Michaela Forthuber** (Staatliches Naturhistorisches Museum), who was up next, because I remember that when I was a wee undergraduate at my conference-attending-career premiere, Michaela's was the first presentation that I saw (or remember seeing!), and thoroughly enjoyed! This year she spoke about the finer points of constructing a living desert, which led nicely into the virtual and physical preparation of the Collared Plesiosaur by **Nigel Larkin** (Norfolk Museums and Archaeology Service).

Leslie Noè (University of Cambridge) treated us once more (and not for the last time) to his dulcet tones by chairing the second and final session of the SPPC. **Neffra Matthews** (USDOI Bureau of Land Management) had us all seeing double with her trackway magic eye pictures, before **Cindy Howells** (National Museum of Wales) enlightened everybody in the matter of fossils from the Wild, Wild West. Finally, **Emma-Louise Nicholls** (University College London) gave a riveting, informative and all round infallible presentation on the conservation of mammoth material (I may be the only one with the opinion of that being an accurate description).

As the tea flowed and a hint of impending beer delivery excited the air, people's attentions were diverted by the glorious array of posters that had appeared. Just over twenty were on display, covering research areas from sharks through big dead fish to crocodiles and dinosaurs. My personal favourite (thus I feel it worth a specific mention) was a striking poster co-authored by **Benjamin Kear** (University of Adelaide) and **Paul Barrett** (Natural History Museum, London) which was beautifully illustrated with images of *Platypterygius campylodon*.

The evening was one of the many and varied highlights of the conference, but also one of the more expensive for many of us. The auction took place in the Zoology Museum surrounded by a live tarantula, a by now ripe **Dave Hone** (whose suitcase had been sent to the wrong country), and a harvest mouse that lost a year off its life every time the hammer came crashing down within inches of

Dinner at Little Italy. Jeff is at the head of the table playing his 'most important man of the conference' part

its tank (which presumably means it didn't make it past the fourth item). Nevertheless the hammer kept banging, the beer kept flowing and the pockets kept emptying. Among the items up for sale by the ever brilliantly persuasive **Leslie Noè** (University of Cambridge) were a rainforest load of reprints, a more than ample collection of token tat (that, as usual, sold far better than anything else) and a stunning embroidery of a tetrapod trackway crafted by our American beauty **Neffra Matthews** (USDOI Bureau of Land Management). A swanky Italian restaurant called 'Little Italy' was descended upon by more than enough slightly sozzled palaeontologists (and Harry the mechanical grabbing dinosaur) for dinner, before bedtime was, several hours later, formally announced.

Wednesday

The following morning saw the commencement of the 55th Symposium of Vertebrate Palaeontology and Comparative Anatomy presentations which were delivered in a much larger lecture theatre to accommodate the masses of delegates that had appeared one by one throughout the course of the previous evening. **Ewen Smith** (Director of the Hunterian Museum) kicked off the symposium with a welcome speech and gave the floor to chairman **Jon Jeffery** (International School of Amsterdam) to start the presentations. **Zerina Johanson** (Natural History Museum, London) gave the first lecture of both the day and the symposium, about how naughty homeotic genes are altered, resulting in the mimicking of anterior and posterior segments of the axial skeleton in order to confuse us palaeontologists. Secondly **Kate Trinajstic** (University of Western Australia) got to show off the fieldwork localities you get to sample if you attend a university in Australia, and demonstrated how soft part preservation of her Devonian specimens allowed a detailed analysis of muscle microstructure of Arthrodires. The workload, responsibilities and commitments of a palaeontologist are never as abundant as when one is a PhD student (!?), so as a result I (**Emma-Louise Nicholls**; University College London) very sadly missed these first two lectures due to being at the accommodation finishing my talk that started at 10:10am that day. Waltzing in with five minutes to go before the end of the talk before mine, I was in good time at least to applaud **Robert Carr** (Ohio University) for what I am certain was a fantastic presentation, before having to dart down to the front to load up and talk for 15 minutes about the ever exciting twisted tails of Cretaceous sharks and their ecosystems. My colleagues tell me I missed a fantastic lecture by Robert Carr on why the study of polarity of character state transitions is integral to understanding the ontogeny of basal chondrichthyans and osteichthyans.

After the break (in which the harvest mouse's pulse was checked after the night before) **Marcello Ruta** (University of Bristol) invited the first speaker **Matt Friedman** (University of Chicago) to take us to North America where new skull material of *Protosphyraena gladius* has demonstrated that divorce proceedings are in place from *Protosphyraena* itself in favour of the presumably younger and sexier (and undoubtedly larger) *Leedsichthyes* and *Asthenocormus* models. The morning's chairman **Jon Jeffery** (International School of Amsterdam) then took to the floor once more to delight us with no less than four rare rhizodontid hyomandibular specimens from three separate localities that reveal details of pre-stapes morphological diversity. 'Ear 'ear! Evolution took place (no offence to Jon) to allow **Catherine Boisvert** (Uppsala University) to talk about the pectoral fins of *Panderichthyes rhombolepis* before **Leslie Noè** (University of Cambridge) closed for lunch with an intriguing presentation on the Collection of the Leeds brothers dated between the late 1800s and 1917 when the younger brother passed away. The collection is now spread throughout a number of institutions but was brought together by Leslie to demonstrate the depth of importance and intrigue of the archival material that accompanies the fossils, which sounds to me like a marvellous excuse

for spending hours rooting around in Museum basements! A photography session on the steps outside marked the beginning of lunch, which saw most people head to the 'not huge' Tennants pub on Byers Road for the second day on the trot, subsequently motivating the landlady to ask for how many more days she might expect us, and – I believe – she scheduled an extra staff member to work our programmed lunch breaks for the duration of our conference! Oh how the earth moves for geologists.

Post lunch, **Matt Friedman** (University of Chicago) chaired a session kicked off by **Marcello Ruta** (University of Bristol) and his temnospondyls, explaining the topological consequences of the mother of mass extinctions and diversifications in the Lower Triassic. **Alexandra Houssaye** (Muséum National d'Histoire Naturelle) showed how a whole fossil is better than part of one in the avoidance of parataxonomy, before **Sara Fielding** (University of Portsmouth) explained how the shell of testudinids in the Late Jurassic is not the be all and end all in the implication of habitat, and **Marc Jones** (University College London) followed with a demonstration of how feeding strategies were of absolute importance to the Rhynchocephalians and their diversification, leading to the modern species *Sphenodon*. **Michael Coates** (University of Chicago) finished the session, wetting our appetites for both coffee and the field trip by discussing the Bearsden sharks. In trying to convince us that there is a comparably exquisite site in Montana he remarked upon how, despite the preservation being poorer, the overall taxonomic and morphological diversity is superior in the Bear Gulch. Patriotism states that remains to be seen. **Mark Young** (Natural History Museum, London) used 120 osteological characters to rectify the synonymatical state of the crocodyliforms *Metriorhynchus* and *Geosaurus*. **Marco Brandalise de Andrade** (University of Bristol) explained that although the dentition of crocodilimorphs has always traditionally been used to decipher diet, in some Notosuchians it is not so straightforward. The University of Bristol wasn't quite done with us yet, and with the input of *seven* authors I wasn't sure this lecture would fit into the day let alone the 15 minute slot, but, delivered by the magical, masterful, mighty **Mikey B** (University of Bristol), it of course blew us away with tales of corrupt geological timescales messing with our beliefs of extinction times and causes, and how Russian sections reveal indisputable evidence that the famed Siberian traps are to blame for the pre-dinosaur life collapse. The last presentation of the day took to the water as **Hilary Ketchum** (University of Cambridge) made the 'largest and most comprehensive cladistic analysis of the Plesiosauria to date'. The evening was spent in grand splendour at the Lord Provost's Civic Reception. An evening full of nuts (I am not of course referring to the splendid speech by the elusive **Jeff Liston**) and wine was held in the most exquisitely ornate buildings, the City Chambers. It proved a wonderful opportunity to meet and re-meet hordes of people, and only once did I have to pretend with utmost care and grace that I did indeed remember the person chatting happily away in front of me and trying not to be busted catching a glimpse of their name badge. Not bad going in my book.

Thursday

A morning session of plesiosaurs was introduced and chaired by **Richard Forrest** (University of Leicester) and kicked off by **Adam Stuart Smith** (University College Dublin), who used recently prepared skull material of *Rhomaleosaurus cramptoni* to reconstruct the beast for the first time since 1863. **Donald Henderson** (Royal Tyrrell Museum of Paleontology) dug through volcanic ash to rescue a headless elasmosaur, and **Peggy Vincent** (Muséum National d'Histoire Naturelle) re-examined a skull of *Plesiosaurus macrocephalus*, subsequently awarding it a new genus. **Mark Evans** (New Walk Museum and Art Gallery) spoke about the evolution of the plesiosaur palate which led on to the wetting of ours with coffee.

After the break **Mike Coates** (University of Chicago) introduced the session led by **Dave Unwin** (University of Leicester) who took to the air with morphometric analyses of pterosaurs. **Dave Hone** (then part of Bayerische Staatssammlung für Paläontologie und Geologie and now smelling better post suitcase return) maintained altitude to explain how although Cope's Rule may be rife within archosaurs it may have been the smaller ornithuromorpha which had the upper wing at the KT boundary. **Paul Barrett** (Natural History Museum, London) brought us back to earth with dinosaur diversity curves, before **Nizar Ibraham** (University College Dublin) bridged the gap between North Africa and Ireland to conclude that Morocco is plagued by an epidemic of overzealous fossil hunters. Finally **Vincent Fernandez** (European Synchrotron Radiation Facility) worked up our appetite for eggs before lunch by explaining how he studies the inside of dinosaur eggs from Thailand using x-ray propagation phase contrast microtomography. Lunch for most was at the Tennants pub on Byers Road – for exploratory creatures it's surprising how easily palaeontologists fall into habit (or habitat).

An afternoon of delectable dinosaur data was chaired by **Brent Breithaupt** (University of Wyoming). The first speaker, **Roger Benson** (University of Cambridge), explained the finer and taxonomically important points of the skeleton of *Stokesosaurus*. Theropods continued into the next presentation as **Darren Naish** (University of Portsmouth) discussed the many alter egos of *Becklespinax* and the poor standard of documentation of the Lower Cretaceous theropods of western Europe. **Stephen L. Brusatte** (University of Bristol) re-described the holotype of *Neovenator salerii* and concluded it to be a basal-most member of the Carcharodontosauridae. **Manabu Sakamoto** (University of Bristol) dazzled us with algorithms and complicated images to demonstrate that bite forces can be estimated using scaling in predatory tetrapods. **Tom Hübner** (Bayerische Staatssammlung für Palaontologie und Geologie) finished the day's talks and moved on from theropods but stayed within the Dinosauria. He explained how 14,000 isolated dinosaur bones were pieced together to produce a herd of *Dryosaurus lettowvorbecki* that comprised various ontogenetic stages from which a variety of palaeobiological information was retrieved.

A quick break to gather one's thoughts on the impending plenary on SVP 2009 preceded the inevitable 'discussion' democratically and tactfully chaired by **Jeff Liston**. All of which was then to be immediately forgotten as an evening of whisky tasting appeared on the horizon – with only a thoroughly fascinating tour of William Hunter's fossil vertebrate collection to distract us from the inevitable slurriness of the upcoming evening. Dr **Jim Hansom** took us on a visual and oral tour of whiskies and their heritage. Although the slide projector seemed to need refocusing by the end of the evening, the talk was as interesting as the concentration on people's faces as they attempted to allow one single drop of water to decant itself from the several litre glass jug into their shot of whisky. As the whisky rations inevitably dried up, for most the shenanigans continued into the dark night at the atmospherically lit Salon Restaurant.

Friday

As the last day of the conference dawned, **Darren Naish** (University of Portsmouth) chaired the morning's session begun by **Neffra Matthews** (National Science and Technology Centre) in her second talk of the meeting. Her work compared Middle Jurassic tracks from North America and Scotland. Staying within the Jurassic, **Brent Breithaupt** (University of Wyoming) continued the ichnological theme but compared Wyoming material to tracks of modern emus rather than fossils from across the pond. After a by now thorough introduction on trackways **Kent Stevens** (University of Oregon) used a wide variety of morphological and biological logistics to reconstruct dinosaur

No one was in 'finer spirits' for the whisky tasting than Jon Jeffery

gaits. Finally **Paul Upchurch** (UCL) shunned a monophyletic Euhelopodidae to place *Euhelopus zdanksyi*, the first dinosaur from China to be named, within the Titanosaurs. After the coffee break **Richard Butler** (National History Museum, London) used his global relational database to demonstrate that whilst Nodosauridae may have enjoyed a sea view from its grazing location, its sister-clade Ankylosauridae had slight hydrophobic tendencies and subsequently lived nowhere near the shoreline. **Eric Buffetaut** (Laboratoire de Géologie de l'Ecole Normale Supérieure) gave a whirlwind tour of both recent and rather older *Psittacosaurus* finds before **Stig Walsh** (University of Portsmouth) explained why the insult 'birdbrain' proves the offender to have less cognitive abilities than some birds. **Felix Marx** (University of Bristol) well and truly interrupted the 'Day of the Dinosaur' by going down the furry path of *Morganucodon watsoni* and whether the mammals exhibited diphyodonty. **Anjali Goswami** (University of Cambridge) concluded the morning with the differences between marsupial and placental life strategies.

The age of the mammals had well and truly dawned over the lunch period (which was spent – you guessed it – at Tennants on Byers Road), so **Anjali Goswami** (University of Cambridge) as chair introduced **Stephen Wroe** (University of New South Wales) to dazzle us with finite element analysis models of marsupial and placental carnivores including the *Thylacine*. **J. J. Hooker** (Natural History Museum) took some cheek teeth to invent a whole new clade before **Eugenie C. Barrow** (University of Oxford) took us on until break time with a thrilling presentation on cranial and postcranial material of a hyracoid from the late Eocene.

Post lunch – near end of conference – is always a trying time on the eyelids it seems, and frequently the result of prolonged periods of hard concentration (and possibly a little to do with a week's hard drinking). Despite the lecture theatre being designed in such a way that ducking down behind the person in front to have a sneaky snooze before that lecture you were particularly waiting for was utterly impossible in every way, somewhere within the second half came a loud snore emanating from the back of the room followed by a grunt – presumably as a result of a sharp nudge by

a neighbour. The very interesting speaker carried on with unruffled pizzazz and the audience paid that much more attention to the presentation as a result of the nasal interruption. I must remember this tactic for future presentations of my own.

A coffee break injected enough stimulant into everyone to have an uninterrupted last session chaired by **Tom Kemp** (University of Oxford). **Sarah Joomun** (University of London) took to the floor with a change in perissodactylian diets over a period of climate change with specific reference to *Plagiolophus minor*. **Eleanor M. Weston** (Natural History Museum) proved that size didn't make for any less of an important or interesting presentation as extinct dwarf hippos danced across the screen. In the final talk of the conference **Mark Hagge** (Louisiana State University) put the C and A into SVPCA through an ontogenetic study of modern and the Miocene rhinoceros *Teleoceras major*.

The Annual Dinner took place at Arisaig, a fantastically debonair restaurant, where free wine and fancy napkin arrangements awaited the 70 odd, suavely dressed, palaeontologically orientated alcoholics. Speeches were made by several, and all who stood up to talk verbally patted **Jeff Liston** on the back for an outstanding feat of organisational skill. Dinner was divine (even before the numerous pints of beer – such a classy lady), and drinks in a nearby bar were soon to follow. The final establishment was to the vast majority of tastes, with somewhat pornographic images delicately placed high on the wall behind the main area. The somewhat less subtle live action videos that were captivating the male audience and making subsequent conversation all the more intellectual were reserved for the main front of house area. The only brawl to break out was between Paul Upchurch and a door which resulted in a large plaster being applied to his bleeding eyebrow in a fantastically bright, yet nevertheless manly, shade of blue. At some ridiculous hour we were finally evicted, though not content with the current levels of intoxication, drinks in someone's kitchen were the only way forward. Sharing a single bottle of wine between around ten palaeontologists, all of whom probably should have stopped drinking many glasses ago, was a fitting way to end the conference, and a final toast was made in honour of our esteemed organiser Jeff Liston.

Saturday

With hangovers ranging from non-existent through mild to hideously heinous, the intrepid 18 hardcorers braved the rain and left for the conference field trip. For anyone with a fear of water (yes that would be me and yes that is ironic considering that I study sharks) the first location was one of physical challenges and mental strength. A single LARGE stream meandered its way from one side of our path to the other, making a number of river crossings (involving numerous rescue attempts by the gallant Dr Liston) necessary to reach the site. Led by **Neil Clark** – who had sole responsibility for The Key – we tramped across field (and stream) after field (and stream) to gain access to Lesmahagow – a site containing anapsids with marvellous levels of preservation. We were the first people to enter the site in 15 years and were subsequently blown away by the material we found. The post lunch locality (dare I say where we ate?) was Bearsden where shark fossils have been recovered (my excitement was barely contained as many would attest), and subsequently I braved the incredibly slippery slope down to the stream bed (I feel the need to reiterate the fact that I am inflicted with hydrophobia!). Sadly my complete specimen of that new genus I have been meaning to unearth decided to wait for a rainy (rain-ier) day before surfacing itself, but nevertheless we had an absolutely amazing day full of laughs, fossils, landslides, frogs, impromptu football in the rain and lunch at the Tennants pub on Byers Road.

All is done except for the most important of jobs which is to thank **Jeff Liston** and his coerced minions (who are amazingly few in number in terms of how long it took and how much there was to organise) for doing a most stupendous job at what has been crowned on a vast number of websites as 'The Best Conference *Ever*'. Well done, and thank you Jeff!

Emma-Louise Nicholls
University College London

The intrepid (and soggy) 'Field Trippers'

Craniogenesis: The Development and Evolution of the Head
London, UK *8 February 2008*

This free one-day symposium was organised by Michael Depew (Kings College London, UK) and sponsored by the EU Marie Curie Early Stage Training Award (<**http://network.nature.com/london/events/2008/02/08/4934, http://www.kcl.ac.uk/depsta/crdebi/whoswho/MichaelD.html**>). It was deliberately timed to precede the Gordon Craniofacial Morphogenesis & Tissue Regeneration conference taking place in Italy (10–15 February), thus attracting several leading developmental biologists already en route to mainland Europe.

At first glance many palaeontologists may not consider this meeting at all relevant to palaeontology or even vertebrate palaeontology, and it is true that the talks focused on details of developmental biology (placodes, cell fate mapping *etc.*). However several talks discussed macroevolutionary trends, referred to cladograms, compared taxa (rather than using a single "model organism"), and some even mentioned fossil species. Palaeontologists should find it encouraging that so many of the speakers (and audience members) recognised the important role of palaeontology in 21st century biological sciences, as argued elsewhere (*e.g.* Depew and Simpson, 2006; Koentges, 2008).

The conference opened with a brief introduction to head development and evolution from **Michael Depew** (Kings College London, UK) followed by **Gerhard Schlosser** (University of Bremen, Germany) who discussed how all cranial placodes originate from a single region near the anterior neural plate that is characterised by expression of the genes Six1 and Eya1. He then presented results from experiments using Xenopus (the clawed frog) that demonstrate how the placodes differentiate, and the role of Six1 and Eya1 in regulating subsequent neurogenesis. To illustrate implications for macroevolution, expression data were mapped onto a tree of deuterostomes.

Next was **Clare Baker** (University of Cambridge, UK) who described her work on trigeminal placodes and cell fate-maps in the chick embryo, and **Ralph Marcucio** (University of California at San Francisco, USA) who gave a talk about development of the upper jaw in chicks and mice. **Lennart Olsson** (Friedrich-Schiller-Universität, Jena, Germany) discussed his lab's work on cranial muscle development in amphibians and an interest in how and why the shoulder girdle became independent of the skull in early tetrapods (as it is in Tiktaalik, but not in Eusthenopteron). He plotted developmental data from all three extant groups of modern amphibians (caecilians, frogs and salamanders) onto a phylogenetic framework using the Australian lungfish as an outgroup. Parsimov (Jeffery *et al.*, 2005) was applied to this tree in order to identify sequence heterochrony in the relative timing of somite formation and migration of neural crest streams. It demonstrated that distribution of developmental traits on the tree was related to both the phylogenetic relationships and feeding strategy of individual taxa.

The last speaker before lunch was **Anthony Graham** (Kings College London, UK) who talked about the patterning of pharyngeal arches in chickens and emphasised the importance of the underlying endoderm (as opposed to neural crest). To put this work in context he described how the number of pharyngeal arches seems to have reduced within vertebrates. Extant lampreys have seven gill arches, extant hexanchiform sharks have six or seven, and other living jawed vertebrates have no more than five. The extinct jawless vertebrate *Euphanerops longaevus* (Janvier *et al.*, 2005; Janvier and Arnesault 2007) from the Devonian of Canada received special mention because it possessed at least 30 gill arches.

Perhaps appropriately, the first two talks after lunch concerned teeth. **David Stock** (University of Colorado, USA) discussed the apparent trend within vertebrates of reduction in the number of teeth and tooth-bearing locations. He asked whether this was because teeth could not be re-gained once lost or whether it is simply advantageous to have less teeth. To test competing hypotheses his lab is comparing gene expression and function in the cyprinid zebra fish, which lacks oral teeth, and Astyanax mexicanus (Mexican tetra), a relative of the pirhana that retains such teeth. **Malcolm Snead** (University of Southern California, USA) gave a talk on enamel and discussed new preliminary data from Dr Rodrigo Lacruz that shed light on whether or not the bands in enamel really do reflect 24 hour growth increments. This represents the first molecular evidence for a circadian clock in ameloblasts, something of direct relevance to palaeoanthropology (*e.g.* Bromage and Dean, 1985; Beynon and Wood, 1987; Risnes, 1998; Lacruz *et al.*, 2006) and of more general interest to the study of growth chronology (*e.g.* Pebody, 1961; Clark, 1974).

The penultimate speaker of the day, **Rob Maxson** (University of Southern California, USA), described his work on skull vault morphogenesis, and specifically how cranial sutures develop, in mice. Using a mouse model **Paul Trainor** (Stowers Institute, Kansas, USA) investigated the relationship between

genes, neural crest cells (again in mice) and the phenotype of Treacher Collins syndrome (*e.g.* cleft palate, hypoplasia of the facial bones, ear defects).

Abstracts of the talks were freely provided in a smart booklet, and complimentary tea and biscuits were available during two 20 minute breaks. Lunch was provided for the speakers and students while other delegates used the opportunity to forage in the nearby Borough Market (<**http://www.boroughmarket.org.uk/**>). After the symposium drinks were available on floor 27 of Guy's tower where discussion continued enthusiastically. We hope that some of the attitudes expressed during this symposium are a sign that interest in palaeontology from some quarters of more mainstream biology is perhaps increasing and that future links between palaeontology (or at least aspects of palaeontology) and developmental biology will continue to grow; after all, palaeontology has an equal responsibility to take an interest in developmental biology.

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Lyell Meeting 2008
The Geological Society, Burlington House, London *20 February 2008*

This year's Lyell Meeting *Marine Climate Change – past and future* aimed to bring together researchers who do not usually talk with each other: micropalaeontologists reconstructing the past and people predicting the future of climate change. The meeting was organised by Daniela Schmidt and Sarah Cornell, University of Bristol, and Jennifer Pike, Cardiff University. It was well attended by 130 people, with a large number of PhD students and young researchers.

Carol Turley (PML) started the day with an overview of ocean acidification: vulnerabilities for the future. Carol emphasised the high uncertainty of our knowledge of ecosystem changes due to ocean acidification in marginal sea, shelf areas and upwelling systems. The Arctic Ocean will be especially strongly affected, with the water projected to become undersaturated with respect to aragonite in 2040 and calcite by 2070. She highlighted the need for further research on all live stages of organisms, since different developmental stages might have different sensitivities to ocean acidification. Turning to the insights from the past, **Samantha Gibbs** (NOCS) outlined the insights we can obtain from records of ocean acidification, then explored the contradictions between laboratory results and the geological record of coccolithophore calcification. She drew attention to our lack of knowledge in regard to adaptation and microevolution.

Carrie Lear (Cardiff) gave an overview of palaeo-temperature reconstructions from magnesium calcium in foraminifera, alkenones produced by coccolithophores and the new TEX86 palaeothermometry technique based on Crenarcheota. She demonstrated how these proxies can be applied to improve our understanding of the sequence of events at the Eocene–Oligocene boundary, from sea level changes via carbonate compensation depth to temperature, by combining the proxies. **Carol Robinson** (UEA) continued on records of present and predictions of future changes in ocean temperature. She showed examples of changes in stratification of the surface ocean and its effect on primary productivity, and the effect of temperature changes on the oxygen content of the ocean and hence respiration of organisms. The talk covered changes in upwelling in the California Current, the change in sea ice in high latitudes and the frequency of hurricanes and their effects on ecosystems from physiology, distribution to phenology. She set priorities for future research with regards to resilience of organisms to climate change, potential for adaptation and its effect on ocean chemistry and biogeochemical cycles.

Robin Edwards (Trinity, Dublin) showed examples of reconstructions of Holocene sea level change (with great pictures of micropalaeontological fieldwork!). In his presentation he combined evidence from a wide range of microfossils such as pollen, diatoms, foraminifera and testate amoebae. **Mikis Tsimplis** (NOCS) linked global, regional and local sea level change, and described how the lack of long term records of past changes is a major constraint in forecasting future changes. He emphasised the differences between recent sea level rise due to warming compared to changes observed in the earlier part of the 20th century. Both of these presentations highlighted the need for more regional and local records and predictions of sea level change in vulnerable areas of the world, as opposed to using large-scale, global average sea level predictions.

Peter Liss (UEA) presented an overview of the effects of climate change on the production of climate active gases ranging from increased wind speed, to changes in the mixed layer depth of

solar radiation due to changes in cloud cover. He predicted that ocean acidification will decrease the production of dimethyl sulphide (DMS) by phytoplankton and that this trend will be reinforced by predicted increases in mixed layer depth and stratification. His talk was followed by a joint presentation by **Jeremy Young** (NHM), **Dan Franklin** and **Gill Malin** on past records of DMS producers. Jeremy summarised the results of culture experiments on DMS and DMSP production, talked about biological function, and provided an ecological framework for the different phytoplankton groups. This was followed by a discussion on glacial–interglacial changes in DMS production highlighting our lack of understanding of short-term changes. He finished the talk with a geological perspective on DMS production driven by the evolutionary rise of the diatoms and decline of coccolithophores.

Seymour Laxon's (UCL) presentation showed the dramatic changes in sea ice in the Arctic. He highlighted the effect of sea ice changes on the Earth's albedo, resulting in an important contribution to future temperature changes. Seymour explained the technical improvements in sea ice thickness measurements which are the basis for extrapolation of sea ice changes into the future. Current data suggest that there will be no Summer sea ice in the Arctic from 2030 onwards. His data, showing the dramatic 2007 sea ice low, were the most iconic graph of the meeting. **Xavier Crosta** (Bordeaux) then provided an overview of reconstructions of past sea ice cover as a way to overcome the problem of our short instrumental records of sea ice distributions. He showed a series of regional and time-resolved reconstructions of Antarctic sea ice covering the last 200,000 years, with an emphasis on high-frequency changes in the Holocene. These show regular changes, suggesting that increases in solar energy increase the frequency of storms and increase temperature which in turn leads to ice break-up.

The final talk of the meeting, and an appropriately thought-provoking one, was presented by **David Cope** (Parliamentary Office for Science and Technology). His 'rule of thumb' is that interest in future changes lies in the timeframe of two generations, often articulated as "saving the planet for our children and their children". Projections of climate change far into the future will get little policy response unless the impacts are brought into this human-scale timeframe. He discussed current concerns about rapid climate change, and the urgent need to think about adaptation to committed climate change, for example using geo-engineering solutions such as carbon capture and storage for climate management. Unfortunately, **Claus Otto**'s (Shell) planned talk was cancelled; Claus was due to discuss carbon sequestration into deep saline aquifers, depleted oil and gas fields and into producing oil reservoirs. We would have loved to hear his views, especially on storage of CO_2 in the deep ocean and fixing of CO_2 by chemical mineralization; however, the European weather defeated us!

In short, the meeting was a great success, with modellers and micropalaeontologists discussing the future climate over a glass of wine and nibbles at the reception. The organising committee would like to thank sponsors The Micropalaeontological Society, the Challenger Society for Marine Sciences, the Geological Society, London, the Palaeontological Association and QUEST, as well as the local organising team at the Geological Society, London, especially Alys Johnson.

Daniela Schmidt *University of Bristol*
Sarah Cornell *University of Bristol*
Jennifer Pike *Cardiff University*

[This report has also been published in *The Micropalaeontological Society Newsletter.*]

Leicester Literary and Philosophical Society (Section C) Seminar 2008
University of Leicester *15 March 2008*

Reflecting the all-conquering popularity of all things dinosaur, this year's annual Section C (Geology) Leicester Literary and Philosophical Society symposium entered the world of "Dynamic dinosaurs: cutting edge approaches to ecology and behaviour". The event ran in conjunction with National Science and Engineering week, and as usual attracted a large public and academic audience, including plenty of LLPS members.

After a welcome from Section C Chair **Joanne Norris**, the first morning session focused on living dinosaurs. Kicking off for the home team, **David Unwin** (University of Leicester) examined the evolution of that remarkable dinosaur innovation, the feather. He showed that although we have a useful developmental framework for feather origins – a simple linear progression of increasing structural complexity, derived from studies of extant birds – only the fossil record can reveal the distribution of these various morphological stages within dinosaurs. It should probably come as no surprise that the record suggests a far more complex picture, with multiple losses and gains of different morphologies in different groups of dinosaurs. Despite all the recent finds of feathered dinosaurs, there clearly remain substantial gaps in our knowledge of feather evolution.

We do know that *Archaeopteryx* sported feathers that were almost indistinguishable from those of modern birds, but did it possess the neural equipment necessary for flight? Thanks to the close fit of the archosaur brain into the archosaur skull, **Angela Milner** (Natural History Museum) was able to use CT scans of braincases to generate virtual endocasts. These reveal that *Archaeopteryx*'s gross brain organisation was more avian than crocodilian, indicating that much of the distinctive physical structure of the bird brain originated early in the evolution of the group. Unfortunately, three-dimensionally preserved braincases are a rarity in bird fossils, but results from similar analyses of early seabirds suggests that tracking avian neural evolution is possible using this technique.

Attention turned next to dinosaur feeding. **Laura Porro** (University of Cambridge) presented her research into the unusual jaw mechanics of the early ornithischian *Heterodontosaurus*, focused around the now seemingly ubiquitous Finite Element Analysis, an engineering technique which models stress and strain in 3D structures during function. **Vince Williams** (University of Leicester) then talked about his work, demonstrating the power of tooth microwear analysis – quantifying damage patterns on teeth generated during function – to test and constrain hypotheses of jaw kinematics in hadrosaurs. Both talks highlighted the uniqueness of dinosaurs: in the absence of good extant feeding analogues, novel methods of obtaining information from the fossils themselves seem to represent the best chance of understanding dinosaur feeding.

After indulging in some jaw kinematics of our own over lunch, we took an afternoon walk with dinosaurs, as **Phil Manning** (University of Manchester) illustrated the plethora of high technology he and co-workers were utilising to elucidate function in the important but often overlooked elastic components of dinosaur locomotary systems; an endeavour that may be aided considerably by the discovery of an exceptionally preserved hadrosaur mummy, complete with skin microstructure, organic residues and an unfortunate crocodile (they can't fit through the mouth of a carcass, so apparently crocodiles favour an easier orifice towards the rear; in this case it seems there still wasn't enough space. What a way to go.).

Then for something completely different: **Paul Upchurch** (University College, London) gave us an introduction to dinosaur biogeography. Detailed quantitative analysis of the similarities and differences in vicariance patterns for various dinosaur groups can indicate whether the distributions were driven by intrinsic ecological factors or were the result of geographic contingency. Interestingly, the results suggest that dinosaurs originated on the continent perhaps least historically associated with the group: South America.

Returning to dinosaur locomotion, **Bill Sellers** (University of Manchester) again raised the difficulty of finding dinosaur analogues in the modern world: specifically, no living organism moves like a bipedal dinosaur. Using evolutionary robotics, he is trying to teach computer models of dinosaurs to walk, by searching through the astronomical numbers of potential muscle movements to find functionally optimal gaits. Certainly the twitching and stumbling models produced to date bear little resemblance to the slick Hollywood imagery to which we are accustomed, but the models are in their infancy. And unlike the primarily artistic visions of film makers, this approach has potential to generate reconstructions both visually appealing *and* biomechanically viable.

Finishing the presentations on a somewhat philosophical note, **John Hutchinson** (Royal Veterinary College, London) encouraged us to consider what is wrong with models of dinosaur biomechanics, rather than what is right; in particular, to acknowledge the errors and ambiguities inherent in the assumptions on which they are based. Since these uncertainties will always be present, no matter how advanced the models, the way they are presented is a key consideration for the communication of science to the media and public.

There followed an open floor discussion, providing an opportunity for the audience to quiz the day's speakers, with the origin of feathers proving to be the main talking point. **Joanne Norris** then brought proceedings to a close by thanking the speakers for a day of excellent talks. Finally, those attendees urgently in need of refreshment repaired to the reception upstairs (at which point your reporter had to leave, but the event doubtless proceeded without incident).

I came away from the day's talks thinking about the historical debate over whether dinosaurs were most like big lizards or scaly mammals. It seems this argument has been rendered obsolete by the reality that they were neither. The symposium highlighted how unique dinosaurs were, in their behaviour, locomotion and morphology, and how this has driven the application of sophisticated statistical and modelling approaches to tackle the many complex questions that still remain surrounding their palaeobiology. It also made an effective demonstration of why it is so important that palaeontology as a whole continues to exploit cutting-edge quantitative techniques.

David Jones
University of Leicester

Exploiting Geoscience Collections
Geological Society of London, Burlington House *12 – 13 May 2008*

Working in "The Collections" is a major part of the work of many palaeontologists, but this meeting brought together a diverse group of people involved with various aspects of the curation and

dissemination of geoscience collections data, as well as the use of these data for research projects. The conference was jointly organized by the Geoscience Information Group and Geological Curators Group, which are both special interest groups of the Geological Society of London.

Talks presented at the meeting covered fossil, mineral, rock, paper and digital collections and spanned the whole spectrum of uses of these collections from pure research to the incorporation of geoscience data into the regulation and planning of land development. The meeting attracted delegates from around the globe and palaeontology was well represented. As abstracts, and in some cases speakers' presentations, are available from the meeting website <**http://www.exploitinggeosciencecollections.com/**>, reporting on each individual talk across such a broad range of topics seems a touch inappropriate for the *Newsletter*. Instead, this report will provide an overview of the major themes that were developed in the meeting, followed by a more detailed report of talks that were of particular interest or relevance to palaeontology.

A proposal for collecting papers based on the meeting in a special volume of the Geological Society of London is in preparation, but until then readers are encouraged to visit the meeting website and contact authors directly. Email addresses are given for all contributors. Thanks go to the meeting organizers for an excellent meeting in a wonderful venue.

Major themes

A central theme of many of the talks given at the meeting was how to justify the retention of physical collections to "the bean counters". Whether the physical objects were paper maps, field slips and borehole records held at the British Geological Survey (BGS) that have now been almost entirely converted into digital data (**Giles**, **Hughes**, **Garcia-Bajo**), mineral specimens collected centuries ago in Middle Europe that were used to investigate the provenance of copper used to make Bronze Age artefacts (**Ehling**), or the chance discovery that a trilobite specimen from Bohemia held in the Natural History Museum, London (NHM) collections was one of the first trilobites to be illustrated (**Fortey**), most delegates were in favour of using the precautionary principle of retaining as much original material as possible, because we cannot foresee how data and specimens may be used in the future. **Jeremy Giles** (BGS) discussed the problems created by the use of data sets for tackling scientific questions that these original data were not intended to address. While a major justification for retention of collections is the opportunity to reuse them in the future, Jeremy stressed the need to educate users to the limitations of these historical data. Specialists in digital data storage reminded the meeting that we have almost no data on the long-term storage of digital archives. Some of the delegates did identify specific paper collections that they thought could be disposed of in the near future, but this was a minority view.

Collections are rather pointless without making them accessible to users, whether for research purposes or to ensure that the house you are moving to is not on a floodplain. The BGS has made many of its collections available, at low cost, to a wide range of users who require the data for site investigation or planning requests. Their online ordering system incorporates a mechanism that allows validation of digital scans by BGS staff at the time that orders are processed, thus generating funds from the borehole record data while allowing simultaneous quality control (**Westhead**).

Portal sites which allow users to access data from many sources through a single website are becoming more common. Two such projects discussed at the meeting were the GeoCASE (Geological

Collections Access in Europe) initiative (**Rissoné**) and a new portal, GNOSIS (Generalized Natural sciences Online Spatial Information System), which unites databases from the Royal Belgian Institute of Natural Sciences, the Royal Meteorological Institute, and the Royal Museum for Central Africa (**De Ceukelaire**). Such systems require common vocabularies and dictionaries of terms to avoid confusion, misspellings or the idiosyncratic use of terminology if data from many sources are going to be combined successfully through such portal sites. With increasing availability of data sets with different levels of access for different user groups, the generation of metadata to accompany raw data is becoming ever more important. Metadata comprises summary information about which organizations administer these data sets, the format and contents of such data sets. This allows users to track down data they need, to be sure who owns it and what tool(s) they need to handle it.

Keynotes speeches

Richard Fortey (President of the Geological Society of London) gave the first keynote speech on "How do we value geological collections?" in which he passionately argued for the retention of physical natural history collections at a time when more and more institutions are being encouraged – or forced by financial constraints – to downsize or dispose of collections, making use of examples from his research career of 'lost' holotype material that was rediscovered in collections. His talk provided an important reminder of the cumulative nature of science that is the strongest argument against disposing of specimens. Science continues to progress, often in ways that we cannot foresee, and future generations of researchers, or even the same scientist later in her/his career, may have new techniques or questions that cannot be applied or answered if material has been disposed of.

Tom Steinberg (My Society) is part of the team responsible for websites such as <**TheyWorkForYou.com**>, which tracks the voting behaviour and speeches of members of the UK parliament. His main interest is making data available and usable to not-for-profit users. He expressed concern at the barriers to accessing much of the geoscience data that he found on the web, such as the need to register to use data sets, or long pages of copyright information to scroll through before reaching the data, that might deter users from downloading data sets that they are entitled to use. Tom was also concerned about the lack of web services and application programming interfaces (APIs – snippets of computer code that request services and/or data from other web servers to be incorporated into webpages automatically). He encouraged geoscientists as a community to make their data more accessible and to develop interfaces that can be used by all user groups, as the old wisdom that one interface is required for expert users and another for non-experts has been overturned. If an interface is good enough, all user groups will use it. This benefits both regular users, who will get an easier-to-use service, and new users, who do not have to go through a lengthy learning process to access data.

Talks of interest to Association members

Andy Howard (BGS) discussed the evolution of the BGS System for Integrated Geological MApping (SIGMA) in his talk "A new perspective on old data: making geological prior information accessible in the fieldwork environment." The BGS, along with the Ordnance Survey, were early adopters of field-portable computing technology and digital data storage. An aspect of this shift in the BGS was the shift to digital tools for field mapping. Incredibly, the first attempt at such a system, called MERLIN, was in 1989! The evolution of software and hardware has allowed the BGS to deploy

the SIGMA, based on a tablet PC that also incorporates automatic GPS location data collection and carries all previous geological information about an area in memory. The use of the tablet PC allows users to sketch and write field notes by hand that are then translated into digital files immediately. An important part of the new system is the availability of 3D virtual reality models that a mapping team can inspect to plan the fieldwork and identify key areas to visit to test the current interpretation of the geology of an area. Amusingly, the point at which the SIGMA team knew that they had finally built a system that the field geologists had accepted was when a geologist cracked the PC screen, and continued to use it in preference to returning to paper recording until a replacement unit arrived. Future plans for development of SIGMA include an 'enhanced reality' system where geological, biological, archaeological and landscape information will all be available to overlay on the terrain a user is working on. The system has enormous potential and some universities are already trialling it.

Philip Stone (BGS) gave an entertaining talk about the problems with the provenance of collections of early fossils from the Falklands; "Falklands fossils – famous, forgotten and filched?". Darwin was the first person to report on fossils from the Falklands, on the famed *Beagle* voyage. Research in the NHM uncovered some material collected by Darwin that was part of bequests to the NHM made later in the 19th century. The NHM also holds collections made by Ross's *Erberus* and *Terror* expeditions. The next famous expeditionary vessel to pass through was the *Challenger* in 1876. Some fossil collections made by this expedition represent a classic problem for historical collections. The locality information recorded with the collections is extremely improbable, given modern knowledge about the geology of the Falklands. This incorrect locality information caused significant problems in the interpretation of the geology of the Falklands, as earlier maps tried to accommodate the anomalous outcrops. The original material cannot be located in the NHM collections to verify a new locality, but at least the geological maps make more sense now. Philip also presented a strong case that fossils collected in the Falklands by a 1902 Swedish Antarctic Expedition were opened and some of the material presented to the Scottish National Antarctic Expedition in 1903. The Swedes vessel was crushed in the ice and when they returned, somewhat belatedly after being rescued, to the Falklands to pick up their fossils, their haul of specimens was somewhat depleted. The talk concluded with the role of Constance Allardyce, the wife of the governor of the Falkland Islands during the period 1904–1914, in initiating ongoing work on the Falklands trilobite fauna by the American Museum of Natural History. She sent large numbers of specimens to the AMNH in response to a letter from J. M. Clarke, which formed the basis of a major publication in 1913. Publications and collection trips by AMNH researchers continue to this day, including a paper in *Palaeontology* in 2006.

Adrian Rissoné (NHM) stepped in to give the presentation "The role of standards in sharing geological collections data through the GEOCase Network" as Charles Copp was unable to attend the meeting, due to a sudden illness. Charles has played a major role in extending the use of the Recorder software package, originally developed for biological records, into archaeological and geoscience collections. This talk illustrated the importance of thinking about how to record data with standard terms and vocabulary. These systems have been developed to support the SYNTHESYS programme in Europe and development is continuing; it will be interesting to watch developments in the attempts to integrate biological, geological and archaeological collections into a common recording framework with common software tools and web portal systems.

Mike Howe (BGS) explored the opportunities that collections offer for 'happy accidents' of scholarship in palaeontological collections. The story of the discovery of the conodont animal in the collections of the BGS in Edinburgh was retold, having been touched upon in the morning during Richard Fortey's keynote speech. The conodont animal specimen BGS GSE13821 from the 'shrimp band' in the Granton Sandstones collected in the 1920s remains the best example, although other examples have been found. Mike used this to emphasize the importance of historical collections, particularly where specimens are rare or have been collected from localities that are difficult or impossible to recollect. Mike emphasized the role of curators in creating the conditions for fossil material and experts to be brought together. He provided further support for the position that collections should not be downsized without careful thought, and that collections-based research cannot be easily made to fit with a culture of standardized management objectives that places emphasis on limiting risk and reducing the uncertainty of project outcomes. He urged researchers to help curators to deal with the "target culture" by bringing them on to papers as co-authors whenever possible, rather than giving them a simple acknowledgement.

Giles Miller (NHM) discussed the impact on visitor numbers and use of the collections resulting from considerable efforts made by the Micropalaeontology section, Department of Palaeontology, NHM to make collections information and images available on the web. Five collections were discussed and Giles presented data on visitor numbers over the past twelve years that showed a decrease in visitors to the foram collections. A rise in radiolarian visitors was attributed to the acquisition of a new collection, rather than the publicity on the web, and ostracod visits are up. Giles noted that collections tended to receive greater numbers of visitors when a member of staff was either in charge of specific collections or working on them. Publicizing these five micropalaeontological collections through both the web and adverts in relevant publications has not resulted in an unmanageable increase in visitors or loan requests, but the profile of these collections has nevertheless been successfully raised.

The utility of palaeontological collections in museums for non-taxonomic research has been questioned due to imprecise locality information, lack of abundance data and concerns about a whole range of collecting biases. **Mark Dean** (BGS) and his co-authors examined the potential for historical palaeontological collections held by the BGS in Edinburgh to yield useful information about the palaeoecology of Carboniferous Limestones in Ayrshire as part of the ongoing Midland Valley Project. The Project compared earlier qualitative assessments of faunal distribution across the different carbonate environments, based on 40 years of field experience, with the interpretation of faunal distributions based on cluster and principal components analysis of presence/absence data derived from the BGS collections. Within the Hurlet Limestone good matches to previous qualitative studies were obtained, but the results from Index Limestone were more ambiguous. Mark noted that the consolidation of fossil collections into larger samples for analyses was particularly helpful in overcoming the problems of relying on presence/absence data alone, and future developments in the project should be of significance in enhancing our understanding of the range of questions that historical palaeontological collections can be used to explore.

Al McGowan
(Newsletter Reporter)

MYSTERY FOSSIL 13

Ian Rolfe has sent in this image of an object that he photographed on the front doorstep of Café Birreria Italia, Via Torrearsa, Trápani, Sicily, in October 2006. The section through the fossil has been naturally foot-polished by the patrons of the Café Birreria over many years. The one euro coin is 23 mm in diameter. Ian suspects that "…this may not be a mystery to some people, but it was thought provoking in the field, as it were!".

If you can identify this fossil, or if you have any interesting stories connected to Café Birreria, please e-mail me via <**newsletter@palass.org**>.

Mystery Fossil 12 – Update

The pictures sent in by **Jesper Milàn** (*Newsletter* **67**) generated a lot of interest. **Elias Samankassou** (Fribourg) was the first of several to identify the specimens as possible *Heterastridium*, "traditionally interpreted as a planktonic hydrozoan and common in the Late Triassic". **Miguel O. Manceñido** (La Plata) was also reminded of "… a late Triassic hydrozoan like *Heterastridium* (*cf.* for instance, pl. 2 of Kristan-Tollmann, 1987, *Shallow Tethys 2*, pp. 169–186, Balkema). Although you may not be dealing necessarily with *H. conglobatum* itself, perhaps it may be a line of evidence worth pursuing further (*cf*. also, Campbell, J. D. 1974, *Journ. Roy. Soc. NZ.* **4(4)**: 447–453)". He goes on to note that it is plausible that a glacier in the region from where the fossil was found may have eroded some Late Triassic strata, although the apparent co-occurrence with dinosaur eggs is "more perplexing".

Ben Brighouse (Bristol) was having none of it, however! "It looks very much like an early golfball to me, and it is about the right size". Of course, I scoffed, until Ben produced some pictures of a type

of early golfball known as a bramble ball, or bramble gutty ball, which apparently these days can fetch up to $1,900 on eBay (decidedly more than a *Heterastridium* I would think). In true *Private Eye* style, Ben's bramble balls are displayed below alongside Mystery Fossil 12. More information on these balls, amongst others, can be found at <**http://www.golfballmuseum.co.uk/**>.

Mystery Fossil 12 ?

The $1,900 bramble gutty ball ?

My interest in the Brighouse hypothesis clearly went to his head. Ben goes on "I've long believed that some of the more "brainy" dinosaurs (for example the Troodontidae) might have enjoyed playing games, the way that we do. Maybe playing helped young *Saurornithoides* develop their hunting skills. And perhaps these games that they played included ball games. What better way, than ball games, is there for them to have developed skills in using their hands to grasp their prey, especially when their prey most likely consisted of small animals? After all they had large eyes and stereoscopic vision, which would have allowed good depth perception – perfect for catching a ball! … PS: you do realise that I am being serious, don't you? Why shouldn't a dinosaur play with a ball? A cat plays with them!"

So, picture the scene: a group of happy, young troodontids honing their skills by playing with specimens of *Heterastridium* that have eroded out of some nearby Upper Triassic outcrop… Perhaps the co-occurrence of *Heterastridium* and dinosaur eggs is not so perplexing after all?

If anybody has any thoughts on these matters, please e-mail them to <**newsletter@palass.org**>.

Richard Twitchett

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

International Congress: Palaeozoic Climates
Lille, France *23 – 31 August 2008*

Climate change is currently one of the most debated and discussed scientific topics. Ancient climate changes are extremely useful to understand the global changes that we live with today. The scientific meeting on Palaeozoic Climates is focused not only on ancient climate and sea-level changes (Ordovician glaciation, end-Devonian extinction, Late Palaeozoic glaciation; greenhouse-icehouse transitions), but also on their modelling, their understanding and their impact on biodiversity.

The Congress will serve as the closing meeting of the International Geoscience Programme (IGCP) n° 503 'Ordovician Palaeogeography and Palaeoclimate', and is also related to the IGCP n° 497 'The Rheic Ocean: its Origin, Evolution and Correlatives', and IGCP n° 499 'Devonian land-sea interaction: evolution of ecosystems and climate'.

The pre-conference excursion will visit outcrops and sections of the Cambrian to Silurian sections of Belgium. The post-conference excursion will allow participants to visit some of the famous sections of the Belgian Upper Palaeozoic, including those from localities such as Givet, Frasnes, Famenne, Tournai, Namur, Dinant, and others, including outcrops in the classical section of the Meuse Valley.

The conference topics are designed to address various subjects related to Palaeozoic Palaeogeography, Palaeoclimate and Palaeoecology, including all geological systems from the Cambrian to the Permian. The major aim of the congress is to analyze and understand the factors driving diversifications, extinctions and radiations of Palaeozoic faunas and floras.

The congress is an event of the International Year of Planet Earth, aiming at contributing to the scientific topic Earth & Life – the Origins of Diversity and Climate Change.

The meeting, organized by the CNRS research unit UMR 8157 Géosystèmes, will take place in the city centre of Lille. Scientific sessions will be organized at the Catholic University of Lille (UCL) in the Institut Supérieur d'Agriculture (ISA) buildings. Some events will take place on the campus of the Université des Sciences et Technologies (USTL), close to Lille, at Villeneuve d'Ascq. Lille, in northern France, can easily be reached from London (90 minutes), Paris (60 minutes) and Brussels (40 minutes) by high speed trains (Eurostar, TGV, Thalys).

Keynote speakers will include Robin Cocks (Natural History Museum, London) on Lower Palaeozoic palaeogeography; Yves Goddéris (Univ. Toulouse, France) on Global biogeochemical cycles; Michael Joachimski (Univ. Erlangen, Germany) on Upper Palaeozoic carbon and oxygen isotopes;Arnold I. Miller (Univ. Cincinnati, Ohio, USA) on Palaeoenvironmental impact on diversity over time; Christian Klug (Univ. Zürich, Switzerland) on Evolution of the marine food web in the Devonian;Alexander Nützel (Bayerische Staatssammlung, München, Germany) on Evolution of planktotrophy; Alberto Pérez-Huerta (Univ. Glasgow, UK) on Palaeoclimatic impact on Late Carboniferous marine ecosystems; Kevin J. Peterson (Dartmouth College, Hanover, NH, USA) on Molecular palaeobiology; Matthew R. Saltzmann (Univ. Columbus, Ohio, USA) on Lower Palaeozoic carbon and oxygen

isotopes; Jörg Schneider (Univ. Freiberg, Germany) on Upper Palaeozoic ecosystems; and Charles Wellman (Univ. Sheffield, UK) on Land plant evolution and terrestrialization.

Talks will be included during the five days of the conference and each will last 20 minutes (including five minutes of discussion). Talks on Lower Palaeozoic topics will be concentrated on the sessions of Monday and Tuesday, 25th and 26th. Talks on Upper Palaeozoic topics will be concentrated on the sessions of Thursday and Friday, 28th and 29th. Parallel sessions will be avoided. Talks of general interest will be placed in the general session of Wednesday 27th.

Abstracts, not exceeding one A4 page, should be sent to the address below by 1st May 2008. State whether the abstract is for an oral or poster presentation. In case of multi-authored talks, please, indicate the speaker. Abstracts should be written in correct English. The organizing Committee reserves the right to accept or refuse any submission. Abstracts are only accepted for print and included in the programme if the registration fee is paid before the registration deadline (1st May 2008, and should be submitted by e-mail to <**Bjorn.Kroger@univ-lille1.fr**>.

Two geological field trips will be organized. On 23–24 August, a pre-conference excursion to the Lower Palaeozoic of Belgium (Brabant, Condroz, Ardennes), led by J. Verniers (Gent), T. Servais (Lille), T. Vandenbroucke (Gent) and others. On 30–31 August, a post-conference excursion to the Upper Palaeozoic of Belgium and northern France (Avesnois, Meuse Valley) led by B. Hubert, B. Mistiaen, T. Servais (Lille) and others.

Grant aid is available from both the organizing committee and IGCP 503. IGCP 503 supports members from developing countries and students to assist the congress at Lille. In addition, the organizing committee is providing support that will preferably be given to (young) scientists travelling from outside the European Union. Applications for grant aid should be made to Thomas Servais, e-mail <Thomas.Servais@univ-lille1.fr>.

For full information see <http://www.univ-lille1.fr/geosciences/

Please send your registration before 1st May 2008, preferably by e-mail, to: Thomas Servais , USTL - Sciences de la Terre, UMR 8157 Géosystèmes, Cité Scientifique SN5, F-59655 Villeneuve d'Ascq cedex, France, fax (+33) (0)3 20 43 69 00, e-mail <**Thomas.Servais@univ-lille1.fr**>.

International Federation of Palynological Societies
Bonn, Germany 30 *August – 6 September 2008*

The next International Palynological Congress will be August 2008 in Bonn (Germany). For details refer to <**http://www.palaeobotany.org/modules.php?name=iop&sec=meetings&page=12**>.

The Second International Congress on Ichnology
Cracow, Poland *1 – 5 September 2008*

Following the successful First ICI, held at Trelew, Argentina in 2004, number 2 is being organized in Europe. Papers are invited on all subjects ichnological, including bioturbation, bioerosion,

ichnofacies and ichnofabrics, leaf mines, coprolites, ichnotaxonomy and fringe areas. Field trips to the Carpathian and Holy Cross Mountains will be included. Intending participants are asked to visit the web page and to pre-register at <**http://www.uj.edu.pl/ING/ichnia08/**>.

For further information, please contact Alfred Uchman at <**alfred.uchman@uj.edu.pl**>, Cluj-Napoca, Romania, e-mail <**sorin@bioge.ubbcluj.ro**>, or Mike Kaminski, UCL, e-mail <**m.kaminski@ucl.ac.uk**>.

2nd AINIC – Atlantic Islands Neogene, International Congress – AZORES
Ponta Delgada city, São Miguel Island, Portugal *2 – 6 September 2008*

The 2nd AINIC – Atlantic Islands Neogene, International Congress will be held on 'Aula Magna', nearby the 'Complexo Científico' of the University of the Azores, at Ponta Delgada (São Miguel Island, Azores, Portugal).

The congress is open to all contributions in the field of palaeontology and may also host further symposia or session proposals (please contact the organizers).

For further information, refer to the meeting website at <**http://www.euromalac2008.org/ainic2_hom.html**>.

56th Symposium of Vertebrate Palaeontology and Comparative Anatomy, and 17th Symposium of Palaeontological Preparation and Conservation
Dublin, Ireland *2 – 6 September 2008*

We are proud to announce that the 17th Symposium of Palaeontological Preparation and Conservation (SPPC) will be held in Dublin (Republic of Ireland) on 2nd September, followed by the 56th Symposium of Vertebrate Palaeontology and Comparative Anatomy (SVPCA) on 3–6 September.

Both events will be hosted jointly by University College Dublin (UCD) and the Natural History Division of the National Museum of Ireland (NMINH) through their collaborative programme 'Collections-based Biology in Dublin' (CoBiD); see <**http://www.ucd.ie/cobid**>.

Presentations and posters associated with the SPPC will be held in the headquarters of the Geological Survey of Ireland (GSI) located in the Beggars Bush complex, Haddington Road, Dublin 2. The main venue for the SVPCA meeting will be the National Museum of Ireland's Archaeology and History Museum on Kildare Street, Dublin 2. These venues are a short walk from one another across the beautiful Georgian southside of Dublin City.

The Beggars Bush complex also houses the Museum's Natural History research collections (including palaeontological and geological specimens). Access to these collections, as well as to those housed in the Geology Museum of Trinity College Dublin, will be available throughout the meeting. Maps and instructions for these venues will be provided in the 2nd Circular that will be mailed in mid March.

The annual Jones-Fenleigh auction to benefit student participation at the SVPCA will take place during the meeting, as will the annual conference dinner. Several other conference events and

receptions are planned. A number of fieldtrip options will be offered within Dublin, the County Dublin area and further afield in Ireland. More details will be provided in the 2nd Circular.

If you would like to express an interest in attending either of these meetings and to receive the 2nd circular, please send an email to <**dublin2008@svpca.org**>.

8th International Workshop on Agglutinated Foraminifera
Cluj-Napoca, Romania *7 – 13 September 2008*

The Grzybowski Foundation and the Department of Geology, Babes-Bolyai University are pleased to announce the dates of the next International Workshop on Agglutinated Foraminifera. The workshop is open to all participants interested in the taxonomy, ecology, evolution and stratigraphy of the Agglutinated Foraminifera, and follows workshops previously held in Amsterdam, Vienna, Tübingen, Kraków, Plymouth, Prague, and Urbino over the last 27 years. The workshop will consist of three days of technical sessions, followed by a field excursion in the spectacular Transylvanian Basin and Southern Carpathians.

The meeting will be held in the Department of Geology, Babes-Bolyai University, situated in the former Roman town of Cluj-Napoca, Romania. The conference room offers modern projection facilities, and lunchtime meals will be taken in the University Restaurant opposite the Geology Department. Microscopes will be available for working groups and demonstration purposes.

Costs:
The registration fee for the conference is estimated to be approx. €120 euros, and a discount will be given to student participants. The fee will cover conference materials, refreshments at the meeting, and the welcoming reception. Field trip costs will be calculated separately. The Grzybowski Foundation will make available a limited number of travel grants for participants from eastern European countries. Accommodation will be at local hotels near the central square, at the discount rate of approximately €50 a night. Full details of costs will be made available in the second circular.

Preliminary Programme:
Sunday 7th September: arrival and welcoming reception
Monday 8th September to Wednesday 10th: Technical Sessions
Wednesday 10th September: Conference Dinner
Thursday 11th September to Saturday 13th: Field Excursion (Transylvania, Carpathians).

Information and Registration:
Sorin Filipescu, Department of Geology, Babes-Bolyai University, str. Kogalniceanu 1, 400084 Cluj-Napoca, Romania, e-mail <**sorin@bioge.ubbcluj.ro**> or Mike Kaminski, UCL, e-mail <**m.kaminski@ucl.ac.uk**.>.

First International Congress on North African Vertebrate Palaeontology (NAVEP1)
Marrakech (Cadi Ayyad University), Morocco *25 – 27 May 2009*

This scientific meeting is co-organized by the Faculty of Sciences Semlalia, the Moroccan Society of Herpetology, the Muséum National d'Histoire Naturelle of Paris and the Centre National de la Recherche Scientifique (CNRS, France). NAVEP1 is intended to gather palaeontologists and geologists from all over the world interested by the various aspects of vertebrate fossils from North Africa and/or neighboring regions and their palaeoenvironments. One of the major aims of NAVEP1 is to draw together the current state of knowledge of previous and current studies on North African vertebrate fossils and to promote the conservation and protection of the fossils as an integral part of the natural heritage.

Thanks to the central position of North Africa within Gondwana, and to its rich geologic history (continental drift and break-up, Tethys, Mesogea, Mediterranea), we believe that a meeting on North African Vertebrate Palaeontology represents a good forum to discuss the evolution and radiation of vertebrates in response to palaeogeographical history. NAVEP1 will welcome all research or studies dealing with the various aspects of vertebrate palaeontology from North Africa, including: anatomy, morphology, osteology, systematic, phylogeny, evolution, taphonomy, palaeoichnology, biostratigraphy, palaeoenvironments, palaeoecology, palaeoclimatology and palaeobiogeography.

For further information contact the meeting coordinator Pr. N.E. Jalil, e-mail <**njalil@ucam.ac.ma**>.

Copies of the first circular, in a variety of formats, are available from <**http://www.mnhn.fr/mnhn/mineralogie/histoire/index/congres/congres2009/**>.

An International Conference on the Cambrian Explosion
Banff, Alberta *August 3 – 7 2009*

We invite you to attend a special Conference on the **Cambrian Explosion** to commemorate the **100th anniversary of the discovery of the Burgess Shale by Charles Doolittle Walcott**. We cordially extend this invitation to all geologists, palaeontologists, geochemists and biologists interested in the profound organismal, ecological and environmental changes that occurred during the Precambrian–Cambrian transition. Moreover, we think that this meeting would be of great interest to historians of geology and anyone curious about the origins of animals.

For further details visit the meeting website at
<**http://www.geology.utoronto.ca/facultycaron/Walcott2009.htm**>.

International Scientific and Organizing Committee (as of April 2007)

Co-Chairs:
Dr Jean Bernard Caron (Royal Ontario Museum, Toronto), <**jcaron@rom.on.ca**>
Dr Doug Erwin (Smithsonian Institution, Washington), <**ERWIND@si.edu**>
David Rudkin (Royal Ontario Museum, Toronto), <**davidru@rom.on.ca**>

Members:
Matthew Devereux (The University of Western Ontario), <**mdevereu@uwo.ca**>
Dr Stephen Dornbos (University of Wisconsin-Milwaukee), <**sdornbos@uwm.edu**>
Dr Sarah Gabbott (University of Leicester), <**sg21@le.ac.uk**>
Dr Robert Gaines (Pomona College), <**robert.gaines@pomona.edu**>
Dr Charles Henderson (University of Calgary), <**cmhender@ucalgary.ca**>
Dr Paul Johnston (Mount Royal College, Calgary), <**pajohnston@mtroyal.ca**>
Kimberley Johnston (Palaeontographica Canadiana), <**kimberley@paleos.ca**>
Dr George Pemberton (University of Alberta), <**george.pemberton@ualberta.ca**>
Dr Jean Vannier (Université Claude Bernard Lyon 1), <**jean.vannier@univ-lyon1.fr**>
Dr Xingliang Zhang (Department of Geology, Northwest University,Xian), <**xlzhang@pub.xaonline.com**>
Dr Maoyan Zhu (Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences), <**myzhu@nigpas.ac.cn**>

5th International Symposium on Lithographic Limestone and Plattenkalk
Basel, Switzerland *17 – 22 August 2009*

The 5th International Symposium on Lithographic Limestone and Plattenkalk will be held at the Naturhistorisches Museum Basel (<**http://www.nmb.bs.ch/**>), on 17–22 August 2009. Following the former editions (Lyon, 1991; Cuenca, 1995; Bergamo, 1999; Eichstätt/Solnhofen, 2005), we are pleased to organise the 5th conference in Basel, close to the Late Jurassic fossil localities of Solothurn and Porrentruy (northwestern Switzerland).

The symposium will consist of three days of presentations (plenary speakers, regular sessions, and posters) on 18–20 August. This multidisciplinary meeting is planned to address various aspects in the study of lithographic limestones and plattenkalk deposits, dealing with palaeontology (taxonomy, palaeoecology, taphonomy), geology (stratigraphy, sedimentology, palaeoenvironments), and also mineralogy and petrology of related Fossil-Lagerstätten.

In addition to the scientific sessions, three excursions will be organised in Germany and Switzerland:

- Frauenweiler (Germany), Monday 17th: Pre-symposium excursion to the Frauenweiler clay pit (Oligocene) famous for fossil fishes and the oldest hummingbirds co-organised by Eberhard "Dino" Frey (Staatliches Museum für Naturkunde, Karlsruhe).
- Porrentruy (Canton Jura), Friday 21st: Post-symposium excursion to Porrentruy. Several dinosaur tracksites have been discovered in sub-lithographic limestones (biolaminites) of Late Kimmeridgian age, along the future course of the "Transjurane" highway (<**http://www.palaeojura.ch/**>). In addition, many fish, turtle and crocodilian remains have been unearthed in coeval marls. Aperitif and dinner will be offered in close vicinity of a dinosaur tracksite and footprints can be observed by night using artificial illumination.
- Solothurn (Canton Solothurn), Saturday 22nd: Post-symposium excursion to Solothurn and surrounding areas. We will visit the well-known outcrops of Solothurn Turtle Limestone (Late

Kimmeridgian) and the Lommiswil dinosaur tracksite. Further, a visit is planned to the Natural History Museum of Solothurn (<**http://www.naturmuseum-so.ch/**>) where many fish, turtle and mesosuchian crocodilian remains are housed.

For further details and registration information contact Antoinette Hitz, Naturhistorisches Museum Basel, Secretary Department of Geosciences, Augustinergasse 2, 4001 Basel, Switzerland, tel +41 61 266 55 26, fax +41 61 266 55 46, e-mail <**antoinette.hitz@bs.ch**>.

International Symposium on the Cretaceous System
Plymouth, UK *6 – 12 September 2009*

The International Symposium on the Cretaceous System will be held at the University of Plymouth, on 6–12 September 2009. The conference will be followed by a number of field excursions visiting Cretaceous locations in the UK. Themes for the meeting may include: 200th Anniversary of the birth of Charles Darwin, sequence stratigraphy and sea level change, Cretaceous oil and gas exploration in the N.W. European Continental Shelf, Cretaceous stratigraphy, palaeontology, isotope stratigraphy, biotic and other events, regional geology and palaeoclimates. Papers will be solicited for peer-reviewed publication with submission of manuscripts at the meeting.

For more information contact Prof Malcolm Hart, School of Earth, Ocean & Environmental Sciences, University of Plymouth, Drake Circus, Plymouth PL4 8AA, e-mail <**mhart@plymouth.ac.uk**>, or Dr Gregory Price, e-mail <**g.price@plymouth.ac.uk**>.

For further details visit the meeting website: <**http://www2.plymouth.ac.uk/science/cretaceous/**>

Southeast Asian Gateway Evolution
Royal Holloway, University of London, UK *14 – 17 September 2009*

This major multidisciplinary meeting will focus on the geological and biological history of the Gateway region, and include discussion of geology, tectonics, oceanography, climate, biogeography and biodiversity. For details visit the meeting website at <**http://sage2009.rhul.ac.uk/**>.

The convenors are Robert Hall, Royal Holloway, e-mail <**sage2009@gl.rhul.ac.uk**>, and Ken Johnson, Natural History Museum, e-mail <**sage2009@nhm.ac.uk**>.

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

A celebration of Hugh Miller, Geologist

A 'Local Hero' event for the Bicentenary of the Geological Society of London, with the National Trust for Scotland and the 'Friends of Hugh Miller'
Cromarty 12–13 April 2008

Hugh Miller was never a Fellow of the Geological Society, but he certainly provided plenty of meat for Fellows to digest in his fossils, and still more in the inspiration which he gave – hence the appropriateness of this weekend event in his birthplace, the small seaside burgh of Cromarty north of Inverness. The meeting was convened by Martin Gostwick, Property Manager of Hugh Miller's birthplace Cottage and the Hugh Miller Museum and Secretary of the Friends, and Nigel Trewin (Aberdeen University), President of the Friends.

Martin Gostwick (who also runs <**http://www.hughmiller.org/**>) welcomed the attendees, then **Lester Borley** (formerly National Trust for Scotland) set the scene with 'Hugh Miller: a late Georgian naturalist in context'. Miller, although thought of as a Victorian, in fact grew up in the Georgian and Regency eras. Miller was initially a geological 'Robinson Crusoe' in his isolation from other workers, but Cromarty itself was, by Highlands standards, a well-connected town, giving Miller a wider intellectual context in which to develop as a writer more generally. In any case Miller eventually got to know John Malcolmson and other local geologists in other small towns around the Moray Firth, especially at Inverness and Elgin. But soon he was head-hunted by the advocates for change in the Church of Scotland, as the editor of their new Edinburgh newspaper, and left Cromarty in January 1840, after a public testimonial dinner.

Lyall Anderson (The Sedgwick Museum, University of Cambridge) and I considered 'The museology of a local, national and supranational hero: Hugh Miller's collections over the decades'. Miller's 'museum' started with the shelves of his stonemason's cottage bedroom, and filled its own building in the garden when he died near Edinburgh in 1856. There was a public appeal to buy the collection as a memorial of his "genius and scientific labours" for what is now National Museums Scotland, where it was initially curated by Charles Peach, fellow Old Red fish collector. Miller's fossils have always been used in the general fossil displays. Moreover, in the 1910s Ben Peach, son of Charles, created a special display on Miller and his fossils which lasted till the 1940s or 1950s. There was a substantial bicentenary temporary exhibition in 2002 and thereafter a small permanent one till the Royal Museum building's current clearance for renovation. Specimens retained by the family became the basis of the Hugh Miller Museum founded in the birthplace cottage in Cromarty when his son Hugh undertook Geological Survey fieldwork there in the 1880s. Every 50 years, in lockstep with successive anniversaries of Miller's birth, there have been reorganizations of the Cromarty museum (latterly National Trust for Scotland) helped by the Edinburgh museum and its staff – most recently the refurbishment of the family's other house next door as the new Hugh Miller Museum, allowing the Cottage to be restored to more nearly its original state (and an excellent excuse for a visit if you haven't been recently). We won't have a full picture of the collection until a computer catalogue is completed, and it's still unclear what happened to Miller's papers.

In 'Casts of Thousands: Hugh Miller's shelly fossils', **Lyall Anderson** and I took a well-illustrated tour of Miller's invertebrates. Miller's fossil collecting was plainly partly shaped by where he variously lived. But, contrary to the impression one sometimes gets, Miller didn't just collect Old Red fishes seasoned with the odd Jurassic ammonite from Eathie near Cromarty. Once he moved to Edinburgh in 1840, he started working through the geological map of Scotland, especially during his annual holidays-cum-reporting trips, as for instance told in *Cruise of the Betsey*, which focused in part on a trip to the Inner Hebrides on the leaky yacht of that name which was the floating manse [*anglice,* parsonage] of his boyhood friend who was now the Free Kirk minister of the Small Isles. Amidst the Jurassic, Carboniferous and 'Silurian' (including now Ordovician) which one would expect in the collection today, there are some real surprises, such as a collection of Cretaceous invertebrates from the 'Buchan Flints', and intriguing presents from expatriates in the Scottish Diaspora – cidarid spines from the Holy Land, a conulariid from Canada, and brachiopods from South Africa. Miller made something of a speciality of the hot topic of the Ice Age deposits, and his Quaternary molluscs include those from the Moray Firth glacial deposits at Gamrie and raised beaches at Fairlie in Ayrshire. But it was his first successes with deciphering the Old Red Sandstone fish that had allowed him to speak with authority on other fossil remains.

The 1859 statue by Handyside Ritchie, for once without a seagull atop. Hugh Miller seems to be holding a split Cromarty fish nodule in his left hand. And spot the Pterichthys*!*

Nigel Trewin (University of Aberdeen) promptly restored the balance in 'Hugh Miller's Fossil Fish Studies', examining Miller's work on the Old Red Sandstone fishes of Cromarty and of Scotland more generally. Miller didn't just discover and collect: he analysed his finds, using reconstruction drawings, three-dimensional paper models (some of which still survive but have hitherto had little attention), and dissections of modern fishes to try and work out the anatomy of his finds. He also sent plaster casts of his specimens to other workers. Paper models and casts have been located at the Natural History Museum and casts also at Aberdeen University, and of course still with Miller's own collection. Miller had early problems sorting out the placoderms *Pterichthys* and *Coccosteus*, which initially he mixed up, but overall his curiosity-driven research was careful and critical. He was not afraid to disagree when necessary with eminent researchers such as Louis Agassiz. If modern conclusions differ in some respects, that is partly because there have been discovered since his time sites, such as Achanarras, yielding still better specimens, such as of *Pterichthyodes* (as it is now known). And of course it was this self-taught palaeontologist who helped lay the groundwork for today's studies.

The weekend was sensibly linked with the Annual General Meeting of the Friends of Hugh Miller, and once the business meeting was over, came the Friends' open public lecture, 'Science versus religion? Faith, fossils and Hugh Miller' by **Ralph O'Connor** (University of Aberdeen). Ralph comes from the English Literature side of life and is therefore a very useful colleague for poor palaeontologists who never got, at least formally, beyond *Henry V* at O-level when it comes to that side of dealing with Miller. This is amply shown by his new book *The Earth on Show: Fossils and the Poetics of Popular Science*, in which Miller features strongly. His talk focused on a common myth about Miller, that he committed suicide because of an agonizing conflict between his science and his faith. This isn't remotely true. For what conflicts could such an evangelical Christian geologist have? It couldn't be evolution: he died just before Darwin and Wallace's Linnean Society paper of 1858, never mind the 1859 *Origin of Species*, and the pre-Darwinian evolutionists were obviously rubbish. Reconciling the Bible with geological evidence for an ancient earth? Nae problem – like most geologists and many a Kirk minister, Miller accepted scientific evidence; *Genesis 1* was obviously not to be read literally. Miller suggested that it was a God-given vision of the geological past – and came under fire from both the hardline literalists and the hardline liberals. And as for his nightmare visions of nature red in tooth and claw, they were standard Victorian currency – and if anything Miller emphasised how innocent, in a way, the toothy rhizodontid fishes and saurians were compared to humans who had moral responsibility (and no excuses) for their actions. It is only hindsight – and a very simplistic hindsight – that projects a later notion of science *versus* religion onto Miller. For Miller, geology was not something to be reconciled with his faith, but an integral part of it, and this fusion helped to energise the power of his writings, which make them great literature by any standard. A most interesting analysis, I thought: I could imagine that Miller would reject both the modern creationists and the modern, almost apologetic, 'dual magisteria' concept – but then to see him in that 21st century context is perhaps as anachronistic as to portray him as a loser in science *versus* religion.

There were ample opportunities to see the birthplace Cottage and Hugh Miller Museum, which showed some Miller specimens from Inverness Museum and National Museums Scotland in addition to the usual displays in the Museum itself, which include a long-term loan of National Museums Scotland fossils. The excursions, led by **Nigel Trewin**, were on the Sunday (even if that would have

shocked poor Hugh to the core). The morning was spent walking around Cromarty and seeing the places associated with Miller's life and work – less changed than one might expect, for Cromarty's landscape was effectively frozen by sudden economic decline in Miller's last years there. The old kirk where he imbibed the faith of his fathers, with the graveyard where he wrought on gravestones, is much as it was in his time, though obviously not the posthumous monument erected on the fossil seacliff behind his house. The mid-April timing and, for the morning anyway, the sunny weather were ideal for seeing the local scenery as free of vegetation as you'll get. One could really grasp why the thick and locally eroding cover of Quaternary drift blanketing the landscape caught his interest. Indeed, the afternoon would be spent at Rosemarkie a few miles away examining the 'Fairy Glen', a drift-filled and now partly exhumed drainage channel which had in Miller's time provided magnificent badland terrain in Quaternary sediments. Alas, the Glen is now largely overgrown, except mainly for the Kaes' Craig [*anglice,* Jackdaws' Cliff] of unconsolidated Quaternary sediments at its mouth which still provides an excellent illustration of valley re-excavation. We also saw the remarkable shattering and brecciation of the Great Glen Fault zone along the shore nearby which is backed by an excellent pair of raised beach terraces.

Miller wrought here as a monumental mason. He did not fail to spot the old sea cliff – raised beach back feature – to left.

And back at Cromarty the morning had concluded with a visit to the remains of a coal mine which failed thanks to the unexpected creation of an artesian well which is still piddling away happily – but in any case the pit had been sunk in the Old Red Sandstone, *before* William Smith had had his bright ideas on stratigraphy (as Miller pointed out). Then we went to the nearby shore. Here is the classic fossil fish locality just as Miller described it in *The Old Red Sandstone*, complete with the Moinian 'granite gneiss' as he called it, of the Sutors catastrophically upthrust (as he thought) through the overlying Devonian sediments. Can one decide between Miller's catastrophism and modern gradualism solely on the field evidence here, I wonder? I had not quite appreciated just

My colleague Sarah Stewart contemplating the glacial erratics largely covering the ORS of Cromarty beach, with town in the background: geotourist mecca since 1841.

what a microcosm of Scottish geology the area seemed to Miller, till seeing it again – 'primary' rocks (in the old sense) underlying stratified 'secondary' rocks (again in the old sense) and with a covering of 'quaternary' drift and erratics, those last plainly linked to recent changes in sea level …. Here – if one knows where and what to look for – one can still see the fishbearing nodules, especially washed up on the glacial erratics in the shingle, even though the site itself was largely dug out in his time and is now protected as a Site of Special Scientific Interest. How appropriate that Cromarty was picked for the launch, the preceding Friday, of the Scottish Fossil Code (*see following article*). The 1841 publication of *Old Red Sandstone* (whose reprinting is currently being sought by the Friends) instantly made Cromarty a key spot on the 19th century geotourist trail. Today – especially with the renovated Hugh Miller Museum – Cromarty is still well worth a visit. As for this weekend, it was an admirable introduction to Miller – who is one of those people, like all good fossils, who benefits from a visit to the original locality – for those unfamiliar with him, and with quite a few surprises even for those who thought they knew a lot about him.

The Coalheugh Well, an artesian well and very rare survival of pre-William Smithian coal prospecting. Scale kindly provided by my partner Helen Handoll.

Michael A. Taylor
National Museums Scotland

Launch of the Scottish Fossil Code

After two years of preparation involving a full public consultation, the Scottish Fossil Code was launched in Cromarty on 11th April 2008, on the eve of the 'Hugh Miller – Local Hero' event. Probably the first national code of its kind, the Scottish Fossil Code aims primarily to help conserve the fossil heritage of Scotland. The Nature Conservation (Scotland) Act 2004 included provision for Scottish Natural Heritage to prepare the Code. Produced with assistance from palaeontological researchers, land managers, collectors and others with an interest in Scotland's fossil heritage, the Code provides advice on best practice in the collection, identification, conservation and storage of fossil specimens found in Scotland. The Code also aims to enhance public interest in the fossil heritage of Scotland and promote this resource for scientific, educational and recreational purposes. It is hoped that following the Code will increase the personal interest and satisfaction that can be gained from forming a fossil collection.

The Code may be viewed and downloaded from <**http://www.snh.org.uk/fossilcode/**>. Alternatively to receive a paper copy contact:

Scottish Natural Heritage
Publications Department
Battleby
Redgorton
Perth
PH1 3EW

tel: 01738 444177
e-mail: <**pubs@snh.gov.uk**>

A specimen of Diplacanthus crassisimus *found at Hugh Miller's collecting locality in Cromarty, one of the specimens used in a workshop for pupils from Cromarty Primary School on the subject of fossils held immediately prior to the launch of the Scottish Fossil Code.*

SCOTTISH FOSSIL CODE

The essentials of the Scottish Fossil Code:

- **Seek permission** – *You are acting within the law if you obtain permission to extract, collect and retain fossils.*
- **Access responsibly** – *Consult the Scottish Outdoor Access Code prior to accessing land. Be aware that there are restrictions on access and collecting at some locations protected by statute.*
- **Collect responsibly** – *Exercise restraint in the amount collected and the equipment used. Be careful not to damage fossils and the fossil resource. Record details of both the location and the rocks from which fossils are collected.*
- **Seek advice** – *If you find an exceptional or unusual fossil do not try to extract it; but seek advice from an expert. Also seek help to identify fossils or dispose of an old collection.*
- **Label and look after** – *Collected specimens should be labelled and taken good care of.*
- **Donate** – *If you are considering donating a fossil or collection choose an Accredited museum, or one local to the collection area.*

Drop the dead deinotherium: palaeontology in the news

Although my official designation on the *Newsletter* team is 'reporter', I don't really report on the news. My primary task is to contribute a column on a topic to each newsletter, so I am really a columnist. Recently it was mooted whether the 'News' section, which was discontinued in 2005, should be revived. The 'News' section used to gather together news reports covering palaeontological publications and topics, news of awards and general information of interest to the palaeontological community. Sometimes obituaries were run in this section, although the *Newsletter* tends to publish obituaries as separate articles. A difficulty of trying to run a current news section in a publication that comes out three times a year is that the news would be anything but new to most of the readership, given the growth of Internet newsgroups, email and science news on the web. Until the late 1990s the *Newsletter* provided a summary of media coverage of palaeontological stories. We have recently started to put up palaeontological stories of interest on the Palaeontological Association website front page in a sidebox which is updated periodically as a compromise. As most readers will guess, most of the palaeontological stories covered by news organizations are about vertebrate palaeontology, with a strong bias towards dinosaurs and human evolution.

Much of newspaper science coverage is led by press releases from journals such as *Nature*, *Science*, *Proceedings of the Royal Society* and *Proceedings of the National Academy of Sciences, USA*. The major journals and learned societies have dedicated press officers who understand how news and media organizations work and have the time to dedicate to developing contacts with journalists. Most of these journals also come out on a weekly basis. Journalists working for daily papers and broadcast news are working to tight deadlines and are glad to receive press releases alerting them to breaking stories, whatever field they work in. Dr Mark Purnell has recently taken over as the Association's Publicity Officer and he is keen to cooperate with authors who want to prepare press releases for papers in *Palaeontology*. As the Palaeontological Association lacks a press office, Mark will be coordinating his efforts with the press offices of funding bodies responsible for funding the published research, as well as with the press offices of universities and museums where authors are based. Extensive coverage of a paper in the May issue of *Palaeontology* on fossil parrots (Waterhouse *et al.* 2008) represents an early success for this new initiative, although a link to the famous *Monty Python* 'Dead Parrot' sketch seems to be the major focus of media interest, rather than a thirst for palaeornithological knowledge – but hopefully Mark's efforts will help to raise the profile of palaeontology.

So how does the coverage of palaeontology vary between the specialist palaeontological journals and magazines aimed at wider audiences? To find out I decided to compare the output of the primary palaeontological literature, represented by the output of the *Journal of Paleontology* and *Palaeontology*, with that of science news magazines over the last 30 or so years. Dedicated science publications seemed a fairer place to carry out a comparison of the relative amounts of coverage given to the different areas of palaeontology than the daily press or broadcast media, as they have a readership that is, by definition, interested in science. Weekly and monthly scientific commercial magazines are not under such tight time constraints as daily papers, but the

publications exist to turn a profit for the companies that publish them. The journalists who work for such publications are more likely to have trained and worked as scientists before switching careers to become science writers. Working on a weekly or monthly publication allows for longer articles on a broader range of topics. Some daily papers, or the dedicated weekend versions, may have science columns that come out on a weekly basis, but these are often only a few pages long. The weekly science section of the *New York Times* is an outstanding supplement, and is widely read by many scientists, which illustrates what a weekly science column can do when it is well resourced and has excellent writers. I examined *New Scientist*, *Discover* and *Scientific American*, which provide Really Simple Syndication (RSS) web services that are a major source for the 'Palaeontology in the News' section of the website. The magazines produced for the members of Geologists' Association (GA), Geological Society of London (GSL) and the American Geological Institute (AGI) were used to get a sense of how geoscience magazines covered palaeontology.

This is not the first *Newsletter* article that has examined the coverage of palaeontology in the UK press. Jo Snell wrote about this topic in *Newsletter* 46, but it seemed worthwhile to go beyond stating what is reported in the newspapers and considering whether the bias towards dinosaur and human evolution stories is pervasive in other areas of the media, and to try to understand why certain areas of palaeontological research get reported, while other research topics published in the same journals are ignored.

Palaeontological coverage in science magazines

The three news magazines that were used to assess the amount of coverage of palaeontological topics were *New Scientist*, the only weekly magazine, and *Scientific American* and *Discover* (which started publication in the 1980s), both monthly publications. As a weekly publication *New Scientist* is most like a daily newspaper in terms of the deadlines writers face and the turnaround time for news. The format of the 1970s version of *New Scientist* is reminiscent of the current *Private Eye*, which reflects its weekly deadline and pre-electronic printing. Before the advent of desktop publishing, newspapers and many weekly magazines had to be laid out in hard copy form. Having the narrow columns meant that sections could be rewritten or literally cut and pasted as page layouts changed during the production process. *New Scientist* is also notable for having more political stories and insider comment than either *Scientific American* or *Discover*. Between 1969 and 2005 Tam Dalyell, a member of the UK parliament, wrote a column in *New Scientist* with a strong emphasis on the links between science and policy issues. This reflects both the ability of a weekly magazine to print political news that will not be out-of-date and the fact that *New Scientist* tends to be read by many more working scientists, or out-of-work scientists looking for jobs, who are interested in this sort of news. *Scientific American* and *Discover* do not follow science policy or funding news to such a great extent. This emphasis on funding news and the interface between science and public policy meant that the 1976 edition contained stories that could have been written in the last year, including the oil and energy crises in the aftermath of the Yom Kippur War of 1973 and problems with the gap in government funding of UK astrophysics.

The articles in the two monthly magazines tend to be longer, although *New Scientist* usually has three or four extended articles in each issue. During the 1970s and 1980s *Scientific American* was notable for its focus on using extended essays written by active researchers, rather than journalists. Much more of the output of the magazine is now written by journalists, but *Scientific*

American continues to produce articles that are excellent primers on a vast range of subjects. *Discover* started life with a stronger focus on technological applications of science than the other two magazines, but has converged on a mixture of pure and applied science similar to that of the other two magazines.

The readership of *Geology Today* and *Geotimes* magazines is presumably composed of people who have some background and interest in earth sciences, and some proportion of the readership will be palaeontologists. What was striking and impressive about both publications was the engaging writing style and the breadth and depth of coverage across the earth sciences. If you wanted to give a teacher or community group a comprehensive, yet non-technical overview of the range of research carried out in the earth sciences, these would be the publications to recommend to them. The *Geology Today* series on regional museums, fossils and minerals would be worth collecting and putting into small guides or on a web archive in their own right, as they are excellent resources. The ability of these magazines to cover a broad range of topics reflects the reduced commercial pressure on these publications. Both magazines cover policy and professional issues in depth. Their monthly publication rate is the pace at which official enquiries, parliamentary committees and consultation processes move, making these publications the natural place for societies to communicate developments in these matters to their members.

A common trend across all publications is the shift away from large blocks of text towards much more use of sidebars and inset boxes. Such layout changes owe much to the closer integration between the websites of the magazines and the printed magazine. This is a trend across publishing from newspapers to journals such as *Science* and *Nature*. Another trend driven by changes in printing technology was the introduction of colour across all publications from newspapers to scientific journals. The use of colour figures, and in particular the ability to reproduce colour photographs, has enhanced the impact of stories that rely on graphics. In the science magazines colour became much more widely used in the 1980s, and by the 1990s nearly every page used colour.

Palaeontology in the primary literature

The first task was to measure the relative proportions of papers in different subdisciplines of palaeontology. To do this *Palaeontology* and the *Journal of Paleontology* were used as the source of information on the proportions of different general areas covered and effort in palaeontology. The results are shown in Figure 1. Throughout the figures in this article, the amount of coverage given to the different areas of palaeontology are reported as percentages, as the number of issues per year and number of published pages vary considerably among the different publications. For instance, *Palaeontology* moved from four to six parts per year in 1998, while six issues a year of the *Journal of Paleontology* were published for the whole period in question.

The two peer-reviewed journals publish, unsurprisingly, a lot of articles on invertebrate palaeontology. In the *Journal of Paleontology* 20-30% of the papers are on vertebrate palaeontology, but many vertebrate papers go to the *Journal of Vertebrate Paleontology* and other journals that specialize in studies of vertebrates. Given the number of other venues for publishing vertebrate palaeontological papers, it is interesting to note the increase in vertebrate palaeontological contributions to *Palaeontology* over the period sampled, with the proportion of vertebrate papers more than doubling since 1976.

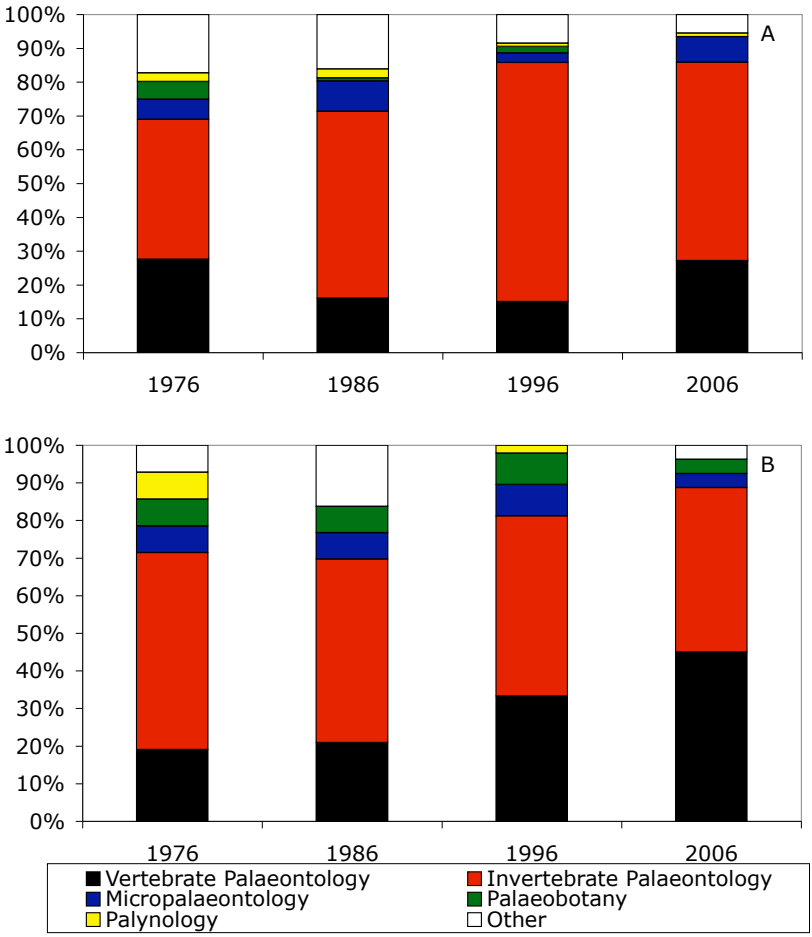

Figure 1: Proportions of peer-reviewed papers published on different areas of palaeontology. A) Journal of Paleontology. *B)* Palaeontology.

Publication rates in other areas of palaeontology are more mixed. In the case of palaeobotany/ palynology these two areas have their own specialist journals, and journals such as the *Botanical Journal of the Linnean Society* handle many palaeobotanical papers as well. Micropalaeontology is also served by a number of specialist publications, and an increasing proportion of micropalaeontological research is directed towards climate change research, so is published in journals with a focus on that topic.

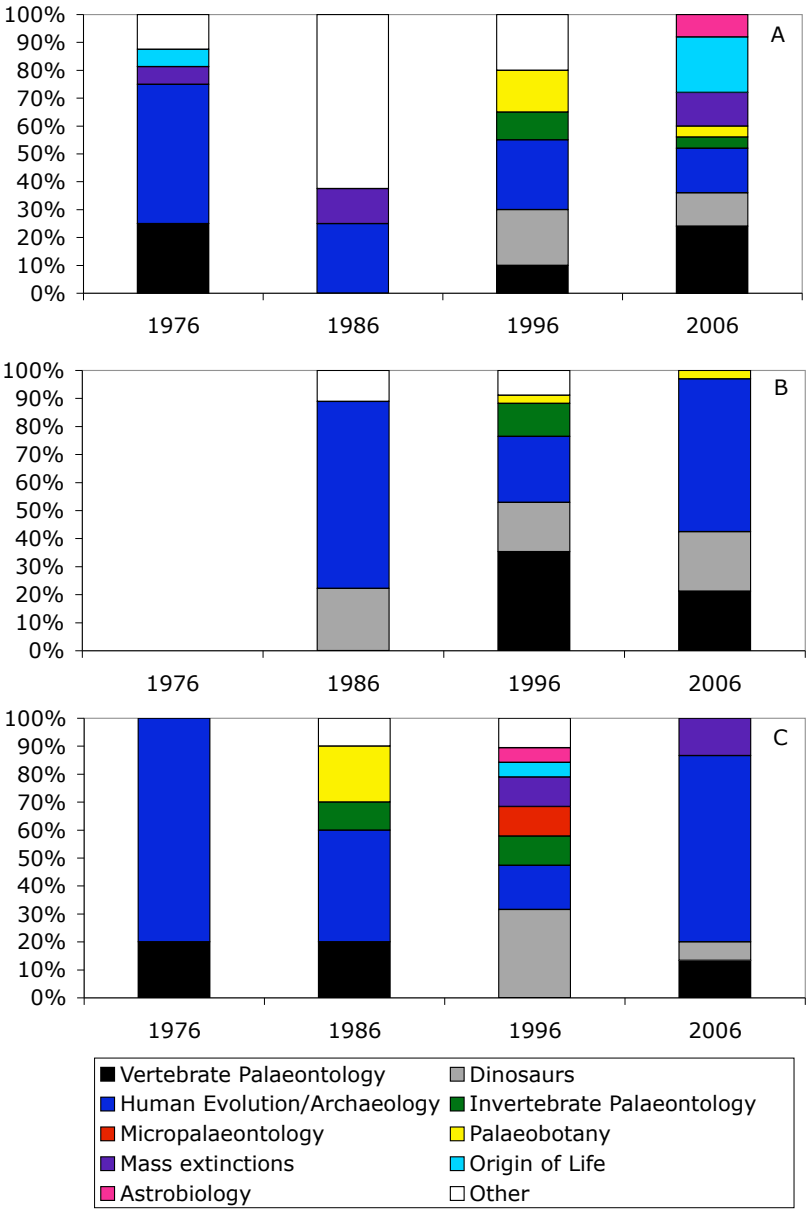

Figure 2: Coverage of the different areas of palaeontology in science news magazines. Extra categories are added to separate out different areas of vertebrate palaeontology and some interdisciplinary 'hot topics' to which palaeontology contributes. A) New Scientist. *B)* Discover *(not published in 1976). C)* Scientific American.

Palaeontological coverage in the wider media: Is it really all dinosaurs?

So which areas of palaeontology get the oxygen of publicity in the wider media? The results for the science magazines are shown in Figure 2; the results for the newsletters are shown in Figure 3. The output of *New Scientist* was assessed on the basis of the issues from January to March in each year to make the number of issues covered comparable to the twelve monthly issues of *Discover* and *Scientific American*. This may have introduced some bias in the sampling of *New Scientist*, as the timing of press releases associated with annual conferences such as the Geological Society of America Annual meeting can affect the range of stories covered. The categories used are slightly different to those used for quantifying the output in the *Journal of Paleontology* and *Palaeontology* to allow trends in specific 'hot topics' to be tracked. Vertebrate palaeontology was also subdivided to separate out dinosaur and human evolution stories from other areas of vertebrate palaeontology.

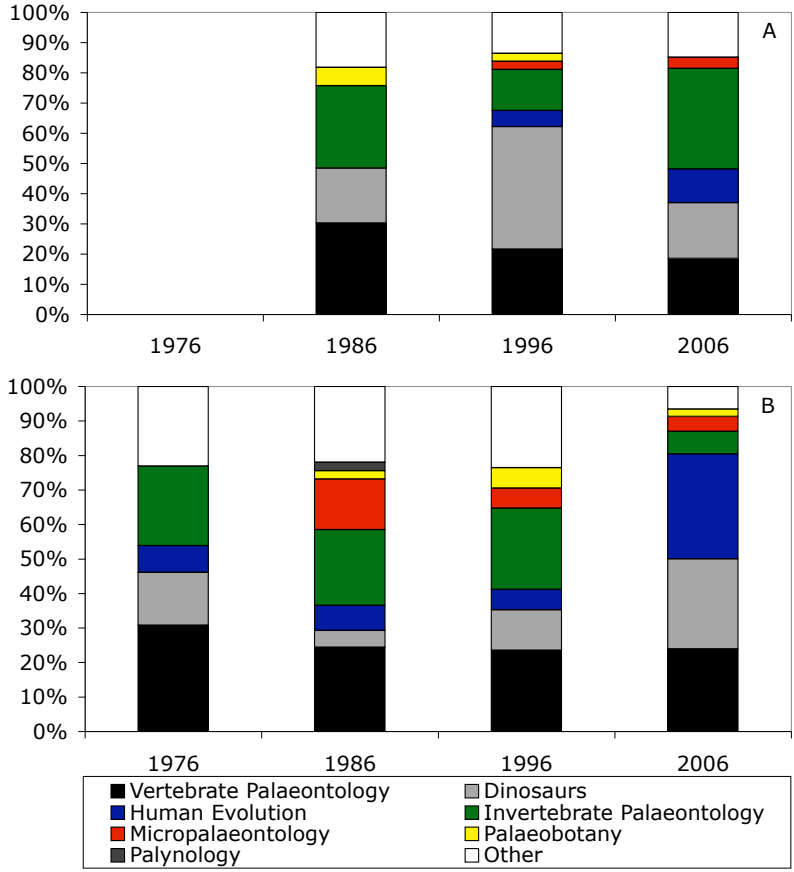

Figure 3: Coverage of the different areas of palaeontology in magazines dedicated to covering the geosciences. Vertebrate palaeontological topics are again separated out. A) Geology Today *(not published in 1976). B)* Geotimes.

Coverage of the various areas of palaeontology varies greatly over the period in question in *New Scientist*. Human evolution and archaeological stories feature strongly throughout the whole interval, outweighing the dinosaur stories. Mass extinctions are another area that is consistently covered by *New Scientist*. *Scientific American* also has a large proportion of human evolution stories. The breadth of topics covered in 1996 is a reflection of the increase in the number of articles per issue as *Scientific American* moved away from publishing seven or eight long articles per issue towards the publication of many shorter articles. By 2006 vertebrate palaeontology had become dominant. *Discover* has a massive proportion of stories on vertebrates, with dinosaurs and human evolution dominating the vertebrate category. The spike in human evolution stories in 2006 was driven almost entirely by the Flores hominids (the 'Hobbits').

What is notable in all three magazines is the consistent lack of coverage of invertebrate palaeontology, relative to the proportion of peer-reviewed articles published over the same period. Most articles about invertebrates fall into pieces about insects in amber or the Cambrian Explosion. The origin of life and mass extinctions get varying coverage. Astrobiology is a relatively new research field, but does have the advantage of combining aliens, astronomy and origin of life, three 'big questions' that are perennial favourites of the science magazines. Nonetheless it is surprising that there is not more coverage of astrobiology. Given the strong graphics and colour that now feature in all three magazines, I was surprised to find only one or two articles about 'evo-devo'. However, this may reflect editorial choices to follow relatively familiar stories, in the same way that newspapers cover the same topics and personalities over and over again in political stories. The coverage of the same stories in all three magazines in many cases is another reflection of the power of press releases, and there is probably an effect of a relatively small group of writers contributing to multiple publications as freelancers. An increasing proportion of palaeontological stories from the 1990s onwards were only mentioned as short items in digests with longer articles available on the magazine websites. As not all the content is available to non-subscribers online this represents a barrier to some readers getting access to the full story, but as has already been noted the commercial magazines exist to make money.

Both of the professional society publications cover a wider range of palaeontological topics than the commercial science magazines. Obviously these society publications are focused on the earth sciences and can devote more attention to sub-disciplines within palaeontology. Between the 1970s and 1990s *Geotimes* covers most of the categories and gives much more attention to invertebrate topics than the commercial science magazines. Dinosaur and human evolution stories only come to dominate in the 2006 volume. As in all other categories of publication palaeobotany and palynology receive little attention and most palaeobotany stories related to either the use of plants as climate proxies or 'oldest fossil' stories. However, *Geotimes* did publish a considerable number of articles on the stratigraphic use of fossils. *Geology Today* tended towards a higher proportion of vertebrate palaeontology stories than *Geotimes*, making up at least 45% of the stories in each year sampled. Invertebrate palaeontology does make up a fair proportion of the stories presented in *Geology Today* and this covers a wide range of topics from the guides to major fossil groups to famous outcrops and their invertebrate faunas.

Different old fossils, same old stories

The introduction noted the prevalence of vertebrate palaeontology and human evolution stories in the daily newspapers and on the web. Examination of the palaeontological coverage of three widely-read science news magazines and two newsletters published by geoscience societies confirms that this preponderance extends throughout much of the media. Given the balance of peer-reviewed papers towards invertebrate palaeontology, should invertebrate workers feel hard done by over the lack of attention their work gets? I would argue not. Journals such as *Palaeontology*, with six issues a year and a mixture of papers across the field of palaeontology, do not have the advantage of coming out every week and thus being something that journalists will get into the habit of checking. Reflection upon our own reading and web browsing habits will soon reveal patterns of bias in which journals are checked as soon as they come out, and which are neglected until a colleague mentions an article relating to your field of research.

The writers and editors working on the reporting of science, including palaeontology, have the pressures of readership, circulation, generation of advertising revenue, space restrictions and the ever-present deadlines. They are for the most part concentrating on producing a commercial product, not aiming at balanced coverage of research. Andrew Marr conveys the dilemma of journalists well in his book *My Trade*. Journalists need 'a story', not necessarily 'the story', and many *Newsletter* readers will have an example of how their research has been misreported or misrepresented in the media, despite their best efforts to communicate 'the story'. The prominence given to human evolution and vertebrate publications is partly due to the familiarity of these organisms, allowing stories to be written that a non-specialist readership can grasp in a few paragraphs. Invertebrate palaeontologists should consider how much coverage is given to modern invertebrates and concede that vertebrates are more familiar to most people, which in turn makes people more likely to read the story featuring vertebrates, whether living or fossil. Human evolution stories are about the most familiar vertebrate of all and are avidly read. Other stories that work well feature the oldest/largest/most complete fossil finds, because they fit into a clear narrative that needs little extra context.

The most important factor to bear in mind is that the scientific press pack is under commercial pressures to some extent. Journalists, even those with scientific training, have different priorities and interests from the scientists whose work they are reporting, and their aim is not merely to reflect research. They are involved in creating articles and publications with a distinctive identity and readership. They also want their stories to be read, and they want to gain future commissions for work on the basis of their byline becoming known to editors. Usually there is less commercial pressure on newsletters, and such publications will often welcome unsolicited articles. Scientists dominate the readership of these magazines, and this group of publications is the most likely to cover all aspects of palaeontology. So if you are unhappy with the amount of coverage your area of palaeontology is getting, consider contacting the editors of such publications and offering to write an article.

And finally…

Given that the newsletters of the earth science organizations provide broader coverage of palaeontology, these are an excellent resource for informing the wider public about the whole range of research carried out in palaeontology. Many readers will have copies of magazines such

as *Geoscientist* or *Geology Today* that they scan through then perhaps consign to a box file or the recycling bin. Yet these publications, as well as the *Newsletter*, could be passed on to schools – particularly those with no geology teaching. Or consider passing them along to your local medical or dental practice for the waiting room tables. My own exposure to geology was very limited until I went to university – and people cannot become interested in subjects they have never heard of.

At a time when the use of websites, YouTube and social networking are advocated as the best channels for outreach, I think the opportunity to sit and browse a newsletter-type publication is just as important because it is an immersive experience, a means of entering another realm and allowing people to realise that there are more branches of science than chemistry, physics and biology. If you lack the time or the contacts to become involved in schools outreach in person, passing along such items could help to raise the profile of palaeontology and its role in the earth sciences. Such magazines also offer the opportunity to convey the much wider range of topics that palaeontology covers.

Altering public perception of what palaeontologists 'do' could have a range of positive outcomes. Museums and science programmes could present more on neglected areas of palaeontology, such as micropalaeontology and palaeobotany, that have made great contributions to our understanding of past climates. Undergraduates would hopefully take palaeontology courses without regarding palaeontology as a synonym for dinosaurs. It isn't all *T. rex* and the Taung child, whatever the papers may say.

Al McGowan
Newsletter Reporter

Sylvester-Bradley REPORTS

Darriwilian trilobites and associated fauna of the eastern Alborz Mountains, Iran: taxonomy, palaeoenvironments and palaeobiogeography

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Our current knowledge of the Middle to Upper Ordovician trilobite and associated faunas of Iran is very incomplete. Early Ordovician faunas of northern and central Iran were documented recently by Bruton *et al*. (2004), Ghobadi Pour (2006) and Ghobadi Pour *et al*. (2007), but the Middle Ordovician and especially Darriwilian faunas remained completely unknown. Thus my project, supported by the Palaeontological Association, was in significant part a pioneering study, diving deep into the unknown world of the early Palaeozoic seas of Iran. Two areas were selected: one is a section near the Simeh-Kuh Mountain in Eastern Alborz, north-west of Damghan, and the other is situated in the Saluk Mountains about 35 km south of Bojnurd on the road to Esfarayen in the Kopet-Dagh region. My choice was made partly because I had visited these areas before and was more or less familiar with the environment, but also relied on intuition. Indeed, in the complete absence of data on fossil localities and confusing published data on local geology, every choice is problematic.

When my funding was awarded I decided not to lose time but to go in the field as soon as I was free from my university duties. The first target was Simeh-Kuh. It was still Winter and some snow might be expected, but in the desert environment of the southern foothills of the Alborz Mountains this did not represent a significant problem and the area was accessible for geological studies for most of the year. There was also a small advantage, because I avoided the Summer heat which would be difficult to tolerate, especially at midday when there is no place to hide.

The Simeh-Kuh section is situated about midway along and somewhat east of the road to Cheshmeh Ali, which is a local tourist attraction famous for its springs. Just 5 km north of Cheshmeh Ali there are ruins of the Gerdkuh castle, formerly a stronghold of Ismaili assassins of Hassan Sabah. However in the 14th century they were defeated by Mongols and their strongholds were destroyed; thus there are no more problems with safety! But I had no time to look at the wonders of Cheshmeh Ali: Winter days were short and I had a lot of work ahead. There was a problem with logistics, however, as it is difficult to get to the section by car. It takes about half an hour to walk to the section, and then heavy samples (*c.* 100 kg including conodont samples) needed to be carried out. This issue was successfully resolved thanks to Dr Leonid Popov from the National Museum of Wales and Dr Mohammad Kebria-ee, my colleague from Damghan

University. It would be difficult also to find the section using an existing geological map of the area, because it is mapped as 'Devonian'. However, I am not a stranger to this place, and a significant part of my Ph.D. thesis was based on the Lower Ordovician trilobites collected from Simeh-Kuh.

Now for a brief introduction to the Middle Ordovician geology of the area. The rocks underlying the Darriwilian part of the sequence represent typical temperate latitude carbonates, comparable to those of the Middle Ordovician Volkhov Stage of Baltoscandia. These were accumulated slowly in a storm-dominated, shallow marine depositional environment starved of clastic sediment. Accumulation rates and the thickness of the pre-Darriwilian Middle Ordovician carbonates of the Lashkarak Formation are comparable to those of the Volkhovian of the East Baltic. Correlation with the Baltic Middle Ordovician sequence is presently well established by numerous occurrences of conodonts.

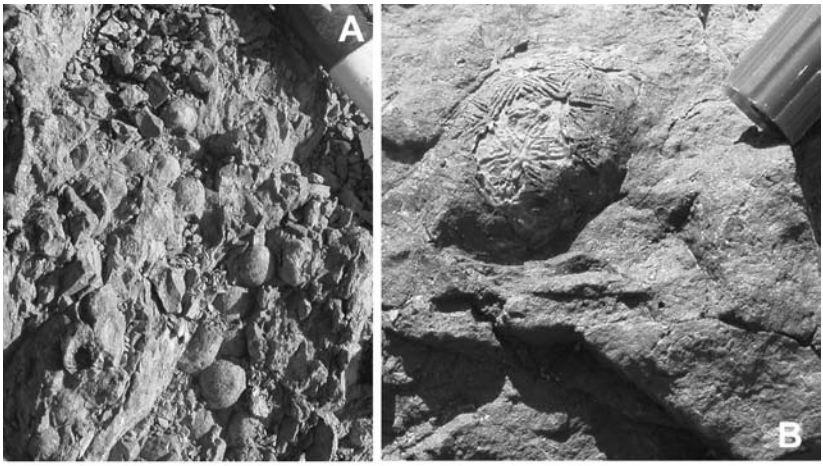

Figure 1. A, argillaceous limestone bed with dense accumulation of well preserved thecae of Echinosphaerites *sp., upper part of Lashkarak Formation, Darriwilian,* Lenodus pseudoplanus *Subzone; B, large rhombiferan cystoid theca in the rock, uppermost Lashkarak Formation.*

The start of the Darriwilian coincided in Eastern Alborz with termination of carbonate sedimentation, sea level drop and an invasion of a low-diversity fauna representing the *Neseuretus* Biofacies. This environmental change might indicate a cooler climate. It was followed by sea level rise and by invasion of a new and very different fauna. In the overlying fine clastics, several argillaceous limestone horizons are extremely rich in echinoderm thecae. These echinoderm beds were spotted five years ago during my Ph.D. work, and Lefebvre *et al.* (2005) is based in significant part on that early collection. A good age constraint for this interval comes from the conodont *Lenodus pseudoplanus* (Viira) identified by Oliver Lehnert (University of Erlangen) from the same unit, which allows correlation with the upper part of the Kunda Regional Stage (lower Darriwilian) in Baltoscandia. This time it was possible to trace these beds over several hundred metres and there is a good potential for echinoderm sampling. The echinoderm assemblage is dominated by the rhombiferan *Echinosphaerites* (Fig. 1A). In Baltoscandia this distinctive fossil appeared and proliferated at a somewhat higher stratigraphical

level, in the base of the Aseri Regional Stage. However, there is one important similarity. Both in Iran and in Baltoscandia the sudden appearance and proliferation of *Echinosphaerites* closely coincides with increased faunal turnover, probably associated with environmental changes. Some time ago I learned also another application for these distinctive fossils, nicknamed 'crystal apples'. In history they were actually used as a weapon by Finnish tribes inhabiting north-western Russia. I hope, however, that this new Iranian discovery does not endanger the World!

The echinoderm-bearing unit is overlain by a bed of sandstone, with cement rich in iron oxides, followed by a barren interval about 15 m thick. This probably indicates another sea level drop. There are several thin limestone beds just below the sandstone unit which were sampled for conodonts to get more precise age constraints. The overlying fossiliferous unit is also mainly siliciclastic, comprising intercalated sandstones and siltstones ((Fig. 2). There are no more carbonates in the sequence, but the recovered faunal assemblage is unusually rich and diverse. Echinoderms are again notably abundant (Fig. 1B). In addition to *Echinosphaerites* some other rhombiferans, probably including *Heliocrinites,* hemicosmitids and diploporites are also present.

Figure 2. Western view of the Ordovician exposures in the Simeh-Kuh section showing Darriwilian deposits of the uppermost Lashkarak Formation. Dark grey hills in front of the photograph represent major fossiliferous horizon.

The trilobite fauna is of medium diversity and constitutes a relatively minor component of the assemblage. *Illaenus* and stiginids are most abundant, which suggests a shallow marine environment. The most easily recognisable taxon here is *Birmanites* (Fig. 3E-F). According to Fortey and Cocks (2003) it is characteristic of the 'East' Gondwanan faunas in the Mid Ordovician. There are rare Reedocalymeninae cranidia. Their taxonomic affiliation still requires further study, but they are definitely distinct from *Neseuretus* which occurs lower in the succession. Another and rather unusual taxon is a pterygometopid, definitely representing a new genus. Trilobites of this family are very rare in Gondwana. Newly recovered specimens are distinct from the Siberian Subfamily Monorakinae, thus there is more likely a Baltic connection.

There are numerous bryozoans but they are mostly decalcified and therefore of little value for taxonomic studies. Brachiopods are the most abundant and diverse. They are represented by at

least 15 genera. Strophomenides are numerous, yet are completely missing from the underlying units. However most of the sampled taxa, maybe with the exception of *Paralenorthis,* are new to me and I will ask my colleagues Leonid Popov and Michael Bassett from the National Museum of Wales, Cardiff for assistance.

There are some surprises. Almost all genera have not been reported from Iran before. The most abundant strophomenide in the assemblage can be assigned to *Ishimia* (Fig. 3A-B). It is another taxon with 'East' Gondwanan signature, which is also known from Kazakhstan, Sibumasu, Tibet and Australia. More importantly it is mainly characteristic of low latitude faunas, thus suggesting that it was considerably warmer in the late Darriwilian. Another interesting taxon is a clitambonitoid, probably *Vellamo* (Fig. 3C). It is relatively widespread in the Late Ordovician, but in the Mid Ordovician it is mainly confined to Baltica. However, the most unusual discovery is the occurrence of the craniid *Pseudocrania* (Fig. 3D). Firstly, existing records of the Middle Ordovician craniides outside Baltica are from Kazakhstan and from North China, and there is nothing reported from the mainland Gondwana. Secondly, the appearance of *Pseudocrania* in Alborz is significantly delayed in comparison to Baltica. Is it another Baltic connection? It requires further study.

It is also interesting to know what is going on in the Late Ordovician of Iran. There is a preliminary report on the mid-Caradoc benthic assemblages from the Katkuyeh Formation of Kerman region by Bassett *et al*. (1999) – a low diversity fauna, which includes gastropods, bivalved molluscs and only four brachiopod genera. *Drabovia,* listed among the brachiopod taxa, is otherwise known from North Africa, Armorica and Perunica. It is definitely a cold water fauna. Thus the Ordovician deposits of Iran preserve a record of alternating episodes of warmer and cooler climate, and the temperate latitude benthic assemblages are good indicators of changing environment.

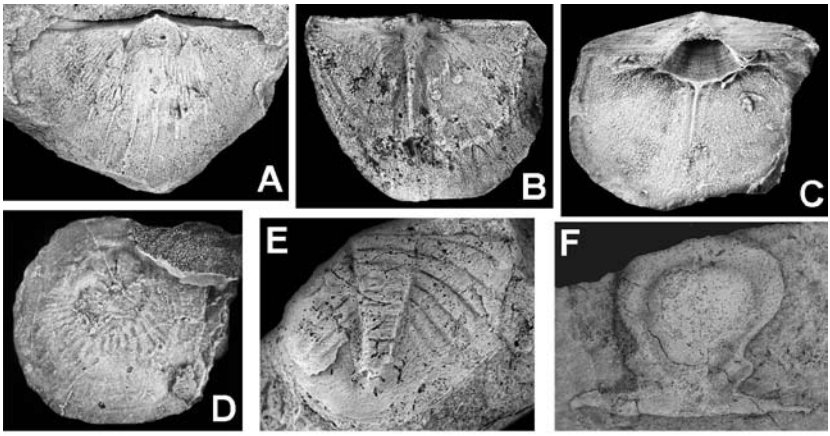

Figure 3. Fossils from the upper part of the Lashkarak Formation: A-B, ventral internal mould and latex cast of dorsal interior of Ishimia *sp., ×1.5, ×1.7; C, latex cast of ventral interior of* Vellamo *sp., ×2; E-F, dorsal view of pygidium (latex cast) and internal mould of cranidium of* Birmanites *sp*., ×1, ×1.5*;* D, *latex cast of ventral interior an dorsal valve fragment showing characteristic tuberculate ornament of* Pseudocrania *sp*., *×1.4.*

My second target was the Soluk Mountains south of Bojnurd in north-eastern Iran. When I started to gather available geological data, the general picture was rather depressing. Two existing geological maps disagreed about presence or absence of the Silurian in the area. The Ordovician and Cambrian were also mapped rather differently. When I looked at the few published data on the palaeontology and biostratigraphy of the area (Ghavidel-syooki, 2001; Ghavidel-syooki and Vecoli 2007, see also references here), I could get neither information on geographical location of the measured sections, nor data on the occurrence of macrofossils. Only acritarchs and chitinozoans were reported. However there was one positive side, I realised that the Ordovician succession in the area exceeds 1 km in thickness, all three series are represented, and there is a transition from the Cambrian and into the Silurian. The local Lower Palaeozoic lithostratigraphy applied to these sections is largely imported. Only the Ghelli Formation introduced mainly for the Upper Ordovician, but also including Darriwilian, is native to the region. The Niur Formation is simply a 'dustbin' for almost every Silurian sedimentary unit in Iran. The Upper Cambrian to Lower Ordovician units in the area were artificially implanted from the Alborz Region, however the tectonic setting and depositional environments are different.

I decided to go to the field in June. Mountains in Saluk are not very high, with altitudes slightly exceeding 2 km, but it is significantly cooler during the Spring, and it may be rainy and windy for days and also covered by snow for most of the year. In my previous visit to the area I spent the first day in the field walking across the mountains in cloud cover, which was unpleasant and counterproductive. There is an obvious safety issue, and my two university colleagues, Mr Amini and Mr Ahmadi, kindly agreed to join me in the fieldwork.

Figure 4. Northern view of exposure of Ordovician–Silurian boundary interval in Kuh-e-Soaluk Mountains. Hills in front represent the uppermost outcrops of the Upper Ordovician Ghelli Formation. Large hills on the far side are mainly Silurian outcrops containing Dalmanites *sp. in the mid part.*

When the weather is good, fieldwork in the Soluk Mountains is really a very nice experience. There is a parking place and some small shops at the highest point of the pass through the mountains. A few hundred metres down the road there is a nice exposure of Silurian, probably Aeronian, sedimentary rocks with a distinctive *Pentamerus* bed. I knew it from my previous trip. But where is the Ordovician? This time I turned to satellite navigation. 'Google Earth' provides a high-resolution image of the area. On the image it is possible to trace the *Pentamerus* bed and several other marker beds. Volcanic rocks reported by Ghavidel-syooki in the upper part of the Ordovician sequence are also clearly recognisable. A starting point to make a profile should be 1.5 km west, up to the valley south of the parking place, and if we are lucky we may get close to the Ordovician/Silurian boundary. Half an hour after setting out the satellite navigation proved reliable. We were in place facing towards the bed of argillaceous limestone with large trilobites, probably *Stenopareia*, and strophomenides, definitely Upper Ordovician, whereas on the southern slope of the valley I found a pygidium of the Silurian trilobite, probably *Dalmanites* (Fig. 4). There is no trace of a well-developed discontinuity surface. At first glance the boundary looks transitional, and if so, it is the second section in Iran where we may have it. The first one is in the Zagros Mountains and therefore on the Arabian Plate. Dr Mohammad Ghavidel-syooki told me that there are some Ordovician and Silurian units traceable also in Saudi Arabia. Thus it will be possible to compare what is going on in Iran and the Arabian Peninsula across the Ordovician/Silurian boundary without crossing the Persian Gulf. I now have another interesting research project in mind.

If we turn south, we walk through the mountains to cross the Ordovician section. There are some distinctive cephalopod beds containing large orthocone shells (Fig. 5). Some units are rich in brachiopods. One unit puzzles me. First I thought that it was a concentration of ostracode shells, but later I realised that these were ferruginous ooids. I have not seen such a lithology before. It must be familiar to British and Baltoscandian geologists, but I assume that there are no previous reports from the Ordovician of Iran. After a long walk through the mountains we got closer to the base of the Ordovician sequence. Suddenly Mr Amini spotted an unusual fossil that he had not seen before. I looked at it and realised that it must be *Rhabdinopora*. The Cambrian/Ordovician boundary should be nearby. A few tens of metres aside we found the trilobite *Asaphellus inflatus*, which is a good indicator of the lowermost Tremadocian in South China and in the Simeh-Kuh section in the Eastern Alborz Mountains. For the first time in Iran we can identify the position of the Cambrian/Ordovician boundary more or less precisely. I am busy collecting conodont samples from the thin limestone beds that occur through the unit. My colleagues are busy with sedimentological observations.

During the following days we decided to concentrate our work mostly on sampling and documenting the section. It is an enormous task, enough for years of research! I could spend only a week in the field and it looked more like a reconnaissance: there is much more work ahead. Our unusual activities were spotted by people from a nearby village. Soon we made new friends and the opportunity to drink tea under almond and cherry trees at lunch time, the hottest time of the day. These kind people also helped us with shipping 200 kg of samples to the car.

Figure 5. A bed of cephalopod limestone in the mid part of the Upper Ordovician Ghelli Formation.

My fieldwork was finished and three weeks later I visited Cardiff. There I shared these new discoveries with my colleagues Leonid Popov, Robert Owens, Michael Bassett from the National Museum of Wales and Lesley Cherns from Cardiff University. They helped me a lot in ongoing studies of the Iranian Ordovician. Conodont samples from Simeh-Kuh were processed in acid and I sent them to Dr Oliver Lehnart (University of Erlangen) at the first opportunity. Now I am awaiting the results. As for the samples from the Kopet-Dagh Mountains, they are still being prepared. Conodont samples are dissolving in acetic acid and there is a significant amount of work to be done on cleaning and taxonomic identification of the fossils collected.

Otherwise, the major outcomes of the work on the project are already evident. Newly obtained data are important for better understanding the regional geology and for ongoing mapping projects in Iran. Several new Ordovician faunas have been recovered, which are now the subject of taxonomic studies and then can be incorporated into palaeoecological and biogeographical models. Finally, an important issue is the sensitivity of temperate latitude shallow marine faunas of Iran to the environmental changes induced by changing climate. It is a new direction for further studies.

I acknowledge with gratitude that my successful and highly productive field studies during the 2007 season and subsequent study of newly collected material have been supported by the Sylvester-Bradley Award from the Palaeontological Association. I thank Dr Leonid Popov from the National Museum of Wales, Dr Mohammad Kebria-ee from the University of Damghan and my university colleagues Mr Amini and Mr Ahmadi (Gorgan University) for their kind assistance during the fieldwork. I am grateful to Dr Lesley Cherns, Cardiff University for her generous comments on the language of the manuscript.

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Post-cranial morphology and biomechanical adaptation of Palaeoloxodon Antiquus

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Palaeoloxodon antiquus is an extinct elephant found in deposits across Europe, dating from *c.* 800,000 until 33,000 years ago (Palombo and Ferretti, 2005; Cardoso 1996). It was larger than living elephants, with an estimated body mass of over 10,000kg (Christiansen 2004), and is thought to be ancestral to dwarf elephant species found on Mediterranean islands throughout the Middle–Late Pleistocene, the smallest of which have an estimated body mass of around 150kg (Roth 1990). Body size is correlated with many physiological and ecological variables (*e.g.* life history, group size, home range), and has ramifications for skeletal morphology and biomechanics.

As the largest living land mammals, extant elephants represent the endpoint taxa for our current understanding of the constraints imposed by large body size, but elephants also have a highly derived skeletal morphology that makes it difficult to draw comparisons with much smaller, differently adapted species. *P. antiquus*, and its dwarf descendents, offer a unique opportunity to study the effect of body size change on skeletal morphology and to understand

the effects of scaling in morphological and biomechanical adaptation. When combined with biomechanical data on living elephant taxa (ongoing research, John Hutchinson at RVC), and existing physiological and behavioural data, this will provide new insights into the evolution of body size change.

P. antiquus dental and skull morphology are well quantified (*e.g.* Davies 2002), but the post-cranial skeleton has been little studied. Previous research has focused on body mass reconstructions or discriminating features between *Palaeoloxodon* and *Mammuthus* (Christiansen 2004, Kroll 1991). The Sylvester-Bradley Award enabled me to redress this through the production of a dataset of *P. antiquus* associated skeletal material from the UK, Germany and Italy that incorporates standard morphometric measurements of limb bones as well as novel measurements of biomechanically important features such as muscle attachment points and moment arms. These data will be integrated with extant elephant and extinct dwarf elephant datasets (Herridge, unpub. data), to understand the *P. antiquus* morphological, ontogenetic variation and biomechanical adaptation.

Four *P. antiquus* skeletons are known from UK deposits (Upnor, Deeping St. James, Aveley, Selsey), but further associated material must be studied to ensure adequate sample sizes for allometric inferences. The Sylvester-Bradley Award funded several short trips to collections in Italy (University of Rome La Sapienza) and Germany (Humboldt Museum für Naturkunde, Berlin; Staatliches Museum für Naturkunde, Stuttgart; Hessisches Landesmuseum, Darmstadt). All skeletons with associated dental material were aged following modified accepted protocols (Laws 1966; Jachman 1988), adapted for *Palaeoloxodon* tooth morphology (Davies 2002; Kroll 1991).

Figure 1. P. antiquus *skeleton from Brühl (SMNS 6517.5). Mounted and on display at the Schloss Rosenstein Museum at the Staatliches Museum für Naturkunde, Stuttgart.*

The degree of epiphyses fusion on all of the limb bone epiphyses were also scored using a new method (Herridge, unpublished; based on similar cranial suture scoring method in Debruyne 2003), developed to capture the elongated growth period of elephants, and enable investigations of ontogenetic scaling.

These data are currently being analysed, but preliminary results presented at the 8th International Congress of Vertebrate Morphology, Paris, June 2007, suggest that *P. antiquus* bone dimensions scale similarly to extant *Elephas maximus* and *Loxodonta africana*, but not to dwarf elephant taxa (Herridge and Hutchinson 2007), with interesting implications for limb bone scaling and biomechanics of large-sized animals such as elephants.

TEXT-FIGURE 2. Reconstruction of the P. antiquus *skeleton from Crumstadt, with original fossils at its base (HLMD RS 3003-3078). Displayed at the Hessiches Landesmuseum Darmstadt.*

Acknowledgements

With thanks to The Palaeontological Association for the Sylvester-Bradley Award that made this project possible. I would also like to thank those who helped me with collections access, and showed me much kindness during my Sylvester-Bradley visits: Reinhard Ziegler, Stuttgart; Oliver Hampe, Berlin; Oliver Sandrock, Darmstadt; Maria Rita-Palombo and Riccardo Manni, Rome.

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Sylvester-Bradley research project report: a comprehensive dataset for the Tritylodontidae

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The Tritylodontidae are a family of non-mammalian synapsids that ranged in time from the Upper Triassic to the Lower Cretaceous (Maisch *et al*. 2004). Discoveries in the last 25 years have added considerably to both the number of taxa and our knowledge of the group as a whole. More than 50% of taxa are known only from China, spanning the Lower, Middle and Upper Jurassic, and the majority of these have been published on only in Chinese, limiting

their inclusion in comparative, phylogenetic and evolutionary studies. Specimens of these, including numerous holotypes, are housed at the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Beijing, and the Sylvester-Bradley fund allowed me to visit the IVPP in order to study these.

The ultimate goal of this project is the construction of a comprehensive dataset for a phylogenetic analysis of the Tritylodontidae. This will then be used to address such evolutionary questions as the nature of faunal transition over the Jurassic–Triassic boundary; the origin of mammals and the identification of their sister group; phylogenetic relationships of the advanced non-mammalian synapsids; and the identification of attributes that promote generic/familial longevity. However, a number of taxonomic issues involving the Chinese taxa require solving first, including synonymy, possible ontogenetic series of a single taxon being confused with separate taxa, taphonomic and preservational effects affecting species identification, *etc*.

With more than half of all known Tritylodontid species represented in the IVPP collections, and possibly the largest collection of Tritylodontid specimens anywhere in the world, there were a formidable number of specimens. These were to be examined, photographed, notes made, and comparison made with others in the collection and those from elsewhere using notes, pictures, publications *etc*. The majority of specimens are from the Lufeng Formation, Yunnan province. This formation has been prospected since the late 1930s, producing one of the most diverse Early Jurassic faunas known (Luo & Wu 1994). Some of the earliest descriptions of near complete tritylodontids relate to Lufeng material (Young 1947), allowing the previously held idea of the group being some of the earliest mammals to be discarded. This has been replaced instead with the current quite variable position of Tritylodontidae within those taxa close to the origin of Mammalia (Kemp 1982, 1983; Hopson & Kitching 2001; Ji *et al.* 2002; Luo *et al.* 2007).

Figure 1. The holotype skull of Bienotherium yunnanese*, IVPP 1. Skull size = approx 15cm in length.*

Starting at the start, specimens of *Bienotherium yunnanese* described by Young (1947) were actually the very first specimens collected and registered by the embryonic IVPP, so asking for specimen numbers 1 onwards (the holotype skull, see Fig. 1) was a good place to begin. While surrounded by mostly dinosaurian workers in the study room assigned, I was able to locate at the end of the week a student who had been studying an undescribed new species of Tritylodontid, and much exchanging of information, reprints, data *etc*. took place – an unexpected bonus!

By the end of the visit the purpose of the trip – to collect data and generate new phylogenetic characters – was successfully accomplished. To date, no phylogenetically informative characters for the postcranial skeleton of Tritylodontids have been suggested, but examination of material in the IVPP and comparison with literature and specimen based observations of other Tritylodontid genera and species has allowed a significant proportion of the data matrix currently under construction to be composed of postcranial characters. It also allowed missing data points in the matrix for the many Chinese specimens to be filled, and a number of taxonomic issues to be cleared up. The predicted output will be a primary paper detailing Tritylodontid phylogeny at

the species level and a number of secondary papers addressing taxonomic issues and using this phylogeny to address the questions above.

I wish to thank Li Jinling and Qi Zhao of the IVPP for discussion and specimen access, Zhe-Xi Luo of the Carnegie Museum for discussion, advice, and specimen locating, and the Sylvester-Bradley research fund for allowing this research visit to happen.

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Mammalian dietary response to Eocene–Oligocene events in Europe

Sarah Joomun

A major turnover in the mammal fauna occurred in the earliest Oligocene of Europe. Most of the endemic mammals became extinct and new taxa dispersed into Europe from Asia. This faunal turnover is known as 'The Grande Coupure' or big break (Stehlin 1910) and had the most significant effect on the ungulate fauna. There was a shift from a greenhouse climate to an icehouse climate from the Late Eocene to Early Oligocene. The Grande Coupure occurred at the same time as the onset of polar glaciation in the Oligocene (Oi-1) (Hooker *et al.* 2004, 2007).

I am studying two of the ungulate genera which survived the faunal turnover, *Plagiolophus* (Palaeotheriidae, Perissodactyla, Mammalia) and *Diplobune* (Anoplotheriidae, Artiodactyla, Mammalia). The aim of this study is to discover whether there was any significant dietary change

for these two genera across the Grande Coupure, and to determine the relationship between their diet and the palaeoenvironment. Palaeoenvironmental change would have a significant and direct effect on the ungulates because they are almost entirely dependent on plants for nutrition. I have compared *Plagiolophus* with *Palaeotherium*, a close relative that became extinct at the Grande Coupure, and similarly I will be comparing *Diplobune* with *Anoplotherium*. The diet of these mammals is assessed by looking at the dental microwear (microscopic-scale wear on the tooth enamel which takes the form of scratches and pits) and dental mesowear (sharpness of the cusps and their relative occlusal relief). The relationship between the survival or extinction of ungulates at the Grande Coupure and the diet will be investigated by comparing the patterns of dietary change.

The Natural History Museum, London contains material from the superposed deposits in the Hampshire Basin, which have very good stratigraphic control and cover the latest Eocene to earliest Oligocene. However, there was a hiatus in the sedimentation immediately after the Grande Coupure, and as a result, material from key localities in France and Germany, spanning the Grande Coupure, are necessary to fill in this gap. The pre-Grande Coupure material came from Paleogene Mammalian reference levels MP18 and MP20, and the post-Grande Coupure material came from early and late MP21.

The Sylvester-Bradley Award allowed me to visit the following collections of Late Eocene and Early Oligocene mammal fossils: the Naturhistorisches Museum, Basel (Soumailles and Ronzon, France, MP21); Bayerische Staatssammlung für Paläontologie, Munich (Bavarian Fissure fills, Möhren 4, 7, 19, 20 and 31, Haag 2 and Burgmagerbein 8, Germany, MP21); Staatliches Museum für Naturkunde, Stuttgart (Frohnstetten, Germany, MP20); Musée Crozatier, Le Puy en Velay (Ronzon, France, Late MP21); and Museum d'Histoire Naturelle de Marseille (Soumailles, France, Early MP21).

During my visit to the collections, I made moulds of the wear facets of the upper molars of *Palaeotherium*, *Plagiolophus*, *Anoplotherium, Diplobune* and post-Grande Coupure ungulates such as *Bothriodon* and *Ronzotherium*. These moulds were made using the high resolution dental moulding material, Coltène President Microsystem© light body. On my return, the resin casts were examined using a scanning electron microscope and the microwear was quantified using Microware 4.02 software (Ungar, 2002). I also took photographs of the specimens in order to assess the mesowear. I had originally intended to study the Post-Grande Coupure rhinos, but unfortunately there were few suitable specimens from MP21 in the Munich collections, and most of the rhino (and also *Pseudopalaeotherium*) specimens from the Musée Crozatier were being restored, and were unavailable during my visit.

Work and data analysis for this project is still ongoing but initial microwear results for *Plagiolophus minor* suggest a change in the diet across the Grande Coupure. *Plagiolophus minor* displays the extensive pitting and enamel polishing, which are typical of an animal with a browsing diet (eating broad leaves, shoots, and fruit). The dietary shift is indicated by a significant increase in the number of pits from the pre-Grande Coupure localities, La Débruge and Frohnstetten, to the post-Grande Coupure localities of Soumailles and Ronzon. The post-Grande Coupure *Plagiolophus* microwear data will be compared with *Palaeotherium* microwear data, from the MP18 locality of La Débruge (Joomun *et al.* submitted manuscript).

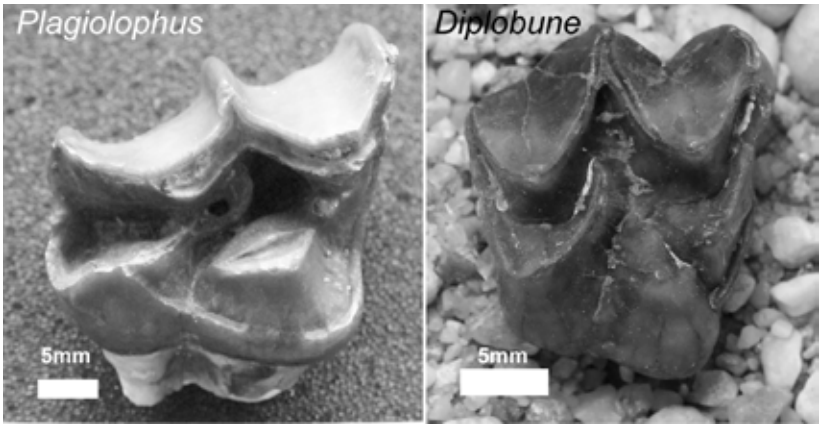

Figure 1. Upper molar teeth of Plagiolophus *and* Diplobune.

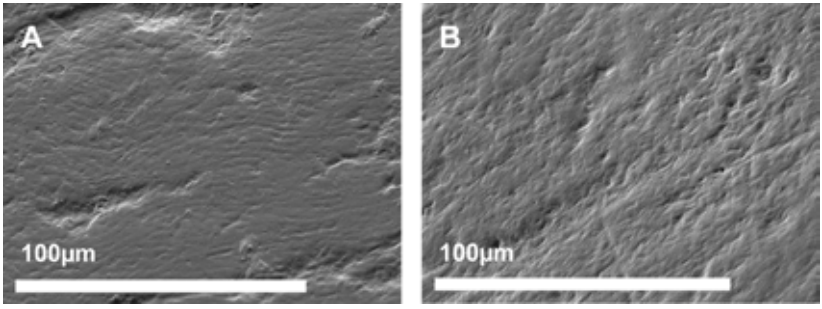

Figure 2. Plagiolophus *dental microwear (A) Frohnstetten, Germany, Pre-Grande Coupure, (B) Soumailles, France, Post-Grande Coupure.*

I would like to thank Prof. Kurt Heissig (Munich), Prof. Elmar Heizmann (Stuttgart), Dr Burkart Engesser and Mr Arne Ziems (Basel), Mme Sylvie Pichard (Marseille) and Dr Frederic Lacombat (Le Puy en Velay) for allowing me access to the specimens and for all the help they gave me during my visits. I gratefully acknowledge the Sylvester-Bradley Award from the Palaeontological Association.

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X-ray investigation of an exceptionally preserved fauna from the Ordovician of Wales

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The Llanfawr Mudstones Lagerstätte (Middle Ordovician, Builth Inlier, Wales, UK) contains pyritised soft-bodied fossils, including the earliest, and second known, fossil solitary hydroid, and is unique in preserving a normal benthic ecosystem from the middle of the Ordovician Radiation. The biota comprises a diverse fauna of sponges, cnidarians, echinoderms, worms, molluscs, arthropods and problematica, with sometimes even the most labile tissues such as cnidarian tentacles preserved in fine detail. The fossils are preserved in pyrite in thin slabs of mudstone, and hence are spectacular in x-ray. Almost all the fossils examined so far have been seen this way, because most specimens are not exposed on the surface of the rock. Excavation of fossils, as can be done for the Hunsrückschiefer, is not desirable in this instance, because of the fragility of the pyrite. At present the known diversity of the fauna is around 35 species, of which half would not normally be preserved.

The Sylvester-Bradley award funded fieldwork to allow detailed logging of the beds, collection of material, and purchase of x-ray film for study of material back in the lab. I and several helpers spent several days doing detailed logs of two sections in the quarry, keeping any slab with obvious pyrite for subsequent x-ray. Additional collecting was carried out at spots where pyritised material had previously been found, with some exploratory collecting at other sites within the quarry.

The fieldwork has given us a much better understanding of how the faunas vary through the section. A log of one of the studied sections is given in Figure 1.

As there are many small faults within the quarry, and bedding is not usually visible, correlation between measured sections was not possible with confidence. Results between levels are not directly comparable, although similar amounts of rock were sampled for each level. One of the most striking patterns to result from the fieldwork is the dominance of either the sponge *Cyathophycus* or the graptoloid *Dicellograptus* within the fauna. These are among the most obvious fossils, and the most abundant, except for a small problematic organism that is normally seen only in X-ray (Fig. 2A). The other major component is either hydroid stalks or sponge root tufts, but these are very similar in morphology, and difficult to distinguish unless other features are also preserved.

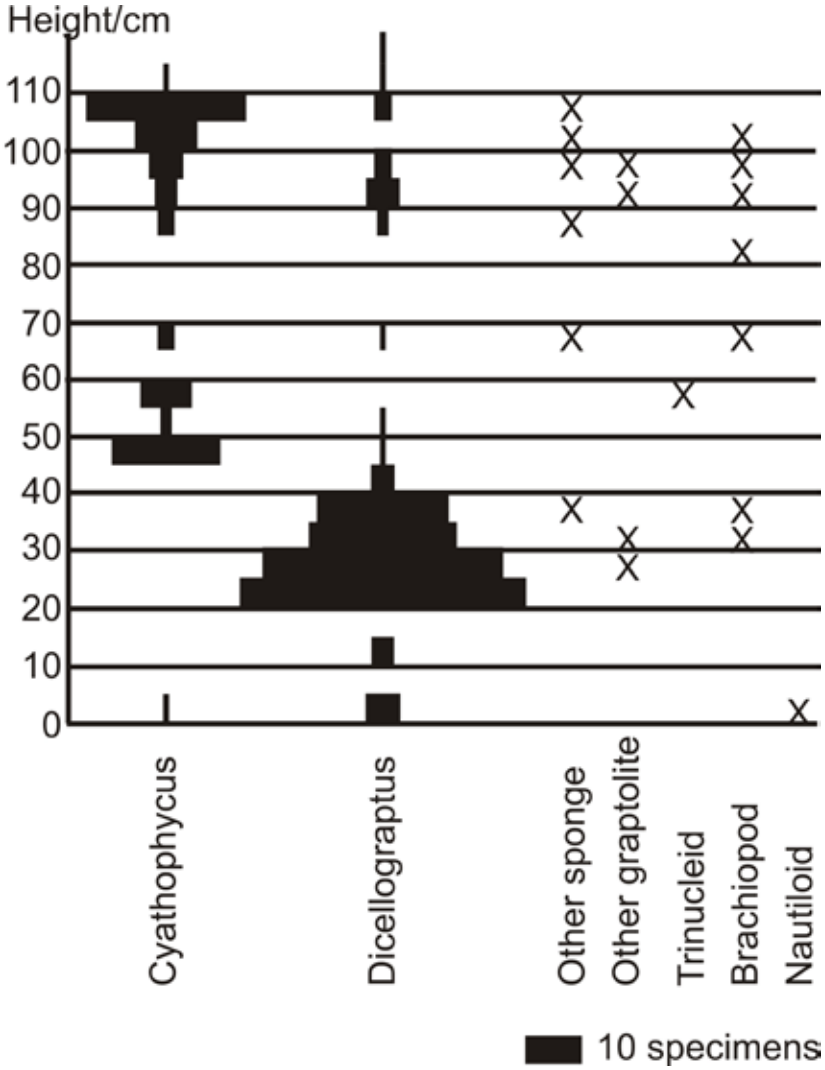

Figure 1. Log of one of the measured sections. For Cyathophycus *and* Dicellograptus*, exact numbers are given; for other taxa, which are present in low numbers, presence-absence data only are given.*

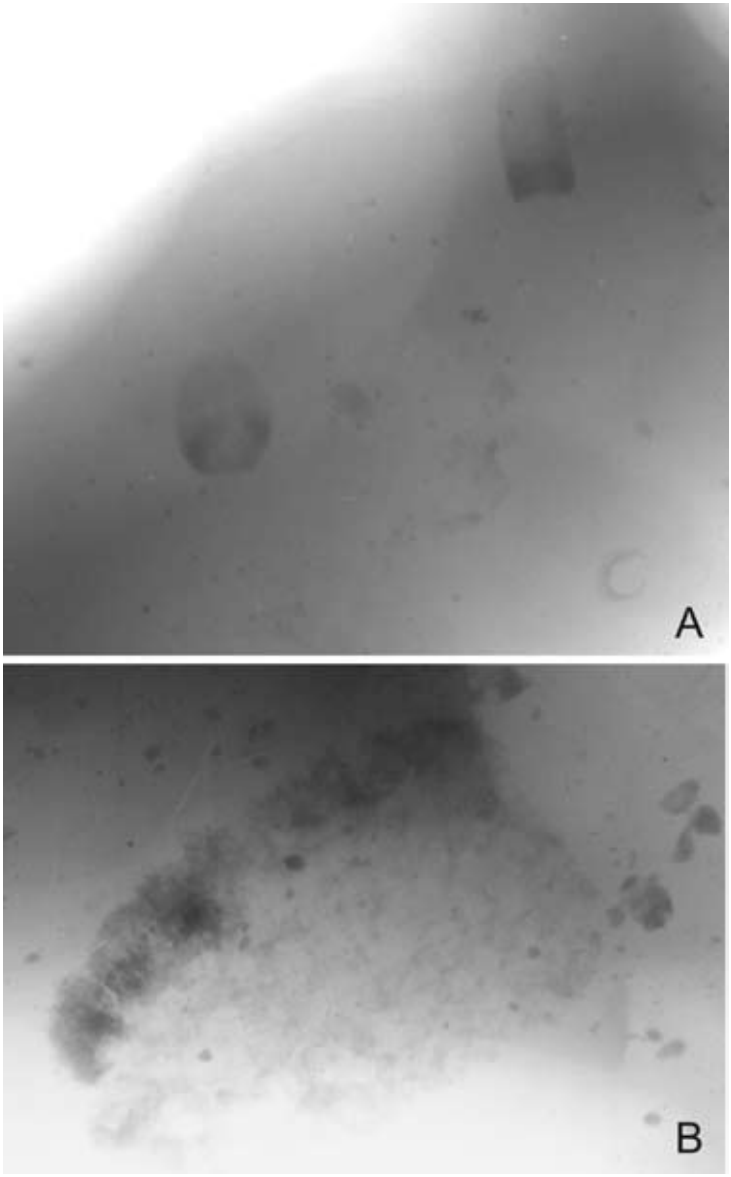

Figure 2. X-radiographs of typical specimens from the Llanfawr Mudstones Lagerstätte. **A**. *Two specimens of the most abundant species in the deposit, a small problematicum. The specimens are cylindrical with thickening at one end. The lower specimen is preserved oblique to the plane of the x-ray, and the upper parallel to it. Upper specimen approximately 4 mm long.* **B**. *The hexactinellid sponge* Cyathophycus *showing both spicules and soft tissue preservation. Specimen approximately 25 mm long.*

Other faunal elements are rather rarer, but there are examples of gastropod steinkerns, organophosphatic brachiopod shells, dendroid graptolites, several other sponge species, and occasional nautiloids. The nautiloids (both orthoconic and coiled, but particularly the former) often bear epibionts. Most are mineralised (weakly preserved calcitic brachiopods, bryozoans), but there are interesting specimens suggesting soft-bodied epibionts as well. Further specimens and work are required before these can be confirmed.

The arthropod fauna is strangely depauperate, with only a few specimens of bivalved arthropod carapaces, one ostracode, and a few trilobite specimens to date. The rarity of trilobites in the fauna is puzzling. At other levels within the quarry complex, trilobites are abundant, and often a major component of the fauna. There is a general pattern in the Builth Inlier that where sponges occur trilobites are rare or absent. The pattern is not absolute, however; although trilobites have not been observed on the same bedding plane as sponges at this site, this has been seen at other sites of similar age and fauna with an apparently similar depositional environment. Another interpretation is that trilobites (and any other arthropods that might have been present) might have burrowed their way out of the mud slides that entombed the rest of the fauna. This idea, however, could not account for the absence of moult fragments. The preliminary hypothesis was that, however unlikely it seemed, there had been virtually no trilobites present in the fauna.

However, the discovery of the Worst Trinucleid in the World has solved the mystery. The aforementioned beastie is exactly what its name says: it is an extremely poorly preserved trilobite – no more than the trace of an imprint upon the rock. It is apparently an isolated cephalon, but there is no trace of the original calcite, nor of any replacement by pyrite (as happened at other beds in the quarry complex), nor is the remaining imprint clear, as in other beds in the quarries. At most angles it is almost invisible. I conclude that trilobites were present, but their calcite skeletons were dissolved very early – certainly before the mudstone had fully hardened. This leaves the problem: why are the trilobites not pyritised, when the graptolites, sponges, and other animals are? No articulated trilobites with fresh pyrite have been recovered yet (one enrolled one was very badly weathered), and it may be that several of the factors suggested above were operating – frequent escape from burial, rarity, and a preservational bias against carbonate.

Back in the lab, X-ray analysis has revealed many specimens not visible in the field. Most of these specimens are the sponge *Cyathophycus* (Fig. 2B) and a small problematicum (Fig. 2A), although some more intriguing remains have been found. Study of these is ongoing, and many will require further specimens showing similar features in order to become describable. The X-raying of large numbers of slabs has, most importantly, allowed a much better understanding of the fauna as a whole, and the soft-tissue preservation. The preservation of truly soft tissue, as in hydroid tentacles, is rare even within the deposit. This implies that the most abundant, problematic organism (Fig. 2A) is composed of somewhat tougher organic matter, as it occurs in large numbers throughout the succession. Graptolites are also more abundant than was at first recognised, with weakly pyritised specimens being common in the deposit. There is substantial evidence for transport, from torn and mass assemblages of sponges without their root tufts, to apparently rolled masses of hydroids forming dense balls. The weathered profile of hardened beds often shows low-angle cross-stratification within individual, 2 cm-thick beds. There is no evidence of bioturbation or individual trace fossils at any level, as might be expected given the chemically unpleasant sediment.

The insights gained from this project confirm the importance of the site, and give us a better understanding of how it came to be. Turbiditic slumps or other mass movement of sediment resulted in local (but sometimes violent) transport and burial of the benthic community. Exceptional pyritised preservation of sponges and some other organisms is present throughout the deposit, and appears to have occurred only when soft tissue was present, but the preservation of the softest tissues appears to be restricted to some individuals within small pockets. With the exception of a few common species that are ubiquitous, most of the organisms represented in the fauna are rare, and the amount of rock needing to be processed to find them is very large. Working of the site is therefore likely to be a long-term process, but further discoveries are expected to continue as these rarer fossils come to light.

Acknowledgements

Fieldwork and x-ray analysis were made possible by a grant from the Sylvester-Bradley Fund. I would like to thank Talfan Barnie, Joseph Botting, Tess Ormrod and Chris Upton for their invaluable assistance with the fieldwork.

Calcareous phytoplankton and the Eocene-Oligocene Transition of the US Gulf Coast

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The concept of Konservat–Lagerstätten – sedimentary deposits with an unusual quality of fossil preservation – is not normally associated with calcareous microfossils, which are ubiquitous in many marine sediments and arguably have one of the most complete Cenozoic fossil records. However, a recent study of the Cretaceous and Palaeogene clay-rich facies of coastal Tanzania has yielded foraminifera and calcareous nannofossils (predominantly the remains of coccolithophores) of such high quality that they rank as a long time series calcareous microfossil Konservat–Lagerstätte (Bown *et al.*, in press). The preservation of original wall structures and geochemical signatures in the foraminifera has provided a wealth of taxonomic data (Pearson *et al.*, 2006) and produced a reassessment of warm-climate tropical sea surface temperatures (Pearson *et al.*, 2001; Pearson *et al.*, 2007). It is the preservation of a dramatic new diversity of Palaeogene calcareous nannoplankton, however, with 86 new species described to date, that makes the Tanzanian material truly exceptional (Bown, 2005; Bown and Dunkley Jones, 2006). Or is it?

On seeing such amazingly well-preserved nannofossils in seemingly ordinary, clay-rich shelf-slope sediments we wanted to check similar facies to understand the controls on microfossil preservation and expand the geographic range of palaeoceanographic records that have been, and continue to be, produced from the Tanzanian material. Our suspicion was that the advent and expansion of deep-sea drilling in the late 1970 and 1980s, and the high-quality, long time series records that this produced, absorbed a great deal of micropalaeontological effort and shifted focus away from some of the early ground-breaking taxonomic and biostratigraphic

work that was done on shallower clay-rich shelf sediments, such as the Gulf Coast of the USA (*e.g.* Hay *et al.*, 1967; Roth, 1970). The aim of this grant was to return to the US Gulf Coast states of Mississippi and Alabama to collect samples from some of the classic Gulf Coast Palaeogene sections. As well as the interest in exceptional preservation, sampling was designed to target the Eocene–Oligocene boundary (EOB) event, a key interval in earth history, which is marked by the rapid transition from a largely ice-free 'greenhouse' climate to an 'icehouse' state, with the growth of a continental-scale ice sheet on Antarctica.

Ten days of fieldwork in April–May 2007 took the form of a journey across the Deep South and its Tertiary clays, from Vicksburg, Mississippi to Tuscaloosa, Alabama. Palaeontological highpoints included a tour of the Eocene outcrops around Jackson, MS with James Starnes, a geologist at the Mississippi Department of Environmental Quality (Figure 1), whose knowledge and fossil finds stretched from bryozoans to whales; and staying with Ernest Russell, retired geology Professor at Mississippi State, World War Two fighter pilot and expert on all things Southern, especially the fossils. I returned to the UK laden with samples, the most exciting of which were two sets of high-resolution samples from cores through the EOB at Mossey Grove, MS and St Stephen's Quarry, AL.

Figure 1. Core (and car seat/tyre) storage area at the Mississippi DEQ, Jackson, MS.

So far SEM studies of both foraminifera and calcareous nannofossils (Figure 2) show the quality of preservation in this material. Fine structure is preserved down to the sub-micron scale, which allows for detailed morphological studies and observation of the fine-fraction (<3µm) nannofossil diversity that is rarely observed in deep-sea settings. Initial nannofossil assemblage counts and an assessment of both benthic and planktic foraminifera suggest the presence of a major regressive event and coincident biotic change within the Mossey Grove core, suspected to be the EOB. A trial run of the TEX86 proxy on this material, though, suggests that there is no major cooling in sea surface temperatures across this interval (27.3ºC below, 28.2ºC above). Further work will integrate these records with foraminiferal stable isotope data to constrain the major positive oxygen isotope excursion in the earliest Oligocene (the start of the Oi1 interval) and assist in the placement of the EOB.

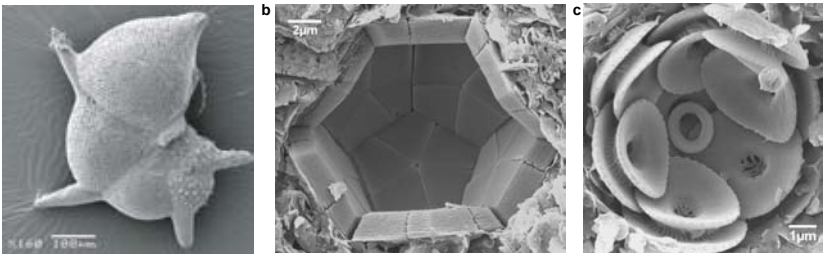

Figure 2. Calcareous microfossils from the Late Eocene of the Mossey Grove core:
a) Hantkenina alabamensis, *b)* Braarudosphaera bigelowii *"coccosphere",*
c) Cyclicargolithus floridanus *coccosphere with proto-coccolith ring in the centre.*

High-resolution nannofossil assemblage data collected from the more widely studied St Stephen's core show a clear nannofossil assemblage change coincident with the increase in oxygen isotopes across the EOB. These data are helpful in the correlation of the EOB between sections, and clearly demonstrate the intimate connection between global climatic and biotic change. Overall, the material collected from the Gulf Coast demonstrates the importance of well-preserved material for both microfossil taxonomy and high-quality palaeoenvironmental proxies, although none of this material contains the exceptional nannofossil diversity of the Tanzanian sediments. While a clay-rich facies may be crucial for excellent calcareous microfossil preservation, there appears to be a missing 'x-factor' in the Tanzanian sections, which preserves a nannofossil assemblage with such quality and diversity that it often looks like a sample drawn from the modern plankton.

Acknowledgements

Many thanks to the Palaeontological Association for their generous support of this work, also sincere thanks to David Dockery and James Starnes (Mississippi DEQ), Ernest Russell (Mississippi State University), and Lewis Dean (Geological Survey of Alabama) for their help in the field and providing core material. Also thanks to Tamsin Lawrence (MSc UCL) for her work on the Mossey Grove Core and to Paul Bown (UCL) for supervising the project.

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A Comprehensive Phylogenetic Review of Therizinosauroidea: with redescription and rediagnosis of Segnosaurus and Therizinosaurus

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Therizinosaurs are an enigmatic group of feathered dinosaurs known from a series of partial skeletons spanning the Cretaceous of Asia and North America. Previous uncertainty as to the proper classification of these dinosaurs resulted from two main handicaps – their odd juxtaposition of sauropodomorph and theropod anatomical characteristics, and the paucity of their fossil remains. It has recently been speculated that therizinosaurs are a plant-eating group of bird-like, predatory dinosaurs known as maniraptorans (raptors) (*e.g.* Kirkland *et al.*, 2005). However, the absence of primitive therizinosaur remains documenting the supposed evolution from small-bodied, raptor-like ancestors to large-bodied, plant-eating therizinosaurs has produced a considerable gap in our understanding of this drastic evolutionary transition in diet and lifestyle. Ultimately, the missing fossil record of early therizinosaurs has fuelled

controversy over the evolutionary relationships and palaeobiology of this bizarre group of dinosaurs for over 50 years (Maleev, 1954; Rozhdestvensky, 1970; Paul, 1984; Gauthier, 1986; Sereno, 1989; Russell & Dong, 1993).

Fortunately, the past decade has witnessed a dramatic increase in our knowledge of therizinosaurs. Despite their historically poor fossil representation, therizinosaurs are currently becoming one of the most diverse maniraptoran groups, with at least fourteen documented species known from Asia and North America. The result of these recent discoveries has been a dramatic increase in the amount of information available for anatomical, palaeobiological and evolutionary studies of therizinosaurs.

Figure 1: Research assistant Terry Gates cleaning and reconstructing the holotype pelvis of Enigmosaurus *at the laboratory.*

The intent of this research project is to take advantage of the recent increase in therizinosaur discoveries by investigating their impact on the taxonomy and systematics of this enigmatic group of theropods. In order to accomplish this task, re-evaluation of early therizinosaur discoveries needed to be undertaken. Funds were requested from the Palaeontological Association for travel to the Mongolian Academy of Sciences Geologic Institute to examine four species of derived therizinosaur including *Erlicosaurus*, *Segnosaurus*, *Enigmosaurus* and *Therizinosaurus*. Unfortunately, *Therizinosaurus* was found to be crated overseas as part of a travelling exhibit that is not currently on exhibition, so this taxon could not be examined first-hand. Specimens of *Erlicosaurus*, *Segnosaurus*, and *Enigmosaurus* were studied at the Academy.

Upon arrival my research assistant Terry "Bucky" Gates and I found a significant portion of the therizinosaur materials in dire condition and in need of immediate care. Bucky spent the first four days of our trip stabilizing and gluing specimens including the holotype pelvis of *Enigmosaurus* (Fig. 1-2), which was in six fragments, and the holotype ilium of *Segnosaurus*, which was mostly unsalvageable. Despite these setbacks, a significant number of specimens representing these taxa and *Erlicosaurus* were available for study. However, the cranium of *Erlicosaurus*, the mandible of *Segnosaurus*, and other important therizinosaur materials are currently kept at a private location offsite and we were unable to gain access to these specimens during our trip.

Examination of Mongolian taxa proved to be a critical component of my research project, and Bucky and I felt fortunate to have been able to care for the specimens as part of our contribution. Characterizing the anatomy of derived Mongolian therizinosaurs provided comparative information that I used in the completion of a detailed osteological description of the primitive therizinosaur *Falcarius utahensis* (Zanno, in review). Additionally, the taxonomic and phylogenetic component of this project (Zanno, in prep) is nearing completion and scheduled for submission to the *Journal of Systematic Paleontology*. Major results of this component of my dissertation include: (1) characterizing the availability, condition, and status of published

Figure 2: The holotype pelvis of Enigmosaurus *after reconstruction.*

therizinosaur holotypes and referred materials; (2) re-evaluating original diagnoses for valid therizinosaur species in light of recent discoveries; (3) creating a phylogenetically supported, higher taxonomy for therizinosaurs; (4) providing a comprehensive phylogeny of therizinosaurs thus far including over 400 characters; and (5) examining patterns of biogeography and palaeobiology evident in the evolutionary history of therizinosaurs.

I sincerely thank the Palaeontological Association and its members for supporting this research, which I believe to be an essential component to reconstructing the evolutionary history of Theropoda. I look forward to presenting the final results of my research at the Association's Annual Meeting!

Additional acknowledgements

Thanks to Terry Gates for his assistance on this trip. Special thanks to R. Barsbold, K. Tsogtbaatar, and C. Tsogtbaatar of the Mongolian Geologic Institute for access to collections and assistance. Additional thanks to the myriad of other individuals who provided access to comparative specimens, including: R. Barrick, J. Bartlett, J. Bird, Y. Hailu, X. Xu, P. Sereno, M. Norell and I. Rutzky. Additional sources of funding for this project were contributed by the Jurassic Foundation, The Paleontological Society, The Discovery Channel, a National Science Foundation travel grant, a University of Utah Graduate Research Fellowship, and a NSF GK-12 Fellowship.

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Book Reviews

Papers in honour of John H. Shergold (1938-2006)

J. R. Laurie & J. R. Paterson (eds) (2007). Memoir 34 of the Australasian Association of Palaeontologists, 562 pp, ISBN 978-0-949466-32-7(softback) £63/$132 Australia; £66/$139 overseas, including postage (surface mail)

Since its inception as a series in 1983, four palaeontologists have had a memoir of the Australasian Association of Palaeontologists dedicated in their honour. In celebration of the doyen of coral workers, the Dorothy Hill Jubilee volume initiated the series. It was succeeded in 1988 by a memoir of palynological/palaeobotanical contributions for Basil Balme; then in 1993 by one for Ken Campbell whose research encompassed both vertebrates (fish) and invertebrates (arthropods/trilobites); and in 2004 by a collection of palynological and micropalaeontological papers for Geoffrey Playford. Memoir 34 represents a Festschrift volume dedicated to John Shergold.

Jake Shergold (as he was known to all his associates) was born in Southampton, on the Tertiary, but by the age of ten had moved to North Yorkshire where his interest in geology and palaeontology began by collecting ammonites from the Jurassic coastal exposures. Following a first degree at Durham (1962) he then moved the short distance to Newcastle where he undertook a PhD on the classic rocks and fossils of the Shropshire Silurian (Ludlow Series) under Jack Shirley. On completion (1966) he went to Australia to take up a position with the Bureau of Mineral Resources, Geology and Geophysics. Initial expectations of continuing Silurian research were thwarted, and during the late 1960s he was drawn into a phosphate project in Queensland – and in consequence another downward stratigraphical migration to the Cambrian. Apart from occasional forays into the Proterozoic and the Lower Ordovician, he was to spend the next thirty years, initially as a mentee of A. A. Öpik, essentially researching the palaeontology and geology of this system. During this time he produced some 200 papers, perhaps most notably on trilobite systematics, but his output also included papers on biostratigraphy, correlation, sedimentology, and basin and structural analysis.

After his retirement to France in 1996 Shergold continued to publish, and his last paper – co-authored with John Laurie and Judie Shergold on the Cambrian and Early Ordovician trilobite taxonomy and biostratigraphy of the Bonaparte Basin, Western Australia – is appropriately the first in this multi-authored volume. It is a typically careful and measured piece of work on what for the most part is intractable material preserved in friable sandstone, but which nevertheless enabled revision of the informal biostratigraphy suggested for this sequence by Öpik in the mid 1960s.

Of the 31 papers comprising this volume, several in particular caught the eye of this reviewer and give a flavour of the contributions. Over the last couple of decades some of the major groups of

fossils that historically were of uncertain affinity (conodonts and machaerideans, for example) have now had their identity determined to general consensus. The status of hyoliths remains less clear, but in their review of the zoological placement of the group, Malinky and Yochelson favour its inclusion as a class within Mollusca rather than as an independent phylum. This conclusion is based on their belief that the presence of cross-lamellar structure is a stronger indication of relationship than are considerations based on notions regarding the phylogeny of the phylum. They re-iterate the earlier comments of Marek and Yochelson (1976) that "it is awkward that Hyolitha do not fit into some schemes of molluscan phylogeny, but, perhaps, the fault lies with the schemes rather than with the animals".

Fortey and Rushton unravel the relationships of the middle Cambrian trilobite *Beishanella* on the basis of specimens from south Wales. The morphology of this genus is very like that of *Bohemilla* (to which the Welsh cranidia had previously been assigned) because, they argue, of strong convergence rather than any true relationship. Stratigraphical evidence is used to supplement critical morphological features to indicate that *Beishanella* belongs within Centropleuridae, members of which are confined to the middle Cambrian, whereas *Bohemilla* is related to Remopleurididae, which appears in the late Cambrian and is familiar from the early Ordovician (Tremadocian), with the first bohemillid being of late Tremadocian age. The similarity of *Beishanella* and *Bohemilla* is indicative of similar life habits, the implication being that the pelagic lifestyle that is generally accepted for *Bohemilla* had already evolved in polymeroid trilobites by mid-Cambrian times.

The nature of phosphatic preservation across the Proterozoic-Cambrian (*c*. 1000 Ma to *c*. 450 Ma) transition is modelled by Brasier and Callow. They conclude that the high quality cellular phosphatic preservation that is known from the Precambrian – for example from the Torridonian and the late Ediacaran Doushantou Formation – is only sporadically present in the Cambrian, and is extremely rare in post-Cambrian phosphates. They also highlight the changing nature of the organisms that become phosphatised. The phosphatised microbiotas of the Doushanto and older deposits show phosphatic preservation of algae and other photic zone flora and fauna. By mid-Cambrian times, only deeper water heterotrophic organisms are typically phosphatised, for example the Orsten arthropods. In post-Cambrian phosphates the most commonly preserved material seem to be processed organic remains and faecal matter. They point to a likely shift of the phosphogenic zone from the shallow photic zone in the Precambrian towards the outer shelf or slope in the later Phanerozoic.

The evolution of the metazoans is inferred to have had a significant effect on the position of the zone of phosphatisation within the water column. In a metazoan-less Neoproterozoic world, phosphogenesis was possible higher in the water column and within the photic zone, so enabling *in situ* phosphatisation of benthic algae and other photic zone organisms. The evolution of pelagic metazoans from Cambrian times allowed expansion of the oxygenated upper water column, forcing the phosphogenic zone downwards and from near-shore to outer shelf environments. By the late Cambrian, the phosphogenic zone may have typically lain at or below the base of the photic zone, this facilitating the phosphatisation of such as the Orsten arthropods. Additionally, from Cambrian times, the expansion of the oxygenated upper sediment layer by bioturbation forced the phosphogenic zone downwards from the surface through the sediment profile. By the time any organic material reached these greater depths it was almost entirely decomposed.

An Orsten-style phosphatically-preserved roundworm from the middle Cambrian of Queensland is investigated by Maas Waloszek, Haug and Müller. Roundworms (= Nemathelminthes *sensu* Ax) include gastrotrichs, kinorhynchs, nematomorphs (horse-hair worms), nematodes and priapulids, as well as loriciferans. The Rotifera and Acanthocephala are also included in traditional classifications, but there is no general consensus of the composition of Nemathelminthes, or its position within the Bilateria. With the exception of their putative sister taxon Gastrotricha, all other Nemathelminthes share a ring shaped nerve mass (circumpharyngeal brain), hence the name Cycloneuralia for this group. The single tiny roundworm specimen from Australia is exquisitely preserved, with detail down to at least 1μm, and is interpreted as representing an immature stage of a free-living cycloneuralian. It allows fine-scale morphological comparisons with extant cycloneuralians, and in particular shows significant similarities to nematomorph larvae. However although it possesses a mixture of characters developed in different cycloneuralian groups, the particular combination shown in this new taxon, *Shergoldana australiensis*, is unknown elsewhere. The full significance of this fossil will be best realised through more wide-ranging future analysis of macroscopic 2D and microscopic 3D preserved Cambrian putative roundworms.

Approximately 30% of the papers in the volume concern Cambrian trilobites, variously from China, the USA, Greenland, Argentina, Antarctica, the UK and Spain, in addition to Australia. Other Cambrian papers address biozonation and correlation in the Great Basin, USA; a faunule from South Australia; linguliformean brachiopods from South China; biogeography and the Cambrian radiation of arachnomorph arthropods; a new mollusc from Oklahoma; reworked late Cambrian and early Ordovician conodonts from the Devonian of central Australia; and a frondose fossil of uncertain affinity from Georgia, USA. Contributions on Ordovician fossils include more trilobites – from China (two papers), from New South Wales and Tasmania, and from Ohio and Kentucky – as well as ostracods from Argentina, and bryozoans from Australia. The Silurian time-scale in Australia, Silurian athyridide brachiopods from New South Wales, and Devonian sponges from northwestern China provide the basis of the papers that complete the memoir.

The price tag represents pretty good value considering the size of the memoir and the number of papers. The production is excellent and the plates are of a uniformly high quality. It should be on the shelf of geological research institutes and university libraries; the abundance of relevant papers could justify the outlay of a personal copy for any dedicated Cambrian researcher. The volume is a fitting tribute to the enthusiasm, energy and very considerable contribution of John Shergold to in particular Cambrian studies, and is a reflection of the camaraderie he engendered and the respect in which he was held by his colleagues and friends.

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British Jurassic Irregular Echinoids

Colin G. Barras. 2006. Palaeontographical Society Monographs 159 (no. 625). 273 pp. + 14 plates. London: The Palaeontographical Society. ISSN 0269-3445. Price £130 plus p+p (paperback).

Contained between the familiar sky-blue covers of the Palaeontographical Society's monograph series is publication number 625 – a comprehensive, well illustrated and clearly written account of the British Jurassic irregular echinoids.

These fossils first came to the attention of the scientific community in the 1670s with the earliest illustrations of a 'polar stone' (now known more prosaically as *Clypeus plotii*) from Oxfordshire. Since that time, an array of species has been described, but the British taxa have been subject to just one monographic treatment, by Wright in the mid to late 1800s. Subsequent work on Jurassic irregular echinoids has concentrated on the detailed morphology of particular groups, or on placing these taxa within a broader phylogenetic framework.

The importance of Jurassic irregular echinoids is in their position on the echinoid phylogenetic tree – at the base of the irregular echinoids. Whilst the vast majority of workers have regarded the irregulars as a single monophyletic group, Mortensen (perhaps the single most influential – and formidable – echinoid taxonomist of his era) believed that the irregulars had two separate origins within the regular echinoids, and it was this minority view that made its way into the *Treatise on Invertebrate Paleontology* in 1966.

The time is undoubtedly ripe for an update of Wright's work, and Barras has delivered that in his thorough yet user-friendly monograph of the British Jurassic irregular echinoids, set within an explicitly phylogenetic framework. In contrast to previous work on the fauna, there is an emphasis on cross-correlation with material from continental Europe.

Thirty-three species in seventeen genera (including two new species and one new genus) are described and illustrated. The photographic plates, in common with all pictures taken by NHM photographers, are first rate. Abundant line drawings clearly illustrate the salient features of test architecture on which taxonomic identifications are based, while biometric comparisons graphically indicate criteria for the splitting or lumping of taxa. A dichotomous key to genera is a very useful addition.

Barras has set his taxonomic work within an explicitly phylogenetic framework. The characters for phylogenetic analysis are well defined – the detailed explanations of character states nicely complement the systematic species descriptions, clarifying the types of features that Barras has used to distinguish taxa. The cladistic analysis of the British Jurassic irregular echinoids confirms the monophyly of the irregular echinoids as a whole, but suggests that many traditionally used family level taxa are paraphyletic. The analysis also indicates that these early irregular echinoids evolved rapidly – within only 35 million years of their origination, nearly all the major orders had already evolved.

All in all, this is an excellent piece of taxonomic work. Barras has done a great job of integrating information from influential but often ignored literature on the morphology of early irregular echinoids as well as from continental taxonomic tracts. The rigorous cladistic analysis lifts this above the level of many taxonomic monographs and guarantees that this will be a well-thumbed work of reference for years to come. It deserves a place on every echinoid worker's bookshelf.

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Extinct Birds of New Zealand

Alan Tennyson and Paul Martinson. 2006. Te Papa Press, Wellington, 180 pp. ISBN 978-0-909010-21-8 (Hardback) £35.00 NZ$65.00.

The story of the fantastic and unique bird fauna of New Zealand and its sad demise at the hands of human invaders and their associated introduced animals has been told in numerous books and television programmes. However, focus always seems to be on the same few avian victims of devastation: the magnificent moas; Haast's eagle; the beautiful Huia; the extremely threatened kiwis; and the thought-to-be-extinct but fortunately rediscovered Takahē. Sometimes one might even get treated to the sad stories of the quick disappearance of the once abundant South Island kōkako – as late as 1967 – or of how the entire population of Lyall's wren (the world's smallest flightless bird) was allegedly exterminated by the singular destructive actions of the lighthouse keeper's cat on Stephens Island.

Yet it is on this oft-repeated subject that New Zealand palaeontologist Alan Tennyson and artist Paul Martinson have produced a new book. My initial impression was that it had all the looks of a coffee-table style volume, with little value to a researcher; wonderful illustrations, but short text probably lacking new information and any reference section. However, I was delighted to find that I was dead wrong on these points, for this is one of those rarely-seen gems of a book which is relevant and useful to both the interested audience and the professional researcher.

The book springs from the scientific review of the pre-human-contact New Zealand avifauna by Holdaway *et al.* (2001), and includes all revisions and additions made of the avifauna up to, and including, 2006. For example, the moa taxonomy includes the revisions prompted by the relatively recent nuclear DNA studies of Bunce *et al.* (2003) and Huynen *et al.* (2003).

After a brief preface introducing the background to the book, the reader is presented with two single-page, black and white, line-drawn maps. One shows New Zealand and the surrounding area, and the other is a more detailed map of New Zealand and the Chatham Islands with place and locality names. Both provide a good, easy to digest overview of the geographical context. The same can be said for two well-presented, easily understandable, double-spread diagrams in the first chapter. One plots the dates of predator arrival at various localities against the extinction dates of individual species; it is a sad but fascinating fact that the (geologically speaking) precise historical dates allow very well supported cause-and-effect extinction scenarios (data often detail the exact year of appearance of specific predators on small isolated islands). The other diagram

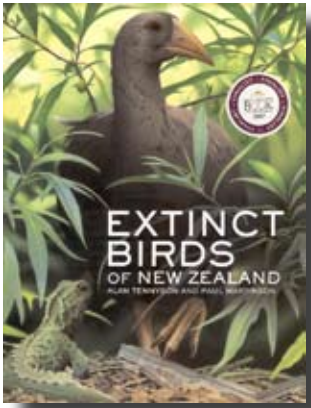
is a histogram-like plot showing which predator was the unequivocal or very likely cause of the extinction of which bird species. Humans, pacific rats (*Rattus exulans*) and cats are shown to be responsible for the largest share of extinctions. As noted, both diagrams are extremely well-presented and almost beg to be used in teaching or a popular presentation.

The first chapter is an overview, which deals mainly with the plight of prehistoric and historic extinctions in New Zealand and continuing threats to the country's wildlife brought on by globalisation-introduced pests. So far 58 species (26%) of the islands' endemic bird population have been eradicated. The authors strongly (almost blinkered) advocate one hypothesis: the devastation of New Zealand's avifauna is solely the result of 'ecologically naïve species' (to borrow the expression of David Quammen [1997]) being exterminated by introduced humans and other alien predators. Alternative suggestions, such as avian malaria, are only briefly mentioned and their potential quickly downplayed. For example, while it is clearly stated that the habitat change wrought by the Polynesian forest clearance was massive (estimates indicate that 90% of New Zealand was covered by forest, of which 20% remains today), this case of massive, destructive habitat change as a causal agent is quickly dismissed. While the authors do make an extremely good case for their hypothesis with plenty of well-supported factual evidence, one is left with the impression that this has been done in order to convey a single, easily-understood point to the general audience and any decision-makers who might happen to read the book. Unfortunately, in order to further this one hypothesis the text in places seems to force some assumptions upon itself. For example, in the species account for the flightless South Island goose (*Cnemiornis calcitrans*), it is stated that bones are "rare in human middens" (p. 42). Nonetheless, human hunting is still promoted as the primary cause for the extinction of this species. This slightly one-dimensional treatment of potential extinction mechanisms is perhaps one of the book's very few weak points.

The core of the book is the species accounts. Each of the 58 extinct species is presented on a double-page spread. One page of well-written text in everyday language summarises what is known of the particular species' appearance, lifestyle, distribution, fossil record and probable cause of extinction. Where possible, distinguishing features of a species are emphasised. For example, for each species of moa, known distinctions (legs, feathering, colour, *etc*.) are described clearly, without going into further details of skeletal anatomy. In addition, where a behavioural or anatomical feature has been inferred, not substantiated directly from what is known of the extinct species, this is clearly stated, together with the basis for the inference (comparable behaviour or plumage in living species *etc*.). Overall, one gets the distinct feeling that if these birds were still alive, this book would make an excellent visual field guide (in a more 'handy' format, of course) when going moa- or wren-spotting in New Zealand. Finally, a line summarises briefly what is known of each species' distribution; time and cause of extinction; weight; meaning of the scientific binomial; number and type of preserved specimens. Facing the page of text is a magnificent and colourful full-page painted reconstruction by artist Paul Martinson of the bird in its natural habitat.

In addition, the description of the first species within each avian order is accompanied by a short text describing the general appearance of members of the order, their lifestyle and their global and local (New Zealand) distribution. The only exception to this format is the moas, who get two pages to themselves.

As each extinct species has its own two-page account, regardless of the amount of information known, the otherwise splendid reconstructions are inevitably based on wide differences in



what is known for each species. At one end of this range one finds the recently-extinct (1964) South Island snipe (*Coenocorypha iredalei*) – known from skins, spirit specimens, eggs, hundreds of fossils and live observations – and the Upland moa (*Megalapteryx didinus*), known from mummified remains, feathers, and hundreds of bones. At the other end of this spectrum is the tiny long-billed wren (*Dendroscansor decurvirostris*), known only from the fossil remains of six specimens, and the enigmatic megapode from Raoul Island, known from a settlers' personal account. The otherwise very democratic 'one bird, one two-page account' approach therefore necessitates that reconstructions range from those supported extremely well by factual observations, to well-informed 'guesstimates'. However, the authors are very careful to point out where the latter is the case, and what the inspiration for their reconstructions stems from.

The nine species of moa are, of course, treated here, along with von Haast's eagle, the Huia and the South Island kokako. The 'democratic treatment' also allows a number of bird species, which are usually overlooked in popularised accounts, to get their 'fair share' of the extinction story. Importantly, many of these reveal equally, if not even more, interesting and relevant facts. One gets to learn that, based on nitrogen isotope analyses, the large, flightless adzebills (*Aptornis* spp.) were meat-eaters; there was a large diversity of anseriforms (18 species, of which eight are now extinct) along with 11 species of extinct rails (many of which were flightless) in New Zealand. News to me was that a 'cousin' of the Takahē existed on North Island; the Moho (*Porphyrio mantelli*) was the largest rail in world, weighing in at 4.1 kg. I also learned the fascinating story of the grey-headed blackbird (*Turdus poliocephalus*) which survived relatively unmolested until the 1940s but was exterminated quickly by ship rats in the 1960s. Finally, the apocryphal tale of how the entire population of Lyall's wren (*Traversia lyalli*) was exterminated by just the lighthouse keeper's cat on Stephens Island is put to rest. In truth pacific rats exterminated it on mainland New Zealand, while there were several cats present on Stephens Island. This is just a handful of the many, interesting, and inevitably dire stories of the habits and extinction of New Zealand's extinct birds contained in the volume.

So far, all of the above makes *Extinct Birds of New Zealand* a terrific volume for the naturalist and a general audience, interested in New Zealand's past and present avifauna, but it's not perhaps terribly relevant to a researcher. However, the sections following the species accounts are what transforms this volume from an extremely well-written, high-quality, popular account to a *de facto* standard reference work. First, there is an exhaustive four-page appendix listing the global institutions where nearly all known specimens of the birds described in the book are held -– an extremely valuable summary for any researcher. This is followed by a one-page glossary, and an exhaustive, 19-page list of notes and references covering each chapter and species account. This allows one to dip straight into the 15-page bibliography, should one need to find the exact scientific references for the original description, plumage colour or historical records of a specific bird.

Extinct Birds of New Zealand is clearly a quality volume (although the price is a reasonable £35.00); high-quality paper; a solid cover and binding that is likely to survive regular use for many years; and a simple and elegant, well thought-out layout. However, the cost of maintaining this streamlined layout comes at a price; nowhere does one find a picture or photo of an actual specimen, be it fossil bone, eggshell or bird skin, although they are mentioned in the text. If needed, one has to refer to relevant literature in the reference section.

In conclusion, I can highly recommend this book to anyone interested in topics as varied as birds living or extinct, Holocene extinctions, or the natural history of New Zealand – whether you approach these with a professional or a personal interest. *Extinct Birds of New Zealand* provides an easy accessible review of the current taxonomic status of the extinct avifauna, and the addition of an exhaustive, easily accessible reference section and bibliography makes it highly relevant to the professional researcher. In fact, the book, and the information contained within, is almost begging to form the basis of a short course or popular lecture on the subject.

Speaking from the viewpoint of a professional science communicator, it was a joy to see the authors explain what is known of each species' diet and lifestyle – and the basis for this – in a flowing, easily read everyday language. They also show this is not just a story about moas, giant eagles, huias and kiwis, but also ducks, wrens and songbirds, each of which is in itself an interesting case study, of extermination in the face of man and his associated domestic animals and pests. In addition, the authors should also be lauded for clearly stating when (and why) a particular appearance, behaviour or diet is based on circumstantial evidence, and why it is still reasonable to make specific assumptions. *Extinct Birds of New Zealand* can also serve as an excellent inspiration for others wanting to present their scientific research in a popular form. The book definitely shows 'how to do it' if you want to satisfy the general audience, as well as the amateur and the professional ornithologist.

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Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body

Neil Shubin. 2008. Allen Lane (Penguin UK), London. 240 pp.
ISBN 978-0713999358 (Hardback) £20.00.

The best compliment I can give Neil Shubin's new book is that it is sorely needed. The market for palaeontology-themed books is crowded, and most dinosaur workers (such as myself) take at least one obligatory foray into the world of popular publishing. But the current market is just like an evolutionary morphospace. Some themes are well-explored: graphics-heavy children's books, dinosaur encyclopaedias, expedition narratives, and textbooks. Other regions are sadly under populated, most notably the absence of books explaining macroevolution – the single guiding principle of our discipline – to a general audience. Especially rare are such tomes written by scientists themselves.

Enter Neil Shubin and his much-lauded new book *Your Inner Fish*. Behind the bizarre, Austin Powers-eque cover (the American version has a much more urbane dust jacket) is a very important piece of work, and a prime example of how a scientist on the front lines of his discipline can make an impact in the broader arena of science education. This book is unlike most titles reviewed in this newsletter. It is not an obscure academic volume intended for specialists, or even a general book intended for an educated lay audience that may already know something about science. *Your Inner Fish* is science at its most basic, and for me, science at its most fun. In a nutshell, Shubin explains the evolutionary history of many parts of the human body, such as our hands, teeth, eyes, and ears, drawing parallels to features inherited from distant ancestors. As I breezed through Shubin's fast-flowing text I couldn't help but think back to my days as a young teenager, when the big questions of evolutionary biology entranced me into pursuing a career in palaeontology. I'm certain this book will do for today's youngsters what Stephen Jay Gould and Peter Ward did for me.

This of course begs the question: why I am reviewing a short popular science book in a newsletter intended for academic and professional palaeontologists? Sure, I would heartedly recommend Shubin's book as a gift for any cock-eyed family and friends that question why we devote such time and energy to our craft. And sure, reading Shubin's book may refresh many of us on the basics of important concepts in evolutionary biology, such as the genetics of limb formation and the development of various organs. However, my primary rationale is simple: many of you who are reading this review are probably involved in teaching. Having just completed six years of undergraduate and graduate-level classwork in evolutionary biology, not to mention four years of sub-par high school instruction in the United States, I can testify to one fact. Neil Shubin's book explains the process and importance of science, especially evolutionary biology, better than any textbook I have ever seen.

In the interest of full disclosure, Neil Shubin was one of my undergraduate professors at the University of Chicago. The best class I have ever taken was a ten-week comparative anatomy

class co-instructed by Shubin and Mike Coates. True to their reputation as top-notch evolutionary biologists, Shubin and Coates effortlessly blended anatomy, fossils, genetics, and development to give us an integrated picture of vertebrate evolution. It was no surprise to see many of Shubin's most popular lectures condensed into this book, such as his discussion of how hangovers result from an imbalance in the semicircular canals of the inner ear. This is exactly the sort of example perfectly tuned for the hopefully-not-too-imbalanced ears of university students.

The one fear I had before reading Shubin's book was whether he could translate this material for an audience more general than third-year medical and anatomy undergraduates. Happily, he has succeeded marvellously, an impressive accomplishment for a fledgling science writer's first book. Shubin's tricks are to avoid complex and convoluted prose, and to ignore difficult-to-pronounce technical names. Thus, for example, the morphology of bones in a vertebrate limb is reduced to a "one bone-two bones-lotsa blobs" pattern. If I have one complaint about *Your Inner Fish*, it is that Shubin is at times too general, to the point where he may come off a bit flippant and even crass. I'm certain this is the only science book I have ever read that uses words like "glop." But, I realize that I have over a half decade of science training behind me. Although sometimes hard to stomach, Shubin's tone is probably well suited for audiences with little science background.

Your Inner Fish has been jockeying for space on the bestseller lists of early 2008, a sure sign that readers have taken notice. But, although destined for a spot on the educated lay reader's shelves, Shubin's book is even better suited for the classroom. From an American perspective, high school and early university biology textbooks are generally a stagnant bunch, little more than lists of facts to be memorized. Supplementing traditional textbooks and lab work with chapters from Shubin's book is sure to enliven the classroom experience, and may actually succeed in teaching students what science is, how science works, and how science is different from other ways of thinking. Although less of a problem in the UK than the US, we all know the tired story of how evolution is coming under increasing attack. For me, the best way to fight this nonsense is with good education. Shubin's narrative is exactly that: an uplifting and easily accessible story of how learning about our evolutionary past helps us understand our own humanity.

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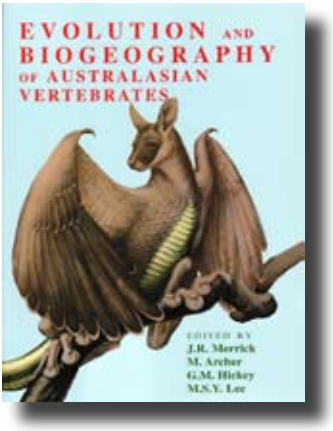
Evolution and Biogeography of Australasian Vertebrates

John R. Merrick, Michael Archer, Georgina M. Hickey and Michael S. Y. Lee (eds). 2006. Ausscipub Pty. Ltd, Oatlands. 942 pp. ISBN 0 9757790 0 1 $AUD 170.00 (paperback), $AUD 230.00 (hardback) from publisher.

There are few summative texts dealing with the history of vertebrate evolution in the Australasian region. Indeed, prior to 2006 only two dated primary reference books were available: *Vertebrate Palaeontology of Australasia* edited by P. Vickers-Rich, J. M. Monaghan, R. F. Baird and T. H. Rich (1991), a revised technical version of an earlier work by P. [Vickers-] Rich and E. M. Thompson (1982); and *Vertebrate Zoogeography and Evolution in Australasia: Animals in Space and Time* edited



by M. Archer and G. Clayton (1984), a student-level textbook and forerunner of the most recent (2006) edition – *Evolution and Biogeography of Australasian Vertebrates* [EBAV] edited by J. R. Merrick, M. Archer, G. M. Hickey and M. S. Y. Lee.

This new volume is substantial, comprising 38 separately authored chapters contributed by researchers from a diverse range of fields including palaeontology, zoology, botany, ecology, systematics, genetics and environmental science. The content of EBAV has been extensively revamped to incorporate the numerous technical and methodological advances that have occurred since its 1984 predecessor, and provide a more detailed synopsis of modern Australasian biodiversity and ecosystems. True to the original format, EBAV retains an informal writing style, which is both consistent and effective given the primary target audience of non-specialist readers, particularly university students. With this in mind, the inclusion of identification keys for selected modern groups (freshwater fish, frogs, skinks, birds and mammals) is useful for teaching laboratory-based zoology; however, as noted in other reviews (*e.g.* Ritchie 2008), their utility for field studies is hampered by the unwieldy size (275 x 210 mm, ~2.5 kg) and non-durable cover of the standard paperback volume. As a professional reference, a major criticism of the text is that it was at least five years out of date at the time of publishing. Knowledge of many key Australasian fossil groups (*e.g.* Mesozoic reptiles, Cenozoic mammals) has progressed considerably since the chapters were initially written. This drawback is certainly not the fault of the authors but rather a product of publication delay, a perennial problem for many technical books and journal articles.

EBAV is divided into seven sections: a preamble (including relevant maps) and 'Background', the latter constituting a prologue of systematics, the geological record, palaeoenvironments, and the development of modern Australasian faunas; a series of five taxonomic headings that examine aspects of the major vertebrate groups from 'Primitive Vertebrates: Fishes' through 'Primitive Tetrapods: Amphibians' and 'Primitive Amniotes: Reptiles' to 'Birds' and 'Mammals'; and finally 'Accelerated Change – the Regional Future', a useful epilogue describing current analytical techniques for assessing biodiversity, faunal management and conservation practice. Each of these sections is well illustrated with black and white photographs, line drawings and diagrams. There are also colour plates episodically distributed, close to relevant chapters.

In terms of content, Chapter 1 from the 'Background' stands out for its succinct review of analytical methods in systematics, and Chapter 3 for its account of aridification in Australia and the significant impact that this has had on the spread of grasslands and the adaptive radiation of vertebrates during the late Cenozoic to Quaternary. The section on fish (chondrichthyans and osteichthyans) includes an overview (Chapter 7) of the current fossil record, which unfortunately falls short when dealing with the rich Mesozoic freshwater and marine faunas from Australia, both summarized in less than half a page (and without illustrations). Much more could also have been said about the globally significant Late Devonian Gogo Formation marine fish assemblage from Western Australia, which is frequently alluded to but never really discussed in depth. In contrast, Chapter 8 provides an excellent précis of the Late Devonian freshwater 'fish kill' site at Canowindra, New South

Wales, with detailed descriptions of the initial discovery, age determination, taphonomy, faunal composition (including line drawings of relevant taxa), palaeoecology and palaeobiogeographical implications. Admittedly, this level of detail is mainly of relevance to the specialist reader; nevertheless, similar chapters on other localities would have been useful as case studies to illustrate the processes involved in interpreting data from fossils and sedimentology.

I enjoyed reading the section on amphibians. The opening Chapter 11 concentrates on Australia's enigmatic early tetrapods and the diverse radiation of temnospondyls in the southern high latitudes of Gondwana during the late Palaeozoic and Mesozoic. Chapter 13 is also particularly informative, outlining current research on the alarming decline of frogs in the Australasian region. The text of this penultimate chapter is especially well organised, explaining what species are in decline and where, the possible causes, and potential strategies for future conservation/management. It therefore makes a valuable reference work for anyone seeking to understand vertebrate extinction in a modern context.

The sections summarizing Australasian reptiles and birds are laid out in a similar format: an introductory chapter reviewing the fossil record; an evolutionary/biogeographical assessment of major extant groups; and identification keys at the end. For birds, this arrangement is complimentary with comprehensive assessments provided for the fossil (Chapter 21) and living Australasian avifauna (Chapter 22) plus an interesting discussion of bird species evolution in isolated island communities (Chapter 23). In contrast, the preceding section on reptiles does not work to best effect. For example, the entire Australasian Mesozoic radiation – including everything from rare therapsids, procolophonids, Triassic lepidosaurs and archosaurs, unusual high-latitude dinosaurs, and the incredibly diverse array of mainly Cretaceous marine reptiles – are all crammed into the single Chapter 15 and thus suffer from a critical loss of information. This is, in part, compensated by the comparatively detailed examinations given to Australasian freshwater turtles (Chapter 16), snakes (Chapter 17), crocodiles (Chapter 18) and lizards (Chapter 19). Sadly however, little attention is paid to marine turtles despite six out of the seven presently living species being found in Australasian waters and the Australian fossil record including important basal forms from the Early Cretaceous; the latter are only listed in Table 1 of Chapter 15 and discussed in four lines of text in Chapter 16.

The bulk of EBAV is devoted to mammals, with opening treatises on monotremes (Chapter 26) and marsupial origins (Chapter 27) providing informative introductions to these prominent Australasian lineages. There are also extensive summations of the mainly Northern Hemisphere record of Mesozoic mammals (Chapter 25) and the evolution of primates (Chapter 34), both incorporating a brief discussion of the Australasian record at the end. Although these latter topics are applicable to the textbook format, they are strangely out of step with the previous sections on fish, amphibians, reptiles and birds, all of which strictly adhere to their Australasian focal theme.

The remaining mammal chapters comprise reports on specific clades: kangaroos (Chapter 29) including an appraisal of their fossil record and controversial in-group relationships; the evolution and biogeography of Australasian bats (Chapter 30); rodents (Chapter 31), featuring a valuable review of the soft tissue, genetic, chromosomal and immunological data relevant to phylogenetic analyses; a short but interesting look at Australia's introduced wild dog, the dingo (Chapter 32); and a brief overview of Australasian cetaceans (Chapter 33). All of the other Australasian marsupials are

dealt with in a single lengthy digest on fossils (Chapter 28); this is unfortunately limiting given the huge amount of genetic and soft tissue information that could have been added for these broadly divergent groups.

The last section of EBAV is certainly one of the best. It discusses modern techniques for determining species biodiversity and how this knowledge can be applied to future conservation. Such information is timely, especially given the catastrophic rates of extinction now affecting the Australasian vertebrate biota. The concluding chapters are also a boon to the book's utility, providing readers with an entry-level understanding of the latest analytical methodologies available to evolutionary/biogeographical research in palaeontology, zoology and ecology.

So, taking into account its various strengths and weaknesses would I recommend this book?

Yes; in the absence of competing texts, EBAV provides a relatively recent large-scale overview of the vertebrate record in Australasia. More importantly, it is an accessible reference for students and non-specialist readers interested in the palaeontology and modern biogeography of Australasia's unique vertebrate fauna. Moreover, the numerous maps and tables are useful for an international audience otherwise unfamiliar with Australasian geography and faunal distributions. Finally, priced at $AUD 170 (from publisher **http://www.auscipub.com/**) EBAV is definitely affordable, and therefore makes an economical prospective addition to the libraries of professional researchers and interested laymen alike.

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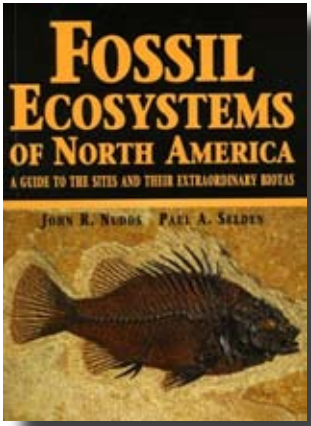
Fossil Ecosystems of North America: a Guide to the Sites and their Extraordinary Biotas

John R. Nudds and Paul A. Selden. 2007. Manson Publishing, London, ISBN: 978-1-84076-088-0, £24.95 (paperback).

Although Fossil Lagerstätten, or evolutionary biotas as they are sometimes called, became a '*cause célèbre*' in the 1980s, the recognition that they are more than just palaeontological curiosities has fuelled sustained analysis since then. A meagre list of famous localities in the 80s: the Burgess Shale, Mazon Creek, Solnhofen, Messel, now runs to many pages. Over the past 30 years or so new

and highly productive fossil localities have been discovered around the globe (the Early Cretaceous Crato and Yixian formations of Brazil and China respectively, to name but two). At the same time historic, obscure and oft forgotten localities have been reappraised to reveal a wealth of new taxa, many exceptionally well preserved and of great palaeobiological significance. Who can doubt the importance of the Lower Cambrian Chengjiang Formation with its pre Burgess Shale chordates and enigmatic vetulicolians or the Late Proterozoic Weng'an Fauna of the Doushantou Formation with microscopic phosphatised embryos. Unfortunately, documenting these wonderful palaeontological resources is extremely time consuming, and few workers have the time (or the RAE incentive) to write synthetic treatments that render such localities accessible to a wider, say undergraduate, audience.



Nudds' and Selden's latest offering, *Fossil Ecosystems of North America*, will be a welcome treat for North American students of palaeobiology. This inexpensive little volume introduces some of the World's most spectacular fossil deposits, and spans a time interval from 2.5 giga years ago (Gunflint Chert) to just 40 kilo years ago (Rancho La Brea). It covers a range of fossil Lagerstätten, both Konservat and Konsentrat, and – because of the temporal scope – a range of organisms from the earliest microbes to dinosaurs, the earliest arthropods to sabre tooth cats, and a host of invertebrates both in and out of amber. Fourteen exceptional sites are covered, in individual sections, each of *circa* 20 pages. Each section has a brief introduction placing the site in its geographical and geological context, with sections on the stratigraphy, biota and palaeoenvironmental setting. The text is fluid and enjoyable, and most, although not all, technical terms are explained. References are kept to a minimum, but the essential texts are listed. Colour images of the sites, the rocks and the fossils are used throughout, and this in itself makes the book astonishingly good value for money.

Overall, *Fossil Ecosystems of North America* is an excellent introduction for undergraduates to some of the most fossiliferous and palaeontologcically important sites in the USA, Canada and the Dominican Republic, but sadly not Mexico. The latter is an unfortunate oversight as Mexico has been in North America for quite a while now, and it has many remarkable fossil Lagerstätten, highly distinct from those of its northern neighbours. Tepexi de Rodrigues, near Puebla, for example is one of the few Mesozoic Tethyan-type fossiliferous plattenkalks to be found in North America and would have added to the diversity of sites covered by this book. This is a minor criticism however, and despite its North American scope, there is little reason for palaeontologists everywhere not to have a copy of this inexpensive, and delightful, book on their shelf.

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Deadline for copy for Issue No. 69 is 6th October 2008.

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