The Palaeontology Newsletter

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Reminder: The deadline for copy for Issue no 53 is 27th June 2003

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

Association Business

Annual Report for 2002

Nature of the Association. The Palaeontological Association is a Charity registered in England, Charity Number 276369. Its Governing Instrument is the Constitution adopted on 27 February 1957, amended on subsequent occasions as recorded in the Council Minutes. Trustees (Council Members) are elected by vote of the Membership at the Annual General Meeting. The contact address of the Association is c/o The Executive Officer, Dr T.J. Palmer, Institute of Geography and Earth Sciences, University of Wales, Aberystwyth, SY23 3DB, Wales, UK.

Membership & subscriptions. Individual membership totalled 1,218 on 31 December 2002, an overall increase of 82 over the 2001 figure. There were 751 Ordinary Members, an increase of 12; 132 Retired Members, an increase of 2; and 335 Student Members, an increase of 68. There were 164 Institutional Members in 2002, a decrease of 6 from last year. Total Individual and Institutional subscriptions to *Palaeontology* through Blackwell's agency numbered 395, a decrease of 1. Subscriptions to *Special Papers in Palaeontology* numbered 120 individuals, a decrease of 20 on last year, and 127 institutions, an increase of 20. Sales to individuals and institutions through the Executive Officer of current and back numbers of *Special Papers in Palaeontology* yielded £11,823.

Income (after costs) from sales of *Field Guides to Fossils* amounted to £13,289. Field Guides sold as follows: *Fossil Plants of the London Clay* – 61; *Fossils of the Chalk (2nd edition)* – 195; *Zechstein Reef Fossils and their Palaeoecology* 49; *Fossils of the Oxford Clay* – 108; *Fossils of the Santana and Crato Formations of North East Brazil* – 87; *Plant Fossils of the British Coal Measures* – 77; *Fossils of the Upper Ordovician* – 71; *The Jurassic Flora of Yorkshire* – 109; *Fossils of the Rhaetian Penarth Group* – 87; *Dinosaurs of the Isle of Wight* – 367.

Finance. Production of *Palaeontology* and *Special Papers in Palaeontology* is managed by Blackwell, who also make sales and manage distribution on behalf of the Association. In addition to the fee that they take directly from the subscribers, the Association paid them a further fee of £4,629. The Association gratefully acknowledges a bequest to the Sylvester-Bradley Fund of £1,000 from the will of Mrs Joan Sylvester-Bradley, and donations from Members to the Sylvester-Bradley Fund, which amounted to £233.

Grants from general funds to external organisations, for the support of palaeontological projects, totalled £10,139.

Publications. Volume **45** of *Palaeontology*, comprising 1,235 pages in total, was published and distributed at a cost of £90,543. *Special Papers in Palaeontology* **67**, *Studies in Palaeozoic palaeontology and biostratigraphy in honour of Charles Hepworth Holland* (ed. by P.N. Wyse Jackson, M.A. Parkes, and R.A. Wood; 260pp) was published at a cost of £8,740, and *Special Papers in Palaeontology* **68**, *Life and environments in Purbeck times* (ed. by A.R. Milner and D.J. Batten; 268pp) was published at a cost of £8,732.

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*.

Meetings. Four meetings were held in 2002, and the Association extends its thanks to the organisers and host institutions of these meetings.

a. Lyell Meeting. "Approaches to Reconstructing Phylogeny", was convened on behalf of the Association by Prof. Gale (University of Greenwich) and Dr P.C.J. Donoghue (Lapworth Museum, University of Birmingham).

b. Forty-fifth Annual General Meeting and Address. 8th May. The address, entitled "Life and work of S.S. Buckmann (1860-1929) Geobiochronologist and the problems of assessing the work of past palaeontologists," was given by Prof. Hugh Torrens and attended by 40 people. The meeting was held at the University of Birmingham and organised by Dr M.P. Smith and Dr T.J. Palmer.

c. Progressive Palaeontology. 12th–13th June. The annual open meeting for presentations by research students was organised by David Gelsthorpe at the University of Leicester.

d. 45th Annual Meeting. 15th–18th December. The Annual Meeting was held in the Department of Earth Sciences, University of Cambridge. Dr Nick Butterfield, Dr Jenny Clack and Dr Rachel Wood with much local support organised the meeting. President's Awards were made to Jodie Howe (University of Leeds) and Liam Herringshaw (University of Birmingham). Council Poster Prizes were presented to Nicole Fraser (University of Southern California, Los Angeles) and Marc Jones (University College London). On the final day a field trip was undertaken to examine the Upper Jurassic section at Upware. The meeting was attended by 330 delegates.

Awards. Sylvester-Bradley Awards were made to David Allen, Colin Barras, Simon Braddy, John Cunningham, Heather Jamniczky, Kathy Keefe, Hannah O'Regan, James Renshaw, Sally Reynolds, Blair Steel, Sebastian Steyer, Mikhail Surkov, Oive Tinn, Lauren Tucker, David Waterhouse and James Wheeley. Mary Anning Awards, to a person not employed in palaeontology who had made an outstanding contribution, were made to Fred Hotchkiss for his work on echinoderms and Michael J. Newman for his work on fossil fish. Hodson Fund awards, for palaeontologists under the age of 35 who have made an outstanding achievement in contributing to the science through a portfolio of original published research, were awarded to Dr Graham Budd and Dr Matthew Wills. The Lapworth Medal, for a person who has made a significant contribution to the science by means of a substantial body of research, was awarded to Sir Alwyn Williams for his outstanding work on brachiopods.

Council. The following members were elected to serve on Council at the AGM on 8th May 2002: Prof. D.E.G. Briggs (President), Prof. D.A.T. Harper (Vice President), Prof. S K. Donovan (editor), Dr P.J. Orr (editor), Dr M.A. Purnell (Website Officer), Dr P. Manning (Publicity), Dr Graham Budd (Newsletter Reporter), Dr Jason Hilton (Ordinary) and Dr Maggie Cusack (Ordinary). Dr Thomas Servais, Prof. E.N.K. Clarkson (editor) and Dr D. Polly (editor) would stand as co-opted members for 2002-3.

At the AGM on 8th May 2002 the following members stepped down from Council: Prof. Paul, Dr Barker, Dr Wood and Dr Pearson.

Dr T.J. Palmer continued to serve as the Executive Officer of the Association, and Prof. D.J. Batten (University of Wales, Aberystwyth) as the Editor-in-Chief.

Council is indebted to the Natural History Museum, the Lapworth Museum University of Birmingham, University of Leicester and the University of Cambridge for providing meeting venues through the year.

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.

Reserves. The Association holds reserves of £368,597 (2001: £381,883) 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 and publications to be produced. 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.

Council Activities. It was with sad regret that the Association noted the passing of Mrs Joan Sylvester-Bradley, Prof. Frank Hodson and Prof. Michael House. All had made substantial contributions to the activities of the Association over many years. The Association continues to improve its administration with further improvements to the Newsletter and the implementation of secure online membership renewal and sales. Following declining attendances at the Annual General Meeting, Council has agreed that the award of the Hodson Fund, Mary Anning Award and Lapworth Medal be moved to the Annual Meeting. From 2003 the Annual Address will also take place at the Annual Meeting. It is hoped these changes will make these events more accessible to the wider membership and increase the profile of the Association's major awards. The Association sponsored the International Trilobite Symposium, Eighth European Conodont Symposium, the British Association Symposium "Sex, violence and death in the history of life," and a symposium on the "Environmental and Biological impact of the end Ordovician glaciation" at the EGS-AGU-EUG Joint Assembly. The Association continues as a Tier 1 sponsor to *Palaeontologica Electronica* and has rejoined the International Palaeontological Association. The Association is also generating more publicity for palaeontology with major press initiatives and a continued high profile on the television. A grant in aid was provided to excavate a giant pachycormid fish from the London Clay. A second edition of the "*Fossils of the Chalk*" was printed within the year. The Sylvester-Bradley Fund continues to attract a large number of quality applications and 16 awards were made this year. Council awards an undergraduate prize to each university department in which palaeontology is taught at a post-1st year level. Five grants of £100 each were also made to overseas postgraduates attending and presenting at the Annual Meeting. The Executive Officer represented the Association at the Geologists' Association's 'Earth Alert' conference in Scarborough, and at the Dudley Rock and Fossil Fair.

Forthcoming plans. In 2003, a similar programme of meetings and publications will be carried out as in 2002, including sponsorship of the Lyell Meeting. Council will continue to make substantial donations, from both Designated and General funds, to permit individuals to carry out research into palaeontological subjects and to disseminate their findings in print and at conferences. The Association will co-sponsor the Systematics Association Biennial Meeting in Dublin. Electronic versions of early volumes of *Palaeontology* will be made available on the Association Web site. The Association will publish the joint venture book, "*Telling the Evolutionary Time: Molecular clocks and the fossil record*" with the Systematics Association. Forthcoming books include the "*Fossils of the type Maastrichtian*" by Prof. S. Donovan. The Annual Meeting has continued to develop as one of the major international palaeontological meetings. With increasing numbers of talks and posters being submitted, resulting in pressures on time and meeting facilities, Council will produce a new set of guidelines for the meeting organisers. The Association is investigating opportunities to sponsor an annual palaeontological symposium at the British Association for the Advancement of Science meeting.

Nominations for election to Council 2003-2004

Vice-President

Dr Mark A. Purnell

Proposed: Dr H.A. Armstrong

Seconded: Prof. S.K. Donovan

Editor

Dr Per Ahlberg

Proposed: Prof. D.J. Batten

Seconded: Dr C.H. Wellman

Dr Jason Hilton will become Web Officer, co-opted members Dr L.I. Anderson, Prof. E.N.K. Clarkson and Dr P.D. Polly will become editors.

Awards and Prizes

Nominations are now being sought for the Hodson Fund and Mary Anning Award.

Hodson Fund

The award is conferred on a palaeontologist under the age of 35 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 comprises a fund of £1,000, and is presented at the Annual Dinner.

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.

Honorary Life Membership

This award is conferred on members who Council deems to have been significant benefactors and/or supporters of the Association. Recipients will receive free membership of the Association. Nominations will be discussed at the December meeting of Council and announced at the Annual General Meeting.

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369

STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2002

			General Funds	Designated Funds	TOTAL FUNDS	TOTAL 2001
			£	£	£	£
INCOMING RESOURCES						
Subscriptions			65,014	0	65,014	60,037
Sales:	*Palaeontology*	118,336				
	Special Papers	11,097				
	Offprints	5,347				
	Field Guides	13,289				
	Postage & Packing	1,224				
Total Sales			149,293	0	149,293	135,035
Investment Income & Interest			12,447	3,155	15,602	18,632
Donations			1,501	2,083	3,584	938
Sundry Income			1,784	0	1,784	1,206
	Total		230,039	5,238	235,277	215,848
RESOURCES EXPENDED						
Public-	*Palaeontology*	63,888				
ations:	*Special Papers*	17,472				
	Offprints	4,318				
	Field Guides	6,711				
	Newsletters	12,400				
	Carriage & Storage	4,149				
	Management	26,964				
Total Publications			135,902	0	135,902	128,351
Scientific Meetings & Costs			2,932	0	2,932	9,819
Grants			7,297	13,011	20,308	17,551
Total Charitable Expenditure			146,131	13,011	159,142	155,721
Marketing & Publicity			3,252	0	3,252	2,453
Administrative Expenditure			36,159	0	36,159	33,855
	Total		185,542	13,011	198,553	192,029
NET INCOMING RESOURCES			44,497	-7,773	36,724	23,819
INVESTMENT GAINS						
Realised Gain		-2,546				
Unrealised Gain		-55,187				
			-57,733	0	-57,733	-60,543
NET MOVEMENT IN FUNDS			-13,236	-7,773	-21,009	-36,724
BROUGHT FORWARD			381,833	93,176	475,009	511,733
CARRIED FORWARD			368,597	85,403	454,000	475,009

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369

DESIGNATED FUNDS

STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2002

	Sylvester Bradley	Jones-Fenleigh	Hodson	TOTAL 2002	TOTAL 2001
Donations	1,233	850	0	2,083	938
Interest Received	1,957	474	724	3,155	4,669
Total Incoming Resources	3,190	1,324	724	5,238	5,607
Grants Made	11,011	0	2,000	13,011	10,207
Net Incoming Resources before Transfers	-7,821	1,324	-1,276	-7,773	-4,600
Transfer In	0	0	0	0	0
Net Incoming Resources	-7,821	1,324	-1,276	-7,773	-4,600
Brought Forward	57,787	13,994	21,395	93,176	97,776
Carried Forward	49,966	15,318	20,119	85,403	93,176

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369

BALANCE SHEET AS AT 31st DECEMBER 2002

2001 £				2002 £
	INVESTMENTS			
313,398	At Market Valuation			245,380
	CURRENT ASSETS			
170,523	Cash at Banks	191,175		
17,140	Field Guide Stocks at Valuation	22,842		
6,606	Sundry Debtors	31,235		
194,269	Total		245,252	
	CURRENT LIABILITIES			
26,895	Subscriptions in Advance	17,730		
5,902	Sundry Creditors	18,902		
32,797	Total		36,632	
161,472	NET CURRENT ASSETS			208,620
475,009	TOTAL			454,000
	Represented by:			
381,833	GENERAL FUNDS			368,597
	DESIGNATED FUNDS			
57,788	Sylvester Bradley Fund		49,966	
13,994	Jones-Fenleigh Fund		15,318	
21,394	Hodson Fund		20,119	
93,176				85,403
475,009	TOTAL			454,000

These financial statements were approved by the Board of Trustees on February 5th 2003.

D.E.G. Briggs **J.M. Hancock** **H.A. Armstrong**

Notes to the Financial Statements for the year ended 31st December 2002

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 published in October 2000 and include the results of all the charity's operations, all of which are continuing.

The effect of events relating to the year ended 31st December 2002 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 representation of the state of affairs at 31st December 2002 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.

1.3.1. Income

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.

1.3.2. 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 are those incurred in connection with the administration of the charity and compliance with constitutional and statutory requirements.

1.4. 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 2002	Total 2001
Publications	19,205	116,697	135,902	128,351
Scientific Meetings & Costs		2,932	2,932	9,819
Grants		20,308	20,308	17,551
Marketing & Publicity		3,252	3,252	2,453
Administration	19,205	16,954	36,159	33,855
	38,410	160,143	198,553	192,029

3. Staff Costs

	Salary	National Insurance	Pension Contributions	Total 2002	Total 2001
Publications – 1 employee (2001 – 1)	15,582	1,286	2,337	19,205	17,124
Administration – 1 employee (2001 – 1)	15,582	1,286	2,337	19,205	16,833
	31,164	2,572	4,674	38,410	33,957

4. Trustees Remuneration and Expenses

Members of Council neither received nor waived any emoluments during the year (2001: nil)

The total of travelling expenses reimbursed to 24 Members of Council amounted to £3,800 (2001: £4,102)

5. Costs of Independent Examiner

	2002	2001
Examination of the accounts	250	250
Accountancy and payroll services	950	950
	1,200	1,200

6. Stocks

Stocks of Field Guides have been included at the lower of cost or net realisable value.

7. Debtors – All Receivable within One Year

	2002	2001
Accrued income	31,235	6,606

8. Creditors – Falling Due within One Year

	2002	2001
Social Security Costs	3,022	2,583
Accrued Expenditure	15,880	3,319
	18,902	5,902

Independent Examiner's Report to the Trustees of the Palaeontological Association (Reg. Charity No 276369)

I report on the accounts of the Palaeontological Association for the year ended 31 December 2002, which are set out in the preceding pages.

Respective responsibilities of trustees and examiner

As the charity's trustees you are responsible for the preparation of the accounts; you consider that the audit requirement of section 43 (2) of the Charities Act 1993 does not apply. It is my responsibility to state on the basis of procedures specified in the General Directions given by the Charity Commissioners under section 43 (7) (b) of the Act, whether particular matters have come to my attention.

Basis of independent examiner's report

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 you as Trustees concerning any 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 view given by 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 requirements: (i) to keep accounting records in accordance with section 41 of the Act; and (ii) to prepare accounts which accord with the accounting records and to comply with the accounting requirements of the Act; have not been met; or
2. to which, in my opinion, attention should be drawn in order to enable a proper understanding of the accounts to be reached.

G.R. Powell B.Sc., F.C.A.

Nether House, Great Bowden, Market Harborough, Leicestershire.

13 February 2003

Nominal	Holding	Cost (bought pre 2002)	Value 31/12/01	Proceeds (sold in 2002)	Cost (bought in 2002)	Gain realised during 2002	Value 12/31/02	Gain unrealised during 2002	Income in 2002	1st Div 02	2nd Div 02	3rd Div 02	4th Div 02	Amount	Holding
£19,000	6 1/4% Treasury 2010	£17,580.14	£20,671.00				£21,547.00	£876.00	£1,187.50	£593.75	£593.75			£19,000	6 1/4% Treasury 2010
£11,772.70	Treasury 5% Stock 07/06/2004	£11,669.00	£11,860.00				£12,032.00	£172.00	£588.64	£294.32	£294.32			£11,772.70	Treasury 5% Stock 07/06/2004
£12,750	Treasury 2% I/L Stock 2006	£29,979.85	£30,837.00				£32,717.00	£1,880.00	£636.23	£318.75	£317.48			£12,750	Treasury 2% I/L Stock 2006
	COIF Charities Fixed Interest Fund	£25,000.00	£24,058.84				£24,650.22	£591.38	£1,586.60	£396.65	£396.65	£396.65	£396.65	£18,029.71	COIF Charities Fixed Interest Fund
2,800	Shell Transport & Trading Ord 25p shares	£4,671.00	£13,216.00				£11,452.00	-£1,764.00	£417.20	£250.60	£166.60			2,800	Shell Transport & Trading Ord 25p shares
8,000	Legal and General Ordinary 25p shares	£2,965.00	£12,640.00				£7,680.16	-£4,959.84	£410.40	£276.80	£133.60			8,000	Legal and General Ordinary 25p shares
2,080	Legal and General Ordinary 25p shares				£1,248.00		£1,996.84	£748.84						2,080	Legal and General Ordinary 25p shares
1,200	Electrocomponents Ordinary 10p shares	£2,817.00	£6,432.00				£3,444.00	-£2,988.00	£190.80	£58.80	£132.00			1,200	Electrocomponents Ordinary 10p shares
3,500	Vodaphone Group Ord $ 0.10 shares	£1,721.00	£6,291.00	£3,640.26		-£2,650.74			£25.28	£25.28				3,500	Vodaphone Group Ord $ 0.10 shares
1,000	Lloyds TSB Ordinary 25p shares	£7,952.00	£7,460.00				£4,460.00	-£3,000.00	£342.00	£235.00	£107.00			1,000	Lloyds TSB Ordinary 25p shares
1,428	Unilever Ordinary 1.4p shares	£7,751.00	£8,054.00				£8,439.00	£385.00	£215.63	£141.23	£74.40			1,428	Unilever Ordinary 1.4p shares
1,055	Glaxo Smithkline Ordinary 25p shares	£16,608.00	£18,178.00				£12,576.00	-£5,602.00	£411.45	£94.95	£126.60	£94.95	£94.95	1,055	Glaxo Smithkline Ordinary 25p shares
2,600	Hays Ordinary 1p shares	£6,048.00	£5,441.00				£2,412.00	-£3,029.00	£121.68	£39.52	£82.16			2,600	Hays Ordinary 1p shares
875	Cable and Wireless Ordinary 25p shares	£5,862.00	£2,892.00				£392.00	-£2,500.00	£144.39	£113.76	£30.63			875	Cable and Wireless Ordinary 25p shares
780	BT Group Ordinary 5p shares	£4,787.00	£1,973.00				£1,521.00	-£452.00	£15.60		£15.60			780	British Telecom Ordinary 25p shares
780	MMO2 0.1p Ordinary shares	£162.00	£675.00				£345.00	-£330.00						780	MMO2 0.1p Ordinary shares
1,050	Powergen Ordinary 50p shares	£9,426.00	£7,928.00	£8,032.50		£104.50			£289.80	£96.60	£96.60	£96.60		1,050	Powergen Ordinary 50p shares
460	Pearson Ordinary 25p shares	£8,069.00	£3,639.00				£2,643.00	-£996.00	£104.42	£62.56	£41.86			460	Pearson Ordinary 25p shares
4,500	BAE Systems 7 3/4%(N) 25p CCRP shares	£4,155.00	£7,380.00				£4,871.00	-£2,509.00	£348.76	£174.38	£174.38			4,500	BAE Systems 7 3/4%(N) 25p CCRP shares
5,720	M & G Charifund Units	£4,073.00	£57,414.00				£48,585.00	-£8,829.00	£2,889.55	£368.90	£790.50	£650.85	£1,079.30	5,720	M & G Charifund Units
1,775	SocGen Technology Units	£7,619.13	£2,927.00				£1,503.00	-£1,424.00						1,775	SocGen Technology Units
1,450	Gartmore European Select Opps Fund	£8,006.31	£6,753.00				£5,200.00	-£1,553.00						1,450	Gartmore European Select Opps Fund
690	Baring European Growth Trust	£6,097.61	£3,913.00				£2,769.00	-£1,144.00	£6.89	£6.89				690	Baring Europan Growth Trust
5,000	Credit Suisse A UK Transatlantic Fund	£8,197.00	£8,134.00				£5,530.00	-£2,604.00						5,000	Credit Suisse A UK Transatlantic Fund
15,000	Fleming Worldwide Zero Div Pref 25p shares	£9,914.95	£10,275.00				£9,713.00	-£562.00						15,000	Fleming Worldwide Zero Div Pref 25P shares
9,500	Inv Trust of Inv Trust Zero Div Pref shares	£9,936.46	£5,178.00				£71.00	-£5,107.00						9,500	Inv Trust of Inv Trust Zero Div Pref shares
9,500	Europ Growth & Inc Trust Zero Div Pref 10p shares	£10,104.70	£5,273.00				£879.00	-£4,394.00						9,500	Europ Growth & Inc Trust Zero Div Pref 10P shares
42,500	M & G Equity Inv Trust Cap 1p shares	£9,579.73	£6,056.00				£4,675.00	-£1,381.00						42,500	M & G Equity Inv Trust Cap 1P shares
8,250	Martin Currie I & G Cap 25p shares	£9,861.82	£4,331.00				£949.00	-£3,382.00						8,250	Martin Currie I & G Cap 25P shares
7,000	Special Utilities Cap 1p shares	£9,644.24	£9,030.00				£8,750.00	-£280.00						7,000	Special Utilities Cap 1P shares
3,000	Themis FTSE all-SM 25p shares	£5,004.22	£4,628.00				£3,578.00	-£1,050.00	£120.00	£67.50	£52.50			3,000	Themis FTSE all-SM 25p shares
	Total	£265,262.16	£313,537.84	£11,672.76	£1,248.00	-£2,546.24	£245,380.22	-£55,186.62	£10,052.82						
	Transitional Tax Relief on equity income								£297.26						
	Total Investment Income								£10,350.08						
	Interest Receivable								£5,252.16						
	Total Investment Income & Interest								£15,602.24						

Annual General Meeting

Wednesday, 7th May 2003
Board Room, Natural History Museum

Formal business of the Association will start at 2pm. Members are reminded that the Annual address and presentation of awards have been moved to the Annual Christmas Meeting.

Agenda

1. Apologies for absence
2. Annual Report for 2002
3. Accounts and Balance Sheet for 2002
4. Election of Council and vote of thanks to retiring members
5. Changes to Article 3 of the Constitution
   Proposed: Dr Armstrong; Seconded: Dr Palmer

   Now to read:

   Membership: There shall be Ordinary Members, Institutional Members and Student Members. There shall be Retired Members, who shall be Ordinary Members of not less than fifteen years standing and over the age of 60, who are not engaged in full time employment. The annual subscription for Retired Members shall be one half of that for Ordinary Members. Each subscriber shall be considered a member of the Association, but Institutional Members shall not be eligible to take part in the government of the Association. In addition there shall be Honorary Life Membership conferred on members who Council deems to have been significant benefactors and/or supporters of the Association. Recipients will receive free membership of the Association.
6. Sylvester-Bradley Awards

AGM MINUTES 2002

Minutes of the Annual General Meeting held on 8th May 2002 at the University of Birmingham.

1. **Apologies for absence**: Dr M.J. Barker, Prof. D.E.G. Briggs, Dr J.A. Clack, Prof. S.K. Donovan, Dr S. Evans, Dr S. Gabbott, Prof. D.A.T. Harper, Dr E. Harper, Dr A.L.A. Johnson, Dr D.K. Loydell, Dr C. Milsom, Dr P.J. Orr, Dr R.A. Wood.
2. **Annual Report for 2001.** Agreed, proposed by Dr Owen and seconded by Dr Cope.
3. **Accounts and Balance Sheet for 2001**. Agreed, proposed by Dr Cope and seconded by Dr Pearson.
4. **Election of Council and vote of thanks to retiring members**

i. Prof. Paul extended a vote of thanks to the retiring members of Council, Dr Barker, Dr Wood and Dr Pearson. Dr Smith proposed a vote of thanks to Prof. Paul.

ii. It was noted the following members of Council would be moving to new posts: Prof. S.K. Donovan (to editor), Prof. D.A.T. Harper (to Vice President), Dr P.J. Orr (to editor) and Dr M.A. Purnell (Web Officer).

iii. New members of Council include Prof. Derek E.G. Briggs (President), Dr P. Manning (Publicity), Dr Graham Budd (Newsletter Reporter), Dr Jason Hilton (Ordinary) and Dr Maggie Cusack (Ordinary). Dr Thomas Servais, Prof. E.N.K. Clarkson and Dr Polly would stand as co-opted members for 2002-3.

5. **Sylvester-Bradley Awards:** Prof. Paul announced 16 grants had been awarded, to David Allen, Colin Barras, Simon Braddy, John Cunningham, Heather Jamniczky, Kathy Keefe, Hannah O'Regan, James Renshaw, Sally Reynolds, Blair Steel, Sebastian Steyer, Mikhail Surkov, Oive Tinn, Lauren Tucker, David Waterhouse and James Wheeley.
6. **Mary Anning Award:** To Dr Fred Hotchkiss for his work and many publications on echinoderms.
7. **Hodson Fund:** Awarded to Dr Graham Budd for his work on arthropods.
8. **Annual Address.** Presented by Prof. Torrens on the "Life and work of S.S. Buckmann (1860–1929) Geobiochronologist and the problems of assessing the work of past palaeontologists."

Howard A. Armstrong
Secretary
<secretary@palass.org>

news

The highest award of the Association, the Lapworth Medal, was awarded to Professor Sir Alwyn Williams FRS, FRSE by The President of the Association, Professor Derek E.G. Briggs, at the 2002 Annual Meeting

The President's citation: Alwyn Williams has been described as one of the great geologists of the second half of the 20th century. His name is associated with two palaeontological fundamentals: brachiopods and the Ordovician, but he always has been a major innovator. He mapped large areas of Palaeozoic rocks in SW Scotland, Wales and the west of Ireland. He introduced and applied biometric methods to the taxonomy of brachiopods (using a hand-held calculator even in the 1950s—a black cylinder with a rotating handle on the top!). He combined statistical methods and phylogeny to produce a landmark series of palaeogeographic maps for the Ordovician Period. He pioneered the investigation of brachiopod shell structure and its application to their classification using the scanning electron microscope, and he has been the major player in the production of the brachiopod volumes of the *Treatise on Invertebrate Paleontology*.

After completing his PhD at the University of Wales (Aberystwyth) on the classic Llandeilo district, Alwyn Williams spent two years (1948–50) in Washington as a Harkness Fellow. This was the start of a long term friendship with G. Arthur Cooper, doyen of N. American brachiopod workers, and an opportunity to study the remarkable collections in the Smithsonian. Before going to Washington Alwyn had already started work on the Ordovician rocks of the Girvan district. The brachiopods there revealed remarkable similarities to the faunas that Cooper was describing from the Appalachians (a decade before plate tectonics).

In 1950 Alwyn moved to Glasgow, as Lecturer in Geology, where he regarded teaching as no less important than research. A former student reported that his laboratory classes presented students with their first opportunity to handle fossils rather than peer at them through glass cases! Four years later, in his early thirties, Alwyn was appointed Professor of Geology at Queen's University of Belfast, where he spent the next 20 years. There he published ground-breaking papers on brachiopod taxonomy and phylogeny, growth and shell structure (with the establishment of an SEM facility), and on palaeobiogeography and stratigraphy, including the 1972 Geological Society Special Report 3 on the *Correlation of Ordovician rocks in the British Isles*. Alwyn's enthusiasm for teaching was legendary; long Easter Vacation days in the field at Girvan, followed by evening seminars timed to end for last orders in the nearest bar. In 1967 he was

President of the Association, Professor Derek Briggs (centre) with Lapworth medal awardee Professor Sir Alwyn Williams and his wife

elected FRS and he was president of the Palaeontological Association in 1968-69, hosting the annual conference in Belfast the following year.

Alwyn Williams enjoyed a long association with Professor Harry Whittington FRS, first recipient of the Lapworth Medal. Harry tells me that one summer in the late 1950s he and his wife Dorothy were in Bala collecting while Douglas Bassett was mapping. Alwyn arrived by train, a one-carriage steam engine from Bala junction. Harry and party laid out a strip of red carpet, he and Doug Bassett held geological hammers aloft in a ceremonial arch and Harry's mother presented Sir Alwyn with a bunch of Welsh leeks. This most articulate of men was for once apparently lost for words!

A brief period as Lapworth Professor in Birmingham was followed by Alwyn's appointment in 1976 as Principal and Vice Chancellor of the University of Glasgow. Despite his administrative commitments, he published some 20 refereed papers (and held three NERC grants) while running the University. It was rumoured that in some years he published more than entire Glasgow departments. Since his retirement in 1988 Alwyn has been a cornerstone of the Palaeobiology Unit at Glasgow. He has published a steady stream of important papers on brachiopods and he has seen four volumes of the revised *Treatise* published as coordinator and chief editor.

Professor Sir Alwyn Williams is an outstanding scientist and administrator. It is a great pleasure to present him with the Lapworth Medal of the Palaeontological Association.

Sir Alwyn replied:

Receiving any medal from a Learned Society is always a privilege but this one is special because it really honours Charles Lapworth to whom I am indebted socially and geologically. As an

Ordovices on my father's side, I am indebted to Lapworth for immortalizing the tribal name. As part Silures on my mother's side, I am grateful to him for settling a family territorial dispute in such style—even if we have to go to Scotland to see where the boundary is drawn. And then there is the Girvan area and the Stinchar Valley, which for a decade or so assuaged my nostalgia for Appalachian geology so vividly revealed to me by Arthur Cooper.

Speeches of thanks for Medals seldom vary in format which is basically a list of colleagues who have contributed to winning the award because no research of consequence is done without support from others. My problem was, therefore, the familiar headache of selecting from among my mentors, collaborators, research assistants and postgraduates those to whom I'm especially indebted without overlooking others who have always been there, like my wife, Joan, who can still smile indulgently in this 53rd year of daily halelluliahs to the Brachiopoda. So I hope I'm forgiven for naming just some palaeontologists who have published papers with me, especially in the Association's Journal.

Before and during my lapse into the heresy of Administration, they included: the evergreen Tony Wright, Bert Rowell, Sarah Mackay, Gordon Curry and Martin Lockley who deserted brachiopods for dinosaurs. I don't know why; walking with brachiopods is much more acrobatic! Since becoming a born-again Palaeontologist my world of collaboration has known no bounds. In the company of the unflappable Howard Brunton and 40 or so other authors from 15 countries, the brachiopod *Treatise* has been undergoing a revision for the past 14 years. With four volumes published and two more to go, contributors can all look forward to the end of the affair by 2006.

On the side and greatly facilitated by the Electronic Revolution, I've enjoyed research with sharp-minded colleagues like Lars Holmer, Leonid Popov, Sandy Carlson, Dave Harper, Bernie Cohen, Carsten Lüter and, above all, Maggie Cusack who has patiently tried to take my familiarity with biochemistry a little beyond the digestion of my next meal.

Finally, despite my promise to limit my thanks to co-authors in *Palaeontology*, there is one whom I have known for 50 years since first we worked together strictly as stratigraphers. He is, Harry Whittington, the first recipient of this Medal. For over ten years, mostly with Doug. Bassett, we worked in Adam Sedgwick's fiefdom of Bala, mapping rocks identified as Sedgwick's Upper Cambrian or Murchison's Lower Silurian—the *raison d'etre* for Lapworth's Ordovician.

Those were golden days, albeit draped in veils of rain. Harry's wife Dorothy drove us to field sites in their armoured truck of a Volvo. One such site was the quarry at Gelli-grin, known to Sedgwick and M'Coy, and almost certainly visited and sat in by Charles Darwin the summer he acted as Sedgwick's field assistant. We took turns in sitting on a damp, cold, mossy block of ash in the hope of absorbing any lingering vibrations of Darwinian wisdom. I didn't, but I do now know what Darwin's mysterious illness was in his later life!

You younger palaeontologists are, of course, experiencing the same scientific excitement and good companionship as we did then. Cherish those memories, they will serve you well in old age!

One to watch out for

Following on from the success of *Dinosaur Detectives*, screened in 2002, RDF Media (of *Wife Swap* fame) has been commissioned by Channel 4 to produce a television series centred on palaeontology. The programme, called *The BIG DIG,* will be screened this summer. It is primarily aimed at children and families, and will show how—armed with some knowhow, a hammer, and a collecting bag—anybody can look for and find beautiful and significant fossils. The programme is presented by Lucy Taylor and, along with palaeontologists Dave Martill and Sarah Gabbott, and sedimentologist John Howell, the *BIG DIG* team tries to solve palaeontological problems brought to them by members of the public. In one programme of the seven in the series, the great great grandchildren of Victorian fossil collector Alfred Leeds asked the team 'how big was *Leedsichthys*?'. A six metre long skull of this giant pachycormid fish had recently been discovered in the Oxford Clay near Peterborough (see *A big gamble for a big dead fish*, this issue), but unfortunately the rest of the fish is missing. So the *BIG DIG* Team accompanied by Jeff Liston (currently studying *Leedsichthys* for his PhD) set about trying to use various methods to determine the true length of the monster fish. Other programmes centre on pterosaurs from the Cretaceous of the Isle of Wight, iguanodons from Hastings, mammoths from Gloucestershire, dinosaur eggs from southern France, and sabre-toothed cats from the Spanish Pyrenees. It's all good fun and the programmes will show what we palaeontologists know already: that the general public can make a significant contribution to our science.

ASSOCIATION MEETINGS

PROGRESSIVE PALAEONTOLOGY MEETING

10th–11th JUNE 2003

CALL FOR ABSTRACTS

Abstracts are invited for presentations and posters for the forthcoming post-graduate student Progressive Palaeontology meeting. Abstracts should be no longer than 200 words and should be sent as a Word document by email to **progpal@earthsci.gla.ac.uk**. Deadline for abstract submission is 1st April.

All delegates are required to complete a registration form by 1st April; this is available at

http://www.earthsci.gla.ac.uk/Palass/progpal.htm

For more information or queries please contact

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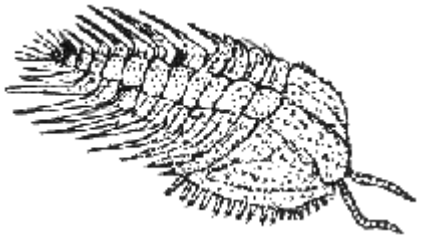


ASSOCIATION • THE PALAEONTOLOGICAL

UNIVERSITY of GLASGOW

Palaeontological Association Review Seminar: British Dinosaurs

Convened by: David M. Martill (University of Portsmouth) and Martin C. Munt (Dinosaur Isle)

At Dinosaur Isle (Sandown) and the Quay Arts Centre (Newport), Isle of Wight.
Wednesday 5 November 2003, 10am – 5.30 pm; 6.15pm – 9.30pm;
Thursday 6 November 10.30 am – c. 4.30pm.

Dinosaur research and discoveries around the world seem to run at an astonishing rate. We are constantly learning of spectacular new finds in China, Africa and South America. In the meantime, in Europe there has been a resurgence in dinosaur studies. Exciting new discoveries in Germany, France and Spain have come to light, while in the UK new dinosaur finds in old hunting grounds continue to indicate that there is still plenty to be discovered in the birth place of the Dinosauria. The Cretaceous strata of the Isle of Wight have very much been the focus of British dinosaurs, with frequent finds of *Iguanodon*, but exciting new dinosaurs such as *Neovenator* and *Eotyrannus* are adding to the picture of dinosaur diversity. The Isle of Wight though has not been alone in this renaissance. Dorset has yielded new trackways, and stunning new discoveries of *Scelidosaurus* and Kimmeridgian theropods have recently come to light, whilst south-east England has seen fresh finds of *Iguanodon* and *Polacanthus*. Scotland too has joined in the fun, the Isle of Skye having provided tantalising glimpses of Jurassic sauropods and stegosaurs,

The British Dinosaurs review seminar is intended to bring together what we know of our dinosaurs and will place them in their national and international context. The focus of the meeting is a series of talks by acknowledged leaders in the field held at the Quay Arts Centre in Newport. For those delegates who wish to stay, there will be an evening reception at Dinosaur Isle Museum in Sandown. There will be the opportunity to display posters on any aspect of dinosaur study and displays of recent finds by collectors and Dinosaur Isle Museum. The second day will be a field trip to the Island's famous south-west coast dinosaur hunting grounds.

Because of the size of the Quay Arts venue, participation in the day of talks is restricted to 134 places. These will be allocated on a strictly first-come-first-served basis. You need to reserve your place by e-mailing or phoning:

Martin Munt, e-mail **martin.munt@iow.gov.uk**, tel 01983 404344.

Could you also indicate your intention to participate in the reception and/or fieldtrip.

Accommodation advice will be provided on request. You are advised to find accommodation in Sandown. On the 5th there will be a finger buffet at about £6/head. Registration is free to Palaeontological Association Members.

Systematic advances in the study of Human Evolution
Trinity College, Dublin, Ireland *18 – 22 August 2003*

This is a one-day symposium forming part of the 4th biennial meeting of the Systematic Association.

Organiser: Dr Una Strand Vidarsdottir, Department of Anthropology, University of Durham, 43 Old Elvet, Durham DH1 3HN, e-mail **una.vidarsdottir@durham.ac.uk**

Recent years have seen great advances in the study of human evolution, many of which have been driven by systematic innovations. Morphological and molecular researchers alike have used systematic approaches to further the understanding of evolutionary histories and relationships, hominin environments, and hominin behaviour. To reflect on these advances the Palaeontological Association and the Systematic Association have co-sponsored this one-day symposium as part of the Biennial meeting of the Systematic Association. The symposium assesses the way in which systematic studies of hominins and other animals have helped to further our understanding of human evolution. It brings together workers who are carrying out some of the most ground-breaking and innovative work in this field, including Ancient DNA, Ontogeny, Morphometrics and Behaviour.

Speakers include:

Professor Dan Lieberman, Harvard University "Making Systematic Sense of Homo"

Professor Paul O'Higgins, Hull York Medical School, and Dr Sam Cobb, University College London: "The Promise of Morphological Ontogenies in Systematics: Practical or Theorectical?"

Professor Alan Bilsborough, University of Durham: "Evolution and Systematics of Homo erectus"

Professor Alan Cooper, Oxford University: "Ancient DNA and Systematics in Human Evolution: Problems and Recent Advances"

Dr Mark Collard, Washington State University: "Cultural Phylogenetics: an Overview"

Dr Todd C. Rae, University of Durham: "Phylogenetics and Character Analysis: how much is too little?"

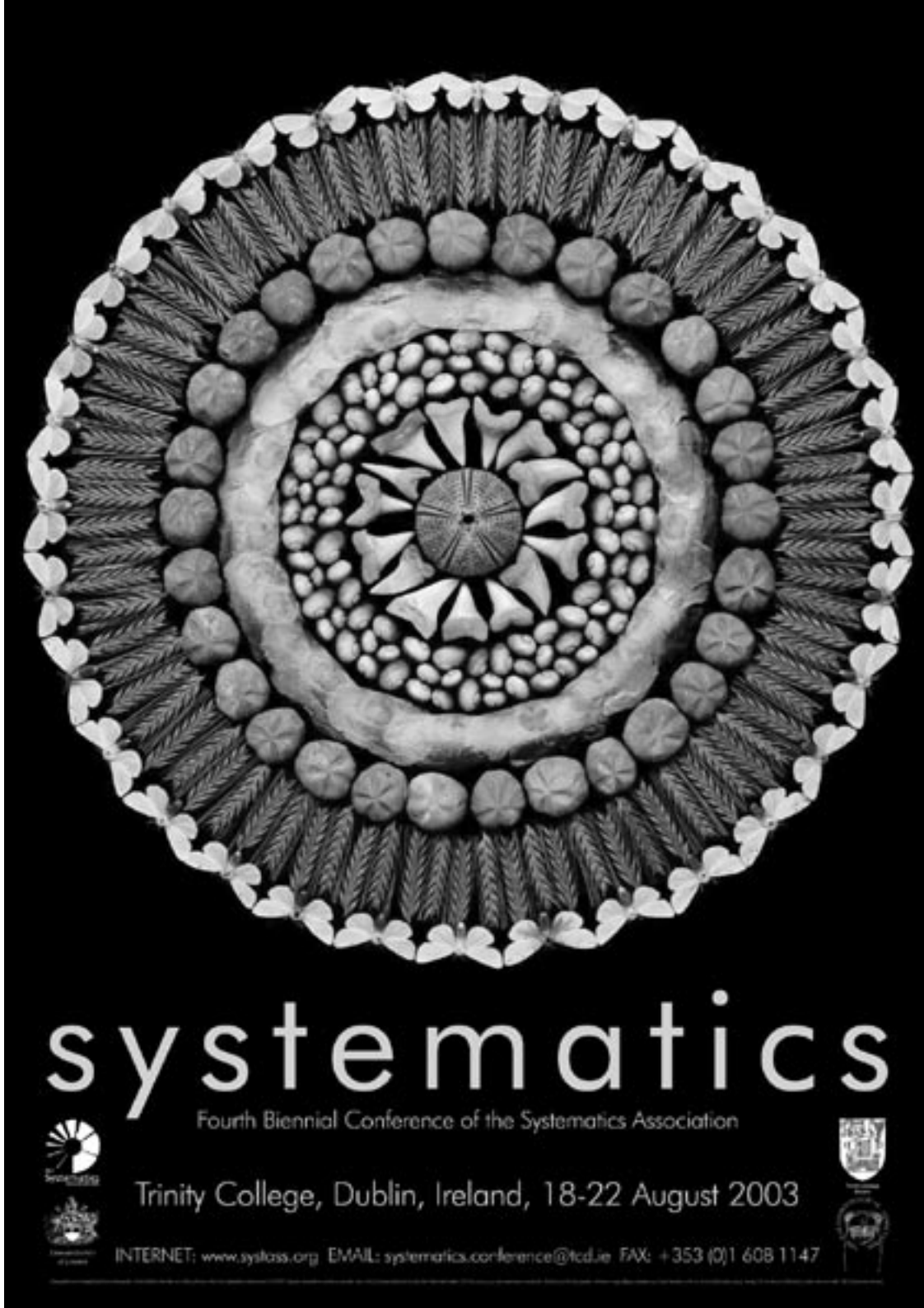
Dr Gary Schwartz, Northern Illinois University: "The Contribution of Dental Development to Systematics"

Dr Una Strand Vidarsdottir, University of Durham: "Systematic Analyses of Facial Form in the Context of Human Evolution"

Dr Danielle Schreve, Royal Holloway: "New Mammal-based Chronologies of NW Europe: a Framework for Understanding Human Evolution and Behaviour"

Dr Nobuyuki Yamaguchi, Oxford University: "Evolutionary Parallels between Modern Lions and Modern Humans?"

We would like to encourage students to submit abstracts for posters to be displayed on the day. Those interested should email their abstracts to <**una.vidarsdottir@durham.ac.uk**> on or before 1st July 2003.



From our Correspondents

Conceptual fossils

Our understanding of the present is tightly linked to our understanding of the past, and the former simply cannot exist without the latter. Obviously, this is scarcely a novel insight for a largely palaeontological audience, the legitimacy of whose very research is to a large degree predicated on this logic. One regular contributor to this newsletter put his perspective on this issue as follows: "If you are interested in how a living group evolved its distinctive features, and the principal transitions that led to it, you must look at the fossils of its stem group—the living forms are no help" (Budd, 2001: 487). Although I have mixed feelings about this statement as a zoologist devoted to reconstructing the phylogeny of the living animal phyla (I will reserve my comments for another time), it nicely underlines the importance of the past as the father of the present.

In similar vein, knowledge of the conceptual fossils that straddle the lawn of scientific progress will help us to understand and appreciate the current status and development of a discipline. Conceptual fossils may be very broadly viewed as ideas and concepts that were formulated in the past, and which can still be seen in action today. Conceptual fossils come in various guises. When we look around us, it is obvious that the most readily recognizable conceptual fossils are concepts that retain their utility across long spans of time. For example, the central logic of the Copernican theory of the universe is still very much with us almost 500 years after it was originally conceived. Similarly, the Linnaean system of classification retains its utility today (intensifying assaults from phylogenetic taxonomists notwithstanding) in a time temporally and conceptually far removed from Linnaeus's original intent to devise a classificatory system to reflect the eternal order of nature as conceived by God.

In contrast, an opposite category of conceptual fossils maintains an existence only as pretty relics of former ways of thought preserved in the horizontal stratigraphy of our library shelves. Among these we may find the Ptolemaic precursor of our modern heliocentric conception of the universe, as well as the concept of downward classification by logical (often dichotomous) division, which dominated classification for at least two centuries before Linnaeus. Interestingly, even though Linnaeus himself worked by the principle of logical division, this logic of classification was later largely abandoned for the principle of upward classification by empirical grouping, which continues to form the logical basis of modern taxonomy. Although Linnaeus's method of classification is superseded, the categories of his classificatory system are nevertheless retained in modern times to house the taxa that are now "constructed" by combining similar species. Aristotle's ideas may then perhaps be viewed as the quintessential conceptual fossils, as his thoughts loom large at the cradle of both cosmology and taxonomy.

However, the importance of conceptual fossils becomes most apparent when scientific progress is hampered or even reversed as a result of ignoring or misrepresenting ideas from the past. So in 1859 (p. 193), T.H. Huxley complained that "if the moderns paid due attention to the labours of their predecessors, an accurate answer to this question should be found in every accredited text-book on zoology." In this case, the question concerned which facts several European morphologists had uncovered in the 18th and 19th centuries about the mode of reproduction in aphids. Huxley (p. 193) concluded that "important errors have crept into the current conceptions respecting the reproductive processes and mode of life of the *Aphides*" as a result of overlooking pertinent previous research. This may superficially seem as a trivial or even esoteric illustration of the importance of being aware of the history of one's discipline. However, Huxley's foray into aphid asexual reproduction played an essential role in his ascent as a leading naturalist in the 19th century. Huxley's work on aphid parthenogenesis pitted him directly against the most powerful anatomist of Victorian England, Richard Owen, and Huxley used his aphids to ridicule and exorcise a lingering vitalistic concept in Owen's work. Owen accepted a residual "spermatic force" in aphids as being responsible for the continuing production of offspring by females in the absence of males. Huxley was quick to label this proposal as "ignorance writ large" (Huxley, 1859: 216). The sheer force of Huxley's polemical assault on Owen led the placid Charles Darwin to exclaim: "your Father confessor trembles for you" (Desmond, 1994: 238). Just to give the reader some flavour of the salvo that Huxley directed at the mighty Owen when he read his paper before the Linnaean Society in November 1857: "The impatient inquirer every now and then calls in the aid of molecular force, or chemical force, or magnetic force, or od-force, to account for the existence of a mass of phenomena which will not arrange themselves under any of his established categories—forgetting that a 'force,' the conditions of whose operation (that is, whose laws) are undetermined, is but a scientific idol, at once empty and mischievous,—empty, because it is but a phrase without real meaning; mischievous, because it acts as an intellectual opiate, confusedly satisfying many minds and obstructing the progress of inquiry into the real laws of the phenomena." (Huxley, 1859: 215-216).

However, I don't want to dedicate this essay to simply pointing out the importance of digging up and studying conceptual fossils. That much should be obvious. Rather, I want to reveal that concepts can truly fossilize by becoming so immutably embedded in the conceptual toolkit of a discipline that they outlast their utility and start to impede scientific progress. Such concepts then become veritable fossil concepts. I will discuss several conceptual fossils in this category that are still very much part of the current practice in metazoan phylogenetics.

First, let us consider an example that dates right back to the founding document of phylogenetic systematics, Hennig (1966). This English adaptation of Hennig's German original that was published in 1950 lays out the logic of a method of phylogenetic reconstruction that has permeated every nook and cranny of systematic biology, almost as a "universal acid," to borrow Daniel Dennett's apt metaphor for natural selection. Many biologists and palaeontologists have accepted the logic of Hennig's system, and subsequent elaborations on the logic of Hennig's concepts have produced a powerful and logically sound methodology of cladistic analysis. Unfortunately, however, every Scripture evokes its own particular brand of fanatic followers. Luckily, as a positive spin-off, such gullible and unquestioning disciples provide welcome fodder for people of opposite temperament.

One of the concepts that Hennig codified is that of comparable semaphoronts. Hennig defined the semaphoront, or character bearer, as an organism at a particular stage in the life cycle, and he advised that for the purposes of reconstructing phylogeny only comparable

semaphoronts are to be used. The utility of this idea is easily seen when one attempts to reconstruct the phylogeny of a group of organisms with a life cycle composed of very different forms, such as caterpillars and butterflies. If organisms can change so dramatically during their lifetime, then systematists may get confused, and so Hennig (1966: 65) designated the semaphoront, rather than the individual organism, as the fundamental "element of systematics." The very different morphologies, functions, and ecologies of larvae/juveniles and adults in taxa such as the holometabolous insects require separate treatment when reconstructing evolutionary lineages because the systematist "cannot work with elements that change with time" (Hennig, 1966: 65).

The presumed logic of this concept was taken over in Wiley (1981), which is another widely used textbook of the principles of phylogenetic systematics, and references to the concept of comparable semaphoronts can be found scattered in the systematic literature. For example, Bartolomaeus & Ruhberg (1999: 172) write that "larvae can only be compared with larvae and adults with adults" when they compare the morphology of the panarthropods and annelids. But how useful is this concept in current comparative zoology?

Hennig formulated the concept of comparable semaphoronts to prevent confusion that would arise when utterly distinct stages of an organism's life cycle are mixed together. In contrast, Bartolomaeus & Ruhberg's invocation of Hennig's concept takes on an entirely different character, namely to forbid the comparison of different life cycle stages. This contrast between what I believe was Hennig's original intent (preventing confusion), and Bartolomaeus & Ruhberg's invocation (to artificially restrict comparison of organisms) might seem to suggest that in the time interval between these publications significant improvements in our understanding of semaphoronts have been achieved. In fact, this is true to a certain extent, but the importance of these developments is quite opposite to that suggested by the citation from Bartolomaeus & Ruhberg.

If there is one evolutionary concept that has undergone a renaissance in interest during the last two and a half decades of the past millennium, it is heterochrony. In these times of evo-devo, body plan evolution is increasingly approached as a succession of changing ontogenies, and the concept of heterochronic change takes pride of place within this rekindled fashion. The importance of heterochrony for phylogenetic reconstruction is that boundaries between different life cycle stages become smeared, especially when these stages are deconstructed into separate characters. This means that homologous structures may exist in the adults of some taxa, but in earlier phases of the life cycle in others. For example, when we consider the distribution of protonephridia within the Bilateria, it becomes clear that structurally very similar, or even identical, protonephridia may be present in the adults of several phyla, such as the gastrotrichs and gnathostomulids, and the larvae of others, such as the phoronids and annelids. When it is noted that for the great majority of characters in phylogenetic analyses simple structural homology criteria are used, then there is no reason not to consider these larval and adult protonephridia in different taxa as potentially homologous. If on the other hand a strict separation is made between the coding of characters for adults and larvae, a very different picture of evolution may emerge. First, the phylogenetic significance of the character will change because its distribution now changes. Second, the interpretation of the synapomorphies on a phylogeny changes, because heterochronic shifts of a structure across a life cycle may now falsely be interpreted as genuine character losses or independently acquired evolutionary novelties.

The coding for many characters in metazoan phylogenetics may differ markedly when the entire life cycle, or only particular stages of the life cycle are compared between taxa. Examples range from ciliation patterns of the epidermis to the structure of nervous systems. However, if you study the coding of characters in recent analyses of metazoan cladistics, it is clear that semaphoront choice does not receive the explicit attention it deserves. The bottom line is that we currently understand very little about the correspondence of life cycles across different phyla, and certainly not enough to restrict our comparisons to larvae only, or adults only. Moreover, in many phyla there is no sharp boundary between the larva and the adult in the first place. Although the larval and the adult body may be sharply separated by a dramatic metamorphosis in animals such as the sea stars and the nemerteans, this situation seems to be the exception rather than the rule. This contrasts with the concept of maximal indirect development, in which the larva and adult are morphologically and morphogenetically entirely separate from each other. This concept has recently enjoyed some popularity in the literature as the type of life cycle that was supposed to be primitive for the bilaterians, or at least the dominant form of life cycle in the deuterostomes and lophotrochozoans (see Peterson *et al.*, 1997, 2000 for arguments). However, the great diversity of life cycles found within the Bilateria defies such simple conceptual shoehorning. In many phyla the transition between life cycle stages is much more gradual and less sharply defined, and various structures already present in the larvae are carried over into the adults. Examples can be found all across the panorama of animal diversity, from the polyclad platyhelminths, through the enteropneust hemichordates, to the phoronids with their dramatic metamorphosis. In fact, the phoronids manage to metamorphose in less than half an hour *because* most of the adult structures are already preformed in the actinotroch larva. In all these cases it seems arbitrary at best to restrict comparisons to certain parts of the life cycle only. In this way important similarities may be missed, and heterochronic aspects of body plan evolution will be systematically ignored. Moreover, Hennig himself rather watered down the utility of his semaphoront concept when he wrote "no generally applicable statements can be made about how long a semaphoront exists as a constant systematically useful entity" (Hennig, 1966: 6). In the absence of evidence to the contrary, why not use the entire life cycle?

The restrictive or inconsistent use of the concept of comparable semaphoronts is by no means the only conceptual fossil in current research on metazoan evolution that deserves to be dug up and studied. Consider the following example. Although metazoan phylogeneticists do typically not justify character selection, one of the few explicit arguments that are repeatedly used to exclude characters from a cladistic analysis is that some observed similarities between organisms are phylogenetically uninformative because they are functional. Because functional constraint may be expected to lead to convergent evolution, functional characters should not be employed in phylogenetic analysis. An extreme form of this argument has led Willmer to dismiss morphological phylogenetics of the Metazoa altogether as an intractable problem (Willmer, 1990).

The same argument surfaces in more moderate guises in recent work. In discussing the evolution of the rotifers, Nielsen (2001: 305) accepts certain similarities in the wheel organs of some rotifers as homologous. At the same time he denies potential homology of

"other types of wheel organs," and explains the observed similarities instead as functional specializations. Gee (1996: 9) surmises that "spiral cleavage may owe less to heritage than to a common solution to a problem of functional design." Now, my opinion is worth as much as anyone else's, but if I would be forced to put my money on any character that is most likely to be truly homologous between different phyla, I would bet on spiral cleavage any time. The detailed similarities in cleavage geometry, and the closely similar developmental fates of the blastomeres between different phyla suggest to me a potentially informative phylogenetic character. If one would believe that functional characters are generally no good for reconstructing phylogeny, the entire enterprise of phylogenetics collapses. Certainly the majority of characters used to sort higher-level metazoan relationships are functional in some sense. In contrast, some would even go so far as to say that without a functional context characters do not exist at all (see Graham Budd's essay on the Naming of parts in issue 49 of this Newsletter).

Surely, to exclude characters from a phylogenetic analysis simply because they have a function must be a conceptual fossil dating back to the third and final phase of 19th century morphology, which Russell (1916) labelled as "causal morphology." This phase in the history of morphology was characterized by a notable shift away from evolutionary morphology towards more experimental and mechanical approaches that aimed to understand the development of organic form in terms of proximate and efficient forces, such as embryonic growth and differentiation. However, within the modern philosophy of biology, proximate and ultimate explanations of form go hand in hand, as organismic features can be at once functional and the product of an evolutionary history.

To prevent this essay from getting uncomfortably long, I will save the excavation of a number of additional conceptual fossils for the next Newsletter. Although these examples range from Libbie Hyman's views of animal phylogeny, through the phylogeny of turtles, to the sex of the Urcirripede, I will dare to suggest a general explanation for the existence of these seemingly unrelated conceptual fossils.

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Sutures joining Ontogeny and Fossils

Development is not limited to the embryonic phase of an organism's life history but rather, is life long. Consequently, whereas embryos might not always be available, postembryonic development remains a potentially informative source of data for palaeontologists and neontologists alike.

A long-standing problem in palaeontology remains how to distinguish between ontogenetic and phylogenetic characters, independent from animal size. Examples of ontogenetic stages of importance to palaeontology include the attainment of sexual maturity (reproductive capacity), skeletal maturity (maximum size, Maisano, 2002) and morphological maturity (morphological characters throughout development) (Brochu, 1996).

Patterns of ossification and suture closure/fusion show remarkable variation among vertebrate taxa and should be used cautiously for evaluating phylogenetic relationships or inferring ontogenetic stages for fossil specimens. In recent studies (Maisano 2002, Brochu 1996), researchers have demonstrated the importance of elucidating the patterns of, and factors underlying, suture closure/fusion among extant and fossil taxa.

So what are sutures? Human anatomy texts often state that sutures are only found in the skull, reflecting Herring's (2000) definition of a suture as "any articulation between dermal bones" (p. 3). Obviously from our introduction, we intend to include a wider group of joints (union between skeletal elements) in our discussion of sutures.

Vertebrate skeletons

Joints between elements of vertebrate skeletons can be divided into two basic categories, freely mobile (or synovial) or restrictive/immobile (synarthroses) joints. Restrictive/immobile joints may be initially connected by dense connective tissue and then fuse, being united by bone when old (synostoses), joined by hyaline cartilage (synchondroses, *e.g.* rib or epiphyseal plates), or joined by an interosseous ligament (syndesmoses).

As sutures are widely considered to restrict if not inhibit movement (the term suture means 'to sew'), freely mobile joints will not be considered further here. Sutures may be cranial, axial (neuro-central, neural), or appendicular (scapula-coracoid, epiphyseal). However, are all of these sutures the same? Do the same processes involved in cranial suture formation and maintanance apply equally to vertebral or epiphyseal sutures?

Suture closure (fusion)

Suture closure patterns have been used to construct systems for identifying maturity stages for extant taxa. A suture may be open (acting as a joint permitting slight movement), closed, fused or transitory between these states. Sutures develop as ossification proceeds and bones contact each other. Generally, vertebrate sutures are open early in development and progressively close as development proceeds and growth slows. Fusion must be confirmed by histological section; closure typically refers to a suture being visibly closed externally, although some growth may still be possible.

Maisano (2002) documented the suture closure (her "fusion") patterns of a wide group of extant squamates. Closure of the "braincase, scapula and coracoid, pelvic bones, limb epiphyses, and/or astragalus and calcaneus" sutures suggested an individual is "probably sexually mature", but, if these sutures are not closed, "the individual is not necessarily sexually mature" (p. 273). Maisano was unable to identify a suite of suture characters correlated with sexual maturity across squamates, although there were patterns within subgroups. That study highlights the importance of recognizing the great variation patterns of suture closure among closely related taxa.

Maisano's study also documented that suture closure does not always correlate with skeletal maturity (as defined by attainment of species maximum size). Among squamates, closure of sutures in the braincase may occur prior to the animal reaching 30% of the species maximum size (Maisano, 2002). These differences may represent size variability within a taxon or demonstrate the distinction between suture closure and fusion.

Brochu (1996) identified a pattern of neurocentral suture closure among crocodylians that correlated with "morphological maturity". Brochu found that neurocentral suture closure proceeded in a caudal to cranial pattern and suggested that fossil taxa with cervical vertebrae exhibiting closed neurocentral sutures represent morphologically mature individuals. However, Brochu also acknowledges Rieppel's (1993) statement that neurocentral suture fusion occurs in the opposite direction (cranial to caudal) in squamates, again demonstrating that patterns of suture closure are variable and taxon specific.

In another examination of sutures, Herring (2000) pointed out the functional role of sutures in providing flexibility, particularly in the cranium. Her study provides an interesting overview of cranial suture patterns across taxa, discussing the role of sutures in biomechanics and in how skulls of many taxa have become more flexible through time.

Mechanisms of suture closure (fusion)

What keeps a suture open, or permits it to fuse? The changes of suture patterns through phylogeny or for functional (*i.e.*, ecological) reasons represent other examples of areas where palaeontology and Evo-Devo intersect.

A recent review (Opperman, 2000) draws attention to the epigenetic and molecular factors that are involved in cranial suture formation and maintenance. Sutures of the skull are sites of bone deposition (bone growth) as well as areas of potential skull mobility. Mechanical factors (such as the expanding brain) likely play a major role in promoting bone growth along cranial sutures.

Interactions between neural-crest-derived cells and epithelium play important roles in permitting, maintaining or fusing of cranial sutures. Dura mater is a neural crest derivative that surrounds the brain and spinal cord and is known to be highly osteogenic. Signals from the dura mater permit suture formation as cranial elements expand and contact each other (Opperman, 2000). Eventually, the cranial suture reaches a stage where it can maintain itself and no longer requires the dura mater signal. Reciprocally, the suture appears to provide signals to the dura mater, causing the dura matter to cease its osteogenic inducing activity, thus preventing sutural fusion.

Dura mater encircles the entire central nervous system and, thus, is present around the spinal cord; it therefore might not be surprising to find that it participates in the formation and maintenance of vertebral sutures. Vertebral growth is likely to be, at least in part, induced by the expanding spinal cord, similar to the relationship previously noted between cranial sutures and the expanding brain. The growing spinal cord cannot become restricted within the ever-diminishing space of the neural canal; the vertebral sutures may permit increased growth as needed.

Tissue interactions are also known to play important roles in the development and maintenance of other sutures. Although sutures of the facial bones do not directly contact dura mater, tissue interactions (possibly between cartilage and epithelium) may be acting in similar manner as the signals from the dura mater (Opperman, 2000). Palaeontological hypotheses that use suture patterns would benefit greatly from additional comparative studies on the factors involved in suture induction, maintenance and fusion. Biomechanical signals and molecular factors (growth and differentiation factors, *e.g.* Gdf5) may play a role in some sutural development and maintenance, but it remains to be seen if this applies to all sutures.

Invertebrate skeletons

Of course sutures are not found strictly among vertebrates. Perhaps the most inclusive definition of suture we have found comes from Henderson's Dictionary of Biological Terms: suture, "n. line of junction of two parts immovably connected, as between bones of skull, sclerites of exoskeleton covering an arthropod segment, etc.; line of seed capsule, etc. along which dehiscence occurs." (p. 531).

Malacologists are familiar with the term suture as meaning the grooves on the shell where the different whorls fuse as an animal grows. In nautiloids, the term suture refers specifically to where the septa (internal part of the shell that separates the 'living space' from the smaller gas chambers) fuse with the shell. Suture patterns are used extensively to identify fossil ammonites. In fact, sutures of ammonites were one of C.H. Waddington's (1975) first fascinations as a biologist. He began his career as a palaeontologist, intrigued by how the developmental stages were preserved and available for study in ammonite shells. The

presence of such clearly interpretable ontogenetic records provoked him to consider that "evolution of organisms must really be regarded as the evolution of developmental systems" (p. 7). Evolution, development and palaeontology were joined closely together.

Arthropods have a hard exoskeleton, which is formed through a process of sclerotization (hardening) of their cuticles. This hardening begins at localized areas within the cuticle and results in the formation of distinct hardened elements (sclerites). The junctions between adjacent sclerites are called sutures, and may or may not refer to regions where the exoskeleton fractures when the cuticle is being shed during moulting, or ecdysis. Specifically, these breaking points in the exocuticle in all arthropods are called ecdysal sutures. One feature used to identify fossil trilobites to species is the facial suture—the region on the anterior carapace that has been assumed to have served as breaking points of the exoskeleton when the animal moults.

From observing horseshoe crabs in our lab, Alison Cole determined that the only suture point in extant xiphosurans appears to be along the edge between the dorsal and ventral carapace. If the moulted shell is left basically intact, we are left to wonder if it might be likely if some fossil xiphosurans, such as some of the Euroopids found in Carboniferous sediments near Joggins (Nova Scotia) might be moulted remains. Perhaps identification of moulted remains would provide the opportunity also to study direct fossil records of stages of ontogeny among xiphosurans.

Investigations of sutures remain scarce, but, hopefully, this article will encourage future studies where development and palaeontology can come together. Increased knowledge about the factors involved in suture formation, maintenance and closure would likely provide an important context for future hypotheses of ontogenetic development among fossil taxa.

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Cladistics and Phylogenetic Systematics

The *Stuttgarter Beiträge zur Naturkunde* is not to be found in every library, so colleagues may have missed the recent (2000) short contribution by Dr Günter Bechly of the Staatliches Museum für Naturkunde, Stuttgart, where Willi Hennig worked and wrote his well-known book (Hennig, 1950).

Siebert (1992) wrote that "Modern cladistics, however, effectively dates from Hennig (1966)." Dr Bechly's main thesis is that cladistics, as now practised, is a different animal (sorry!) from Hennig's phylogenetic systematics. The basic difference is that Hennig regarded evolution as fundamental to his system, whereas modern cladistics consists of computer manipulation of characters, often unpolarised, without any assumption of evolution. The extreme view is exemplified by Patterson (2002, p. 31): "… evolution may well be true, but basing one's systematics on that belief will give bad systematics. Since so-called ancestral groups are the invention of evolutionists, as is the belief that trees not cladograms are the proper level of analysis …".

Dr Bechly takes as exemplifying "mainstream cladism" the writings by Platnick (1979) and Rieppel (1999). Some of us will have read Platnick. Those of us who, like me, find German difficult, will not have read Rieppel's recent exposition.

Bechly details three major differences between the two systems in some detail: 1), a mainly hierarchical diversity is postulated *a priori* by Hennig, based on the theory of evolution, otherwise there would be no basis, using parsimony, for solving the problems posed by conflicting evidence. 2), assumptions as to homology and polarisation must precede attempts to reconstruct phylogeny. The argument of cladists that *a priori* homologization and polarisation should be avoided because they are *ad hoc* hypotheses is irrelevant. The principle of parsimony only refers to unnecessary *ad hoc* hypotheses; some hypotheses are required as a basis for a phylogenetic investigation, which would not make sense without them. 3), different hypotheses of homology, polarity and relationship are supported by different quantities and quality of evidence. Weighting of the plausibility of conflicting hypotheses is necessary to the final aim of elucidating the reality of nature.

Bechly goes on to expound in some detail why he believes that non-weighting of characters is a misconception of mainstream cladistics. He points out that the choice and definition of characters already involves so many subjective decisions, that non-weighting is a chimera. In the following section he observes that a most parsimonious [cladistic] tree can be overturned simply by a different choice and/or definition of characters. So much for objectivity.

As Graham Budd (2002) observed in a recent Newsletter "… no one really knows how to select characters in the first place"—though £70 will buy you a book that purports to tell you how to do it (Newsletter **49**, p. 110).

In an appendix Dr Bechly discusses issues and criteria involved in character weighting.

Notwithstanding the late Colin Patterson's disastrous talk at the American Museum of Natural

History in 1981, which was quoted or misquoted by creationists in support of their position (Forey, 2002; Patterson, 2002), Siebert (1992) stressed the role of cladistics in emphasizing the importance of recognizing monophyletic groups.

Any discussion?

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Skeletal independence and fossil cell footprints

I felt compelled to comment on the challenging article (Fedak, Hall, Olson, Stone and Vickaryous, Newsletter, **51**) which dealt with trying to put development back into the fossil record of vertebrate hard tissues as an aid to clarity, but as it was concluded, resulting in less clarity and a different muddle. Leaving aside what is perhaps the most controversial question of the tissue types in conodont elements and their homology (Sansom *et al*. 1992), the principles of tissue identification can be set out and these do not need *a priori* assumptions as to which part of the skeleton they belong. This in itself is misleading and over simplistic to assign them only to an exoskeleton, or an endoskeleton, as if the vertebrate animal only had two choices, the former as if comparable with invertebrates with the presumed advance of an additional internal skeleton. The ancient idea that teeth may be part of the external skeleton as evolutionarily derived from it, may itself also be misleading (Smith and Coates, 1998, 2001). Teeth are part of the internal (visceral) skeleton, and conodont elements are part of this internal evolutionary story, the phylogenetic order of skeletal origins provides an alternative view to skeletal origins as has been recently reviewed (Donoghue and Sansom, 2002).

Recalling Romer's viscero-somatic animal (Romer, 1972) and the evolution of chordates, we have the basis for the division into three types of skeleton with implications for cell lineage differences. One, is a visceral skeleton around the pharynx derived from cranial neural crest

derived cells with endodermal induction: two, is true endoskeleton (axial and appendicular) derived from the mesodermal somatic part with notochordal induction (Fleming *et al.*, 2001): three, is the dermal skeleton, with exoskeletal ornament of tooth-like tissues (denticles) on the outside, derived from cranial or trunk neural crest cells (McGonnell and Graham, 2002) with ectodermal induction. The neurocranium is part of the endoskeleton with dermal additions, with the visceral skeleton suspended below, part of which may become the jaws. The assumption that teeth are part of the exoskeleton is not one I support; teeth and denticles only being homologous as deeply nested within vertebrates and sharing the same molecular tool kit for construction of the tissues (Smith, 2003). Teeth are part of the visceral skeleton, as also are the cartilage bars of the pharynx and the flat membrane bones of this region; none of them is dermal, all of them are cranial neural crest derived and dependent on endoderm for patterning (Couly *et al.,* 2001). Which of these skeletal systems evolved first is impossible to say, except through a phylogeny. Almost certainly they would evolve and develop independently of each other, based on independent developmental modules (Smith and Hall, 1993), each capable of expansive diversification, or reduction, but cell lineage consistently retained with no evolutionary interchange between the different skeletal systems (Patterson, 1977).

Distribution of tissue types on a phylogeny derived by cladistic analysis of a total character set will determine tissue origins (Maisey, 1988), and perhaps homologies, but the characters will never be quite independent of developmental assumptions as each tissue has a developmental story embedded as part of the structure. Part of the data set for increasing phylogenetic resolution can be tissue type, and we can only judge tissue type in fossils on distribution and shape of cells relative to the matrix they create, relative arrangement and type of growth increments, and topographic position in the body. This does not involve assumptions about cell lineage in development but simply their later development through growth. To ignore this rich amount of fossil data is to throw away fine level understanding of tissue evolution. The wonder of looking into the microstructure of fossil teeth, bones and mineralised cartilages is that the footprints of cell ghosts can be read out from the microsections, or bare bone surfaces, as if the cells had only walked away yesterday (Smith, 1977). None of this requires knowledge or assumptions about development *per se*, but comparisons across the significant taxa will allow decisions of single character states to be formulated and scored as part of the analysis, hence better phylogenetic resolution. The polarity of skeletal tissue change can only be determined by the resultant phylogeny, either embracing all characters, or one without the tissue characters to determine the significance of these for the phylogeny.

There are three classic examples in vertebrate skeletal tissues where development is included as part of the character. One, recent phylogenies of placoderms as jawed vertebrates exclude them from crown group gnathostomes by the lack of a "tooth producing dental lamina" (Goujet, 2001). Therefore, some conical structures are assumed to be produced without a dental lamina, and not homologous with teeth, defined as those produced within a dental lamina (Young, Lelièvre and Goujet, 2001). True the phylogeny will tell us that teeth are not homologous due to lack of historical continuity, but this developmental soft tissue structure is not in any way possible to see in fossil material, and is deduced from the structure of the dentition in the adult state (Reif, 1982). In placoderms teeth may be secondarily independently derived (Smith and Johanson, 2003) and perhaps a dental lamina can evolve more than once? So we can ask, is the molecular

developmental tool kit for making a unit tooth on a dental lamina part of a deeply nested homology for vertebrates? Would this also include conodonts?

The second character with developmental assumptions is the allegedly different two states of bone, acellular and cellular. Now we must reasonably assume that all bone is made from cells, but in one development requires the cells to withdraw as they make it, whereas, in the other the formative cells become trapped and function within the matrix itself, i.e. tissue development differs. The two are not considered homologous, and the phylogeny decides that the acellular type gives rise to the cellular, the latter producing the name of the order Osteostraci. However, we know that the two types of bone are coeval at least (Smith, 1991) and may be independently acquired within three skeletal systems, both can occur in all three topographic positions, endoskeleton, exoskeleton, and visceroskeleton.

The third, is a type of dentine misleadingly called semidentine (as if half way between cellular bone and dentine) and restricted to placoderm tissues, the development of the two is implicitly understood to be different, but the cell lineage could be the same *i.e.* from neural crest. The location of dentine, or semidentine, can be in either or both the exoskeleton and the visceral skeleton.

Conclusions: Development is bound up in tissue identification and comparison of types as used in a cladistic phylogeny. The muddle may be in assuming evolutionary transformations of one tissue type into another, as from bone to dentine, but within the proposed three different skeletal system structures they can be found to be homologous. So where does this put the conodont apparatus? From topographic location and tissue arrangement is it part of the visceral skeleton, a dentition analogue, with non-homologous teeth? Cell lineage homology cuts across the three types of skeleton with neural crest derived cells for the dermal and visceral skeleton, but different inductive and patterning sources of the initial signal from ectoderm and endoderm respectively. Recently even trunk neural crest cells of amniotes have been shown to be able to make bone and cartilage in the right environment (McGonnell and Graham, 2002) and also to contribute to tooth tissues (Militek *pers. com.*). Maybe this level of deep homology (retained skeletogenic potential) puts us into a muddle of a different kind but the breeding colony of conodonts will only tell us if cranial neural crest is present, and if it contributes to the element tissues. What does it tell us if these cells transplanted to the 'trunk', or to a "conodont equivalent of a quail" make skeletal tissues? That conodonts have the potential to make dermal armour, are secondarily naked but have cell homology? Answers please on a postcard to <**newsletter@palass.org**>.

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Palaeontology—and Physics

Readers of our *Newsletter 51* (November 2002) will have united in feelings of delight and congratulation at the news that Brian Hall, of Dalhousie University, was one of three candidates short-listed for the award of the 2002 Gerhard Herzberg Canada Gold Medal, the National Science and Engineering Council of Canada's highest honour and hence one of Canada's most prestigious acknowledgements of excellence in science. The Medal was in the end bestowed on Dr Tito Sciano, a chemist at the University of Ottawa, but the pre-eminence in their fields of the other two finalists is also recognized by means of two NSERC Awards of Excellence, each carrying a grant of $50,000.

But who was Gerhard Herzberg? Born in Hamburg in 1904, he went on to study physics at the Technische Hochschule in Darmstadt and at the University of Göttingen. He witnessed the development in the mid-1920s of the New Physics through the invention of wave-mechanical quantum-theory and soon focused his attention on its then richest source of evidence, the study under high resolution of the spectra of atoms and small molecules. Such spectra are moreover the principal source of evidence in another field that was to fascinate Herzberg all his life, that of the physics of stars and the interstellar medium in Deep Space. But, barely in his thirties and now an internationally recognized authority on spectroscopy, he was suddenly forced to contemplate emigration because of his marriage to a fellow-physicist who came from a family of Jewish background. Academic positions abroad had become hard to find during the Depression, but through a fortunate combination of circumstances and the generous foresight of President Murray, he arrived in 1935 as Guest Professor of Physics at the University of Saskatchewan in Saskatoon. Thus began a life-long attachment to Canada.

In 1948, "GH", as he came to be known among his innumerable friends, students and colleagues, accepted the invitation to become Director of the Division of Physics in a newly-reformed National Research Council in Ottawa. He went on to create what quickly came to be recognized as the world's leading centre of spectroscopy, one of the Grand Labs in physics, with himself as undoubtedly the world's leading authority in the field. His interest in astrophysics led to the analysis of spectra produced in the laboratory that led in turn to the identification *inter alia* of molecular hydrogen in the atmospheres of Neptune and Uranus, of its isotope deuterium in the atmosphere of Jupiter, of the radical-ions H_3^+ and CH^+ in interstellar space, of the molecules C_3 in a comet-tail and in the atmospheres of cool carbon stars (—molecular species that must inevitably figure in the chain of arguments, did they but realize it, of those fantasists who would put the origin of life on Earth, and hence of palaeontology, at some extra-terrestrial Somewhere Else). At another extreme, that of Brief Time, in which a microsecond can be a long time, new techniques made it possible to characterize by means of their spectra many of the short-lived free radicals long postulated by chemists as intermediates in primary gas-phase reactions, molecules such as NH_2, HCO, BO_2, even N_3, and many others. The most fundamental, the radicals CH_2 and CH_3, were also the most difficult, and it was primarily for their discovery in 1959 and 1956 respectively that Herzberg was awarded the Nobel Prize for Chemistry (!) in 1971. He died in 1999 in Ottawa aged 94. The annual award of the Herzberg Canada Gold Medal was launched in 2000 to mark the Millennium by the Federal Government as the country's premier research award, and was named in his honour. *Fine, da capo*.

Coda. One of Herzberg's earliest achievements lay in the interpretation of a spectrum, published in 1929, of the rotational Raman spectrum of ordinary diatomic nitrogen, N_2. Such spectra consist of simple regularly-spaced sharp lines, as predicted by the new quantum-mechanics, expressing the quantization of the rotational momentum of the molecule. But an additional feature is an intensity-alternation of the lines reflecting the spin-characteristics of the atomic nuclei in the molecule, also a quantum-mechanical phenomenon. The nitrogen nucleus, N, of atomic mass 14 and charge 7+ was therefore thought to be made up of 14 protons (H^+) and 7 electrons (e^-). But the rotational spectrum showed unequivocally that this could not be so. It provided, instead, primary evidence for the explanation by Heisenberg in 1932 that the N nucleus was made up of 7 protons (H^+) and 7 neutrons (n), that electrons as such do not exist in nuclei quite generally.

The spectrum in question had been obtained in Rome by Franco Rasetti, collaborator and friend of Enrico Fermi and joint author with him of papers on the theory of nuclear fission leading to the atomic bomb. Forced also to emigrate from Italy in 1939, he declined on moral grounds Fermi's invitation to join him in Chicago to work on what became the Manhatten Project and went instead to Laval University, Québec, as its first Professor of Physics. Always a keen naturalist, there he discovered trilobites, now in Deep Time, and began to collect these in quantity in eastern Canada. By the end-1940s he had become Canada's leading authority on them and continued to pursue his newly-found interest even after moving to Johns Hopkins in Baltimore in 1947. He became a contributor to the trilobite volume of the *Treatise* and in 1955 was awarded the Charles D. Walcott Medal (*sic*) of the National Academy of Sciences. After retiring, he reverted to another old interest and in 1980 published a definitive volume on Alpine botany, *I Fiori delle Alpi*.

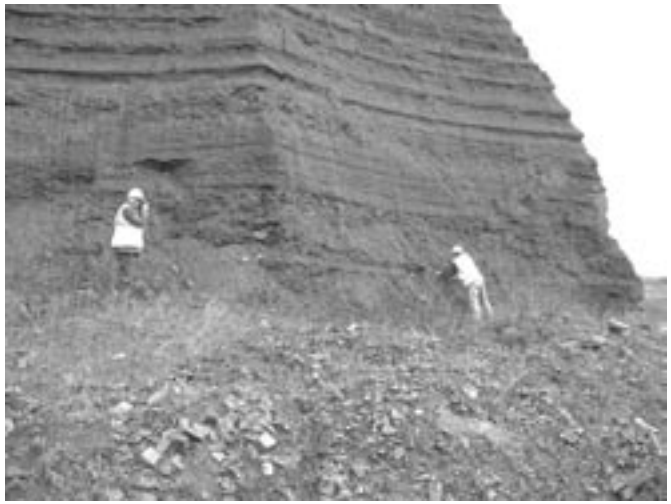
Born in 1901, Rasetti died in 2001 in Belgium aged 100.

Fine della Commedia: back to palaeontology.

John Callomon
University College London, UK
<johncallomon@lineone.net>

Big Gamble for a Big Dead Fish

Thanks Pal. Ass., your gamble paid off. During the summer of 2001 University of Portsmouth students Matt Riley and Marcus Wood discovered *in-situ* remains of the giant pachycormid fish *Leedsichthys problematicus* in the Star Pit at Whittlesey, Cambridgeshire. The only trouble was the bones lay at the foot of a 20-metre face of the Oxford Clay that would require removal before the remains could be excavated.



The site before excavation with the overburden to be removed

Would it be worth the effort, or, more to the point, would it be worth the expense? Excavation was not going to be an army of student volunteers, but a 22-ton Komatsu bucket excavator and a D6 bulldozer. Furthermore, for the excavation to be safe, the slopes had to be at angles of less than 45 degrees, making the total amount of overburden removed 10,000 tonnes—the equivalent of five days non-stop mechanical excavation. Clearly this was not going to be a cheap operation. Furthermore, there was no guarantee that there was anything more than the handful of bones found by Matt and Marcus. During October, Martill, Liston and Alan Dawn from the

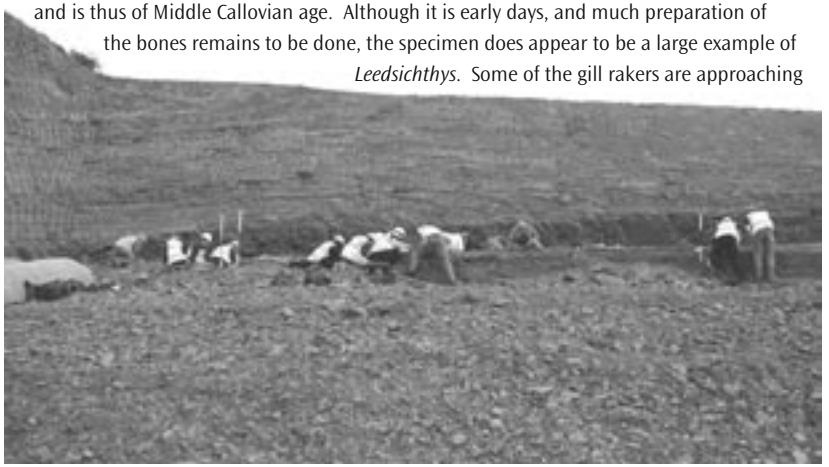
Overburden removal in action!

Peterborough City Museum visited the site to assess the potential for an excavation. More bones were found, and although we were only seeing them 'end on' they appeared to be of articulated remains, with some of the extremely delicate pieces apparently preserving their in-vivo relationships, suggesting that parts of the skeleton, at least, might not have been too disturbed post mortem (though they were very fragile). An immediate start was out of the question, but there was some pressure as the quarry was due to be landscaped, which would involve the grading of all faces, and the inevitable destruction of the site.

We planned for an early summer 2002 excavation, divided into three or four phases. Phase one would be the removal of the overburden to see what was there. Phase two would be the excavation of whatever we discovered, whilst phase three would be the preparation and conservation of the material. We are currently ending phase two and just about to enter phase three. A fourth phase is envisaged in which the specimen is mounted for display and possible touring exhibition purposes. We might also find time do some science on the remains as well!

Phase one was supported by the Palaeontological Association, English Nature, the Stamford and East Midlands Geological Societies, the Hunterian Museum of the University of Glasgow and the University of Portsmouth. We are very grateful to these organisations for their support; after all, it was Martill who didn't find 5,000 hypsilophodons on the BBC's Dinosaur Isle series the year before (Martill blames Bill Oddie), so they took a huge gamble. Well, the gamble paid off. We found over 2,000 bones across the site. In fact, it seemed we couldn't remove a piece of clay without finding bones. If we found one bone, we found ten. Often we couldn't lift a bone for other overlapping bones, sometimes three layers deep. The entire site became a gigantic game of *jackstraws*. We found a pair of pectoral fins, paired jaw bones, part of the gill basket, numerous cheek and skull roof bones, a giant (87 cm long) palatal bone and several hundred gill rakers. Some parts of the skeleton were articulated while others had travelled widely, probably through scavenging. Our site eventually covered 25 x 5 metres, and we have to return next year to remove a bit more overburden.

The specimen occurred in the Peterborough Member of the Oxford Clay, in the Coronatum Zone, and is thus of Middle Callovian age. Although it is early days, and much preparation of the bones remains to be done, the specimen does appear to be a large example of *Leedsichthys*. Some of the gill rakers are approaching



Volunteers assume the position inthe search for remains of Leedsichthys

Remains of Leedsichthys being uncovered and prepared

130 mm in length and are the largest known. The pectoral fins are incomplete distally, but what we have are each 1.6 metres long. This specimen promises to be the most complete skull ever found and the first example of *Leedsichthys* to be excavated in a scientific manner.

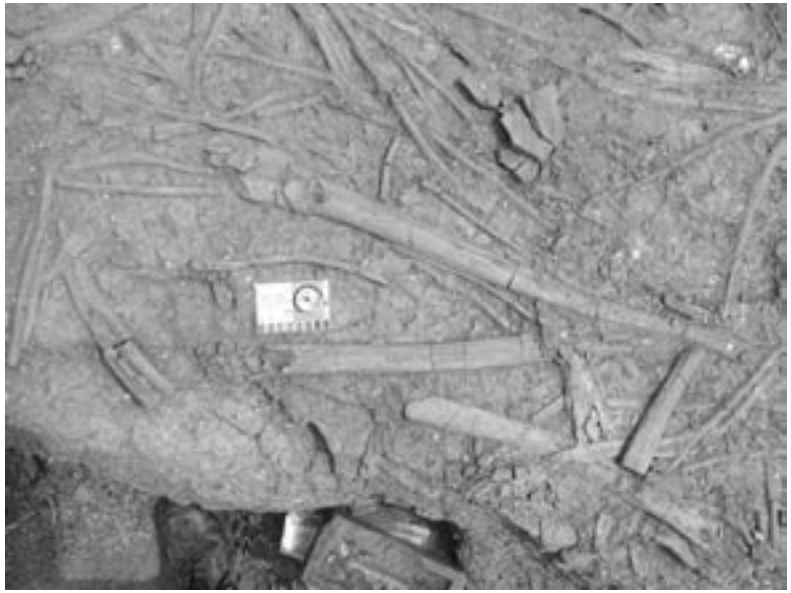
One aspect of this particular dig that amazed us was the sheer size of the beast. Our site was massive and so was the fish, and we only had the head end. Imagine if the specimen had been complete… but the body and tail, it seems, had already been made into bricks. Of course, everyone knows that size doesn't matter, but on this occasion it did. Excavation was not a two-man job. We needed an army of volunteers who needed to be trained. There was no shortage of offers of help, but the dig took all Summer and asking people to give up work (or their holidays) was a tall order. Nevertheless, we had help from students and a battalion of retired amateur geologists all eager to get stuck in. With so many people working in the pit, a party atmosphere soon developed, and our evening barbecues were feasts fit for a king thanks to Stewart Oxley.

And not only did we excavate a fish. While wandering across the site Nick Hannington, one of this year's project students, discovered a nearly complete ichthyosaur. This too was close to the foot of the cliff, and so the excavators were brought back in. This time, a 35 ton bucket excavator was required, as we needed a longer reach to dump the overburden a safe distance away (there being no room for a bulldozer). We got the ichthyosaur out in one piece, which is, to our knowledge, the first time this has been done for an Oxford Clay marine reptile. So now we have our work cut out with two beasts to get cleaned up.

Thanks Pal Ass for your support, and thanks to the many people who volunteered to help. Very special thanks go to the staff at Saxon Works of the Hanson Brick Company who helped in so many ways. Steve Godfrey gave us pretty well anything we needed, including a very welcome Portaloo, a Portakabin for storing the specimens until they could be shipped down to Portsmouth and a pump to drain our excavation out after a particularly nasty storm flooded it.

If you want to see the excavation in action, then look out for a Channel 4 programme next Spring.

Dave Martill and Jeff Liston
School of Earth and Environmental Sciences, University of Portsmouth, UK
<**david.martill@port.ac.uk**>



Abundant skeletal remains of Leedsichthys prepared for site mapping

The Mystery fossil

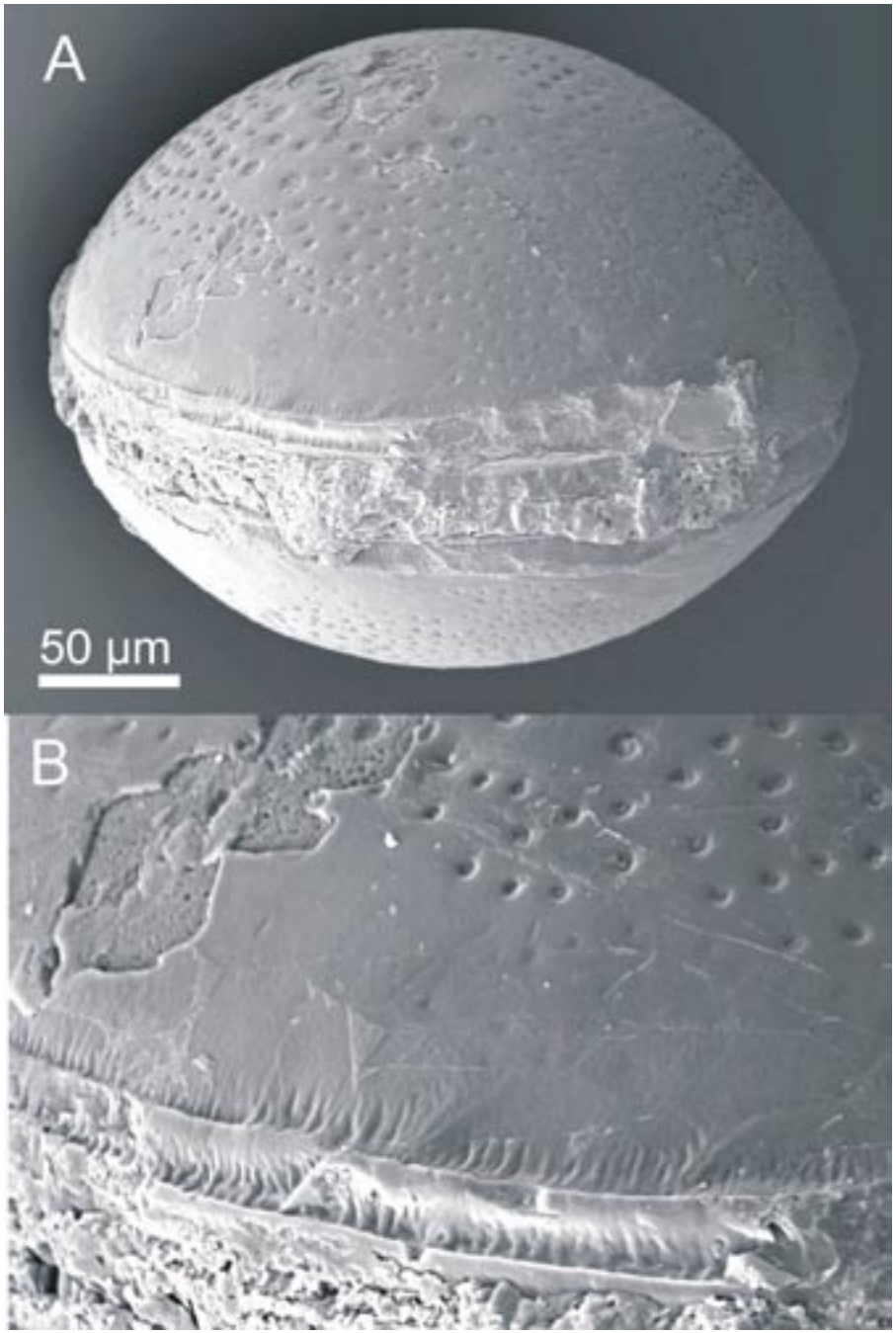
Ever been in the field and picked up a fossil that completely stumped you?

Ever been picking through acid residues and thought "What on Earth is that?".

Ever had the idea that your mystery fossils might be important, but not have the foggiest who to ask to identify them?

Then this new section is for you. Each issue will figure a mystery fossil sent in by members and selected by myself using arbitrary methods. Readers of the Newsletter can then send in their ideas as to the identity of the mystery fossil and these will be published (anonymously if wanted!) in the next issue. Anyone can send in an image of a fossil to feature in the mystery corner or an identification to <**c.little@earth.leeds.ac.uk**>. Please send images as hard copy or in JPEG format (preferred format; please ensure that electronic images are at least 1200 pixels along their long axis and use no more than medium compression) for the images.

To kick off we have Mystery Fossil One—over the page. Two SEM images of a globular microfossil from the Oligocene Lincoln Creek Formation hydrocarbon seep carbonates, Olympic Peninsula, Washington State, USA. B is a detail of the left centre of image A.



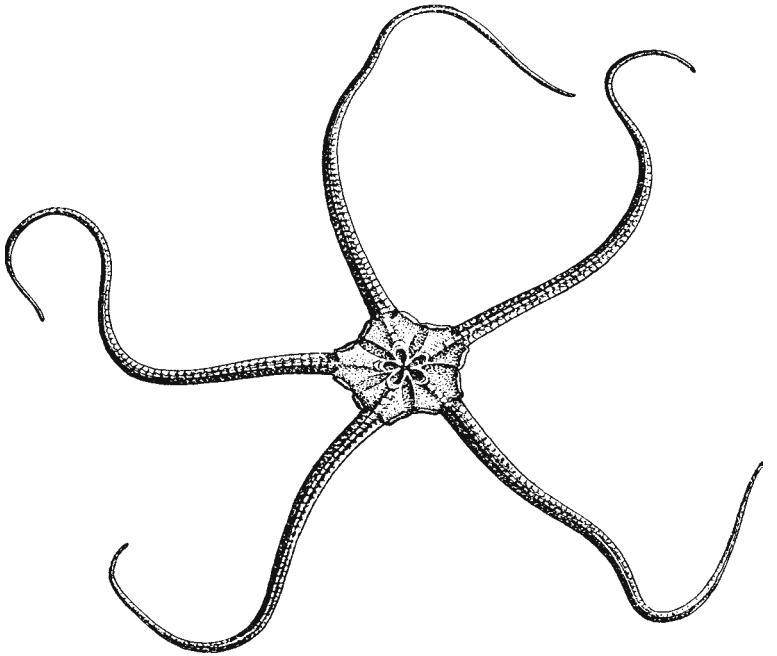
1st London Evolutionary Research Network Conference

London (exact venue to be confirmed)
12th September 2003

The London Evolutionary Research Network (L.E.R.N.) is holding its first one day conference to celebrate the wide range of evolutionary-based research currently taking place in London. It will provide a chance for students of natural history to present their research to a peer audience and meet other students working in London.

This is a call for posters and talks (15–20 minutes long) from final year undergraduate, Masters and PhD students, and postdocs doing research with an evolutionary theme at one of the many universities and institutions in London. It is hoped that the full list of talks will represent a range of topics from as wide a spectrum as possible. Please register and submit abstracts (150 words maximum, stating whether talk or poster) by 13th June.

For further information please contact Marc Jones, Department of Anatomy and Developmental Biology, Rockefeller Building, University Street, University College London, London WC1E 6JJ, e-mail <**marc.jones@ucl.ac.uk**>.



——OBITUARY——

Frank Hodson (1921–2002)

Frank Hodson, palaeontologist and biostratigrapher, Professor of Geology at Southampton University 1958–1981, was one of the more colourful and noteworthy of the Founder Members of the Palaeontological Association. His early career in geology was meteoric; he was appointed to the Geology Department of Reading University under Professor H.L. Hawkins while still working for his first degree of London University, as an external student. Two years later he was awarded a PhD at Reading. It was only nine years after graduating that he was appointed to the first Chair of Geology in Southampton University, and so to the department headship.

Frank, or "Prof." as he was affectionately known to his students and staff, was born in Burnley, and went to Burnley Grammar School. Leaving there at 16 with School Certificate, he worked first as Colliery Clerk at Reedley Colliery, Burnley, and then as Works Chemist at the Lancashire Foundry Coke Company. While in that post he had his first experience in teaching, giving evening classes at Burnley Municipal College. He was already showing his characteristic versatility in having been quoted as saying "You name it, I'll teach it". By 1943 he had been elected to the Geological Society and published his first paper on marine bands in the Millstone Grit. This was a pointer of things to come, for his major research contribution lay in a lifelong commitment to goniatites and their use in Carboniferous biostratigraphy.

On his appointment to the first Chair of Geology in Southampton University, he turned his boundless energy and enthusiasm to building and expanding the scope of teaching and particularly research in the department. One of his most cherished achievements was the move of the Geology Department to a new building and the creation of a geological museum (designed by Sir Basil Spence) in the University, which became as much admired for its imaginative architecture as for its contents. It is typical of the fickle nature of universities' commitments that after his retirement, the museum was demolished, despite his valiant attempt to have it given listed status. His personal research interests developed over twenty years into the history of geology, geochemistry, clay mineralogy, and local Tertiary strata, in addition to archaeology and local history. Music and rare books from his personal library provided relaxation.

It was an expression of Frank Hodson's independent nature that he scorned the affectation of the "field gear" that was becoming popular with geology students in the 50s and 60s, of anorak, mountaineering boots and rucksack with pendant hammer and chisels. He liked to set out for field work "as though he was going out to buy a stamp" as he put it, and thus attired (and often carrying an umbrella) he carried out his field work on the coast of Clare, documenting the goniatites to establish the correlation of the Irish succession with the Namurian of England and the Continent. A Reading colleague, Jimmy Landa, once commented wryly that on one occasion (with justifiable apprehension) he had accompanied Frank "wearing carpet slippers" up the Cliffs of Moher. A former student recalls going from outcrop to outcrop with the Professor singing extracts from the Messiah.

Frank was a great raconteur—always an entertaining after-dinner speaker at Pal. Ass. annual meetings, but equally in more impromptu settings. The same talent was recognised in more formal terms by his appointment as Public Orator for the University. One of his favourite themes was the founding of the Palaeontological Association, of which he liked to say "it was born in a taxi". As a founder member he played a central role with R.G.S. Hudson and others in getting the Palaeontological Association off the ground in 1957, and he served for several years as Honorary Secretary of the fledgling society. The Hodson Fund of the Association is an ongoing legacy.

As head of department at Southampton from 1958–1981, Professor Frank Hodson divided his time between a deep commitment and loyalty to his students and playing a significant role in University affairs and beyond. He was twice Dean Of Science, and was President of Section C of the British Association in 1975. Through his many activities he always found time to talk, not only to students and staff in his department but to administrative, technical and academic staff across the departments of the University, as well as to numerous visitors. His diverse interests and knowledge across the arts as well as the sciences, and of politics, economics, law, sport and music, equipped him to participate in a wide range of debate. He led a very full, active and successful life doing things in his own particular style, with charisma and panache. Many have benefited from his generous personality, his shared academic ability and his friendship. All those qualities will continue to be appreciated—and missed—by members of the Palaeontological Association, his friends, colleagues and former students. He is survived by his wife and their three daughters.

Ronald Austin
21 Bellevue Road, West Cross, Swansea SA3 5QB

Bill Chaloner
Royal Holloway, University of London, Egham, Surrey TW20 OEX.

Frank Hodson, at about the time of his appointment to the lectureship in Geology at Reading University, 1949.

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

Symposium on palaeomammalogy in honour of William Clemens
University of California Museum of Paleontology (UCMP), Berkeley, California, USA *25 – 27 April, 2003*

Bill retired last December and we have organized a reception, symposium and banquet in celebration of his accomplishments. During his career Bill has influenced both the field of vertebrate palaeontology and the academic lives of many palaeontologists as both friend and mentor. The event will include a reception and keynote address on Friday, a day-long symposium on palaeomammalogy followed by an evening banquet on Saturday, and an informal brunch at the UCMP on Sunday morning. The UCMP will be sponsoring the reception, but there is a $15 fee to cover costs of refreshments and coffee (limited to 150 seats), and an additional $40 for those who attend the Saturday evening banquet (limited to 100 seats). Money will be collected at the event, but we ask you to pre-register to allow us to plan for refreshments and the banquet. If you plan to attend, please R.S.V.P. by 21st March to Dr P. David Polly by completing our online RSVP form at <**http://www.ucmp.berkeley.edu/people/wac/celebration/rsvp.html**>, by e-mail to <**d.polly@qmul.ac.uk**>, or by telephone (+44 (0) 207 882-6314). We will need to know which parts of the event you want to attend and how many will be in your party. For questions about the symposium or banquet contact Dr P. David Polly <**d.polly@qmul.ac.uk**>. For questions about visiting the UCMP collections during the event, please contact Dr. Patricia Holroyd <**pholroyd@uclink4.berkeley.edu**>. To send mementos or greetings, please contact Prof. Kevin Padian <**kpadian@socrates.berkeley.edu**> or 001 510-642-7434. For more information about the event, including location, schedule, RSVP form, and information about accommodation in Berkeley, please see <**http://www.ucmp.berkeley.edu/people/wac/celebration/index.htm**>.

British Columbia Paleontological Symposium
Nanaimo, Vancouver Island, British Columbia *2 – 5 May 2003*

The fifth British Columbia Paleontological Symposium will be held in Malaspina University-College, Nanaimo, Vancouver Island, British Columbia, Canada. An exciting variety of presentations, workshops and field trips will appeal to all members of the professional and amateur palaeontological community. The Symposium will feature renowned vertebrate palaeontologist Dr Betsy Nicholls, Royal Tyrell Museum, as the keynote speaker, presenting "Ichthyosaur Update—Current Research on the Ichthyosaur Fauna from the Triassic of Northeastern British Columbia". Registration fee for the Symposium is $65.00 CAD + GST before 1st April 2003. This fee includes the Welcome Reception, banquet, nutrition breaks and the Symposium abstract booklet. For more information visit the Web site: <**http://web.mala.bc.ca/faep/paleo.htm**>.

Bioevents: their stratigraphic records, patterns and causes
Caravaca de la Cruz, Spain *3 – 8 June 2003*

Pre- and post-meeting field-trips will be organized, with geological and/or cultural interest. During the meeting there will also be other scientific-cultural activities, related to Caravaca and the geological setting of the Murcia region. For further details contact: Diego MarÌn Ruiz de AssÌn, SecretarÌa de Bioeventos 2003, Ayuntamiento de Caravaca de la Cruz, 30400 Caravaca, Spain, e-mail <**BIOEVENTOS@telefonica.net**>.

Applied micropalaeontology short course
Department of Paleontology, University at Bonn, Germany
12 – 14 June 2003

Organised by David Jutson, Gitte Laursen, Emma Sheldon and Martin R. Langer. Applied micropalaeontology and biostratigraphy are integral tools in the exploration for oil and gas. Provided that the global population and economy will continue to grow at the current rate, the demand for fossil fuel energy resources will remain at a high level for at least another 60 to 80 years. This provides the economic incentive to sustain and reinvigorate training programmes in the university community to meet the future demands for stratigraphic (micro-)palaeontologists in the next several decades. The course is designed to give the participants an introduction to, and an understanding of, the methods that have been developed to apply micropalaeontology to the requirements of the hydrocarbon industry. A full description of the various stages of drilling a well will be given with discussion of how these processes affect the sample material recovery and quality. The various techniques employed by industrial micropalaeontologists from collecting sample material to applying the analytical results will be discussed and demonstrated in practical exercises. It is hoped that the course will give the participants an insight into applied micropalaeontological methods that will aid the understanding and application of analytical results when they are dealing with drilled material for academic or industrial purposes, and in this respect it should be particularly useful for academic researchers who undertake work for oil companies and students contemplating working in oil exploration and production. The course "Applied Micropalaeontology" is intended for geology/palaeontology students at advanced, undergraduate or early postgraduate level who have a keen interest, but little experience, in industrial and applied micropalaeontology. Additional information and further programme details are available at <**http://www.Paleontology.uni-bonn.de/mitarbeiter/LANGER/INDEX.HTM**>.

9th International Symposium on Fossil Cnidaria and Porifera
Graz, Austria *3 – 7 August 2003*

Further details on the meeting can be obtained from <**http://www.paleoweb.net/cnidaria/**>.

Second Symposium on Mesozoic and Cainozoic decapod crustaceans
Oertijdmuseum de Groene Poort, Boxtel/Natuurhistorisch Museum Maastricht, the Netherlands *3 – 6 September 2003*

All aspects of decapod crustacean palaeontology, palaeoecology and palaeobiogeography will be outlined and discussed in two days of oral and poster presentations, grouped according to subject matter covered. Added to this is a full day of field work in the type area of the Maastrichtian Stage (Late Cretaceous), during which the crab-rich type Maastrichtian strata and the peculiar K/T boundary section of the Geulhemmerberg nearby will be visited (Maastricht area, southern Limburg, the Netherlands). Type material of all Late Cretaceous decapod crustacean taxa described in recent years will be on display at the Oertijdmuseum de Groene Poort, north of Eindhoven in the southeast of the Netherlands, for the duration of the symposium.

The second circular, with a preliminary programme and details regarding accommodation and submission of extended abstracts, will be sent out late 2002/early 2003.

For further information please contact Dr René H.B. Fraaije, <**info@oertijdmuseum.nl**> or Dr John W.M. Jagt, <**john.jagt@maastricht.nl**>.

Mantle plumes: Physical processes, chemical signatures, biological effects
Cardiff University / National Museum, Cardiff, Wales *10 – 11 September 2003*

The meetings will be convened by Andrew Kerr (Cardiff University), Richard England (University of Leicester), and Paul Wignall (University of Leeds). Mantle plumes potentially link the Earth's internal convection with the evolution of life. The ascent of hot asthenospheric mantle beneath the lithosphere can be the catalyst for the formation of ocean basins, reshaping the Earth's surface, and the massive outpouring of lavas, ashes and gas can have significant effects on climate, destabilising the ecosystem and thus having the potential to dictate the course of evolution.

This meeting will address the validity of these links by bringing together geophysicists, petrologists and palaeontologists to discuss the current state of knowledge of mantle plumes and their effects on the environment through geological time. A two-day meeting will be held at Cardiff University and the National Museum & Gallery Cardiff on 10–11 September 2003. The key themes of the meeting will include: What do plumes tell us about mantle circulation? Where do they originate from, 670km? Can present plumes be used to infer the nature of past plumes? What are the sources of plume material? What can the latest petrological results tell us? What is the geology of plume related magmatism? What can we deduce about the frequency and magnitude of eruptions and their potential effects, from the recent and the past? Does the formation of large igneous provinces cause mass extinctions? If so, what is the kill mechanism? Why do most large igneous provinces slightly postdate the start of associated mass extinction events? Are they the final straw?

Specialist keynote speakers will be announced in forthcoming circulars. It is anticipated that selected papers from the conference will be published as a Geological Society Special Publication. Those interested in contributing to the meeting should initially send a provisional title, and authors, to Andrew Kerr. Abstracts will be requested at a later date. To register for

future e-mail circulars please contact: Dr Andrew C. Kerr, Department of Earth Sciences, Cardiff University, Main Building, Park Place, Cardiff, Wales, UK CF10 3YE (tel +44 (0) 29 2087 4578; fax +44 (0) 29 2087 4326; e-mail <**kerra@cf.ac.uk**>). The meeting Web site is <**http://www.earth.cf.ac.uk/news/kerr_meeting.htm**>.

The Rhynie Hot Spring System: Geology, Biota and Mineralisation
Aberdeen, Scotland *17 – 20 September 2003*

This international conference and workshop on the Early Devonian Hot Spring System will serve as a forum for discussion on all aspects of the Rhynie cherts, and will aim to produce a synthesis of our current understanding of this unique Early Devonian ecosystem. Descriptions of new plants and arthropods will be presented, and studies of modern hot springs will provide analogues to explain the exceptional preservation of such biota. Models outlining the geological evolution of the Rhynie area, and the origin of the cherts in particular, will also be presented.

For further details please contact the convenors, Dr Nigel Trewin and Dr Clive Rice, at Rhynie Chert Research Group, Department of Geology and Petroleum Geology, Meston Building, King's College, University of Aberdeen, Aberdeen, Scotland, AB24 3UE; e-mail <**rhynie@abdn.ac.uk**>. Information about the Rhynie chert can also be found on our Web site at **<http://www.abdn.ac.uk/rhynie/>**.

8th International Symposium on Fossil Algae
Granada, Spain *18 – 20 September 2003*

Following the decision of the closing meeting of the 7th International Symposium on Fossil Algae in Nanjing, the 8th ISFA will be held in Granada (Spain) from Thursday 18th to Saturday 20th September 2003. The aim of the Symposium is to provide a forum for all researchers interested in any aspect of the palaeobiology, biology and geological significance of calcareous algae and bacteria. Contributions on the biomineralization, taxonomy, evolutionary history, biogeography, ecology and palaeoecology, sedimentology and biostratigraphy of these groups will be welcome.

16–17 September: Pre-Symposium Field Excursion, Alicante.

18–20 September: Sessions, Granada.

21–22 September: Post-Symposium Field Excursion, Almeria.

The Pre-Symposium Field Excursion will focus on Cretaceous and modern Charales and Cretaceous dasycladaleans. Leaders: Bruno Granier and Carles Martin-Closas. The Post-Symposium Field Excursion will be devoted to Miocene microbial carbonates and Halimeda bioherms, and Pliocene coralline red algae. Leaders: Julio Aguirre, Juan C. Braga, Jose M. Martin and Robert Riding.

For further details contact Juan C. Braga or Julio Aguirre, Departamento de Estratigrafía y Paleontología, Facultad de Ciencias, Universidad de Granada, Campus Fuentenueva s/n, 18002 Granada, Spain; e-mail <**jbraga@ugr.es**>, <**jaguirre@ugr.es**>.

63rd Annual Meeting of the Society of Vertebrate Paleontology
Radison Riverfront Hotel, St. Paul, Minnesota, USA *15 – 18 October 2003*

This year's meeting includes the following symposia: High-latitude Mesozoic and Cenozoic vertebrates: Evolution, palaeoclimate and palaeogeography (Case and Jaelyn Eberle); Biomineralization: Patterns, processes, and analysis of modern and fossil vertebrate skeletal tissues (Mark B. Goodwin and Sandra J. Carlson); Evolutionary transitions among vertebrates: A symposium in honour of Robert L. Carroll (Jason S. Anderson and Hans-Dieter Sues); Preparators Symposium.

There are also two field trips associated with the meeting: Minnesota's north shore—The Iron Range, World-class stromatolites, a failed rift, and wolves (12–14 October); Vertebrate palaeontology of the High Plains—The Late Mesozoic/Cenozoic record of North Dakota (12–14 October). Further details of the meeting can be obtained from <**http://www.vertpaleo.org/**>.

Seventh International Organization of Paleobotany Conference
Bariloche, Argentina *21 – 26 March 2004*

This conference takes place at the Llao Llao Hotel and Resort on the Andean Range. The VII IOPC is open to all those interested in fossil plants as well as scientists linked to plant biology and geology disciplines. For additional information, please check the meeting Web page at <**http://www.iopc2004.org/**> or contact the organizer by e-mail to <**info@iopc2004.org**>.

XI International Palynological Congress (IPC2004)
Conference and Exhibition Centre, Granada, Spain *4 – 9 July 2004*

This international conference will bring together all those people actively involved or interested in the study of pollen from a wide variety of standpoints (botany, biology, environmental sciences, medicine, palaeontology, sedimentology, archaeology). Symposia include: Pollen biology, Pollen and spore morphology, Aerobiology, Pollen and allergy, Entomopalynology and melissopalynology, Forensic palynology, Palaeopalynology and evolution, Quaternary palynology and World pollen databases. The meeting includes a number of pre- and post-congress fieldtrips to Andalusia, south-eastern Spain, Morocco, central Spain, Camino de Santiago-Picos de Europa, Canary Islands, Balearic Islands. Further details can be obtained from the Technical Secretary (tel +34 958 208650, fax +34 958 209400, e-mail <**eurocongres@eurocongres.es**>), and on the Congress Web site at <**http://www.11ipc.org/**>.

International field seminar
Kerman, Iran *14 – 18 April 2004*

Iran has a rich and varied geology, but much of it remains little-known outside the country. In Kerman Province (east-central Iran) there are especially well exposed and extensive sequences of Cambrian-Ordovician-Silurian-Devonian rocks, Jurassic-Cretaceous sediments, and Cenozoic rocks including sediments, metamorphic complexes and extensive volcanics. This notice is the first announcement of plans to hold a field-based seminar programme centred at the University of Shahid Bahonar, Kerman City. Estimated costs are US $950 to include registration, accommodation, all meals and field transportation (students US $600). Day 1: Introductory lectures on the geology of Iran. Days 2,3,4,5: Fieldwork covering four separate themes (Lower Palaeozoic-Devonian stratigraphy and faunas; Jurassic-Cretaceous geology and faunas; Cenozoic sediments, volcanics and structure; Economic geology including ore mineralogy and regional metamorphism). Each theme will run separately over the full four days of fieldwork, with co-ordination and guidance by local experts. For further details contact either Assoc. Prof. Mohammad Dastanpour (Department of Geology, Shahid Bahonar University, P O Box 76169-133, Kerman, Iran, Fax: [+] 98 341 2267 681, <**dastanpour@mailuk.ac.ir**>), or Prof. Michael G. Bassett (Department of Geology, National Museum of Wales, Cardiff, CF10 3NP, Wales, U.K. Fax: [+] 44 2920 667 332, e-mail <**Mike.Bassett@nmgw.ac.uk**>). For those who express an initial interest in participating in this programme, we anticipate sending a full circular and registration details in early January 2003. In responding to this first announcement, please state your specific area(s) of interest.

Ichnia 2004: First International Congress on Ichnology
Trelew, Patagonia, Argentina *19 – 23 April 2004*

Aims and Scope: we have foreseen the necessity and convenience for convening a large, international meeting where researchers with a bewildering variety of backgrounds and interests gather to exchange their different views of Ichnology. It is expected that this exchange will strengthen our discipline and enhance its recognition from the scientific and technical community. We intend to trace, extend and fortify existing bridges between different fields of Ichnology, *e.g.* between palaeoichnology and neoichnology, vertebrate and invertebrate ichnologists, benthic ecologists and palaeoichnologists, soft and hard substrate ichnologists, *etc*. We strongly encourage the participation of a wide variety of non-ichnological scientists in the meeting. Should a soil scientist working on the micromorphology of modern earthworm burrows and its destruction by trampling attend this meeting? What about a biologist or palaeontologist that works on biomechanical interpretation of extant or fossil organisms? Will an anthropologist contribution on human faeces or footprints be welcomed? Could a zoologist working on bioerosion or benthic bioturbation contribute to this meeting? The answer to all these questions is YES, and we wish further to extend the invitation to petroleum geologists/engineers, wildlife biologists, reef biologists, trackers, entomologists, and any other scientist working on Ichnology-related issues.

The meeting will be held at the Museo Paleontológico Egidio Feruglio (MEF), located at the city of Trelew, in the Argentine Patagonia. The MEF is a modern Museum engaged in research and educational activities essentially related to the rich palaeontological content of the Patagonia. Congress sessions will be held from 19th April to 23rd April 2004. Pre, intra, and postcongress trips are scheduled. Preliminary symposia (to be confirmed) include: trace fossils and evolutionary trends; bioerosion in time and space; vertebrate ichnology; biomechanical and functional interpretation of trace fossils; the ichnofabric approach; applications of trace fossils in facies analysis; sequence stratigraphy and reservoir characterization; trace fossil taxonomy; ichnology and benthic ecology.

Visit the conference Web site for further details, at <**http://www.ichnia2004.com/**>.

Computer techniques in the modelling and analysis of biological form, growth and evolution
Firenze, Italy *August 2004*

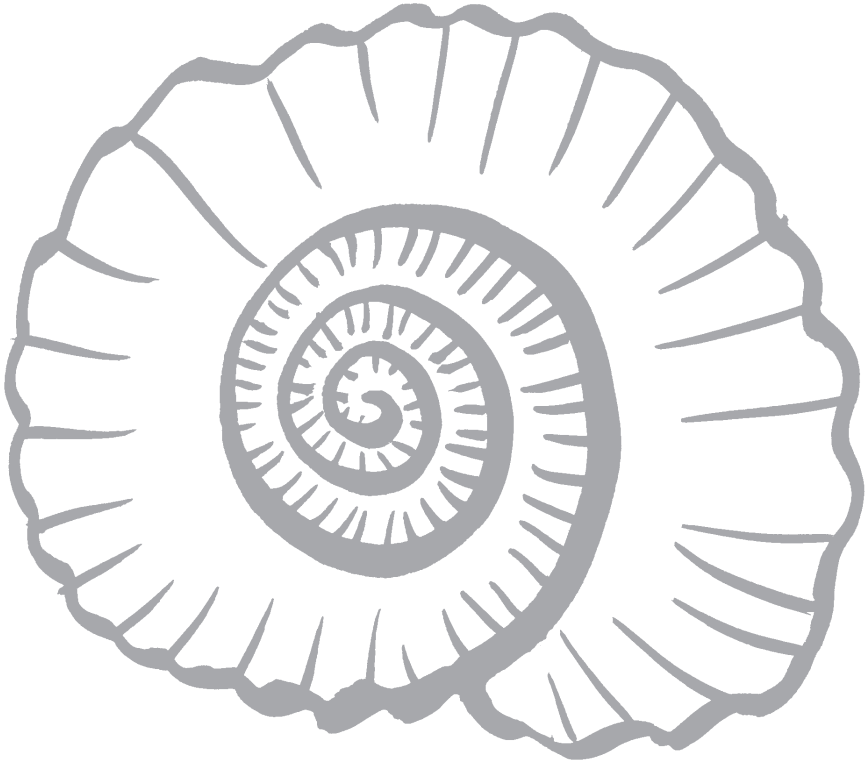
The 32nd International Geological Congress will take place in Firenze, Italy, in August 2004. The first circular is available on-line on the Congress Web site. The first of the general symposia planned in section G17 (Palaeontology) is entitled "Computer techniques in the modelling and analysis of biological form, growth and evolution". Organisers are Enrico Savazzi (Uppsala University <**enrico.savazzi@pal.uu.se**>) and Richard A. Reyment (Swedish Museum of Natural History <**richard.reyment@pal.uu.se**>). The symposium will encompass the following five topics:

- Theoretical morphology of biological skeletons: This topic includes all techniques for generating and displaying models of biological skeletons. Different approaches will aim at modelling morphology alone, or at modelling the growth and constructional processes that govern skeletal morphology.
- Morphogenesis of colour, relief and structural patterns: Unlike the foregoing topic, which has long been the domain of palaeobiologists, this aspect has been largely studied by biologists. It deals with smaller-scale patterns on or within skeletal parts. Of special interest to palaeobiologists are the modelling of morphogenetic programmes producing surficial patterns on shells that grow by marginal accretion, and the modelling of the genesis of microstructures in these shells.
- Modelling of evolutionary processes: This a little developed area of computerized modelling but one that has a high potential. It embraces all aspects of the modelling of evolution, and contributions integrating evolutionary and morphological modelling will be especially welcome.
- Computer-assisted statistical and morphometric techniques: This topic is concerned with applications of geometric morphometrics to problems in the analysis of shape-variation in organisms, though with particular emphasis on advances in Geometric Morphometrics in the spirit of Bookstein, Dryden, Kendall, Kent and Mardia.
- Computer-assisted imaging techniques applied to palaeobiology: This topic will embrace applications of results accruing from image-analytical aspects of morphometrics. Although connected to the foregoing topic, this field involves a different area of expertise.

The symposium will take place over half a day, and will consist of approximately six to eight oral contributions, some from invited speakers. A poster session in connection with the symposium is possible, and can be used to host contributions that cannot be accommodated in the oral part of the symposium. We encourage the submission of volunteered abstracts and expressions of interest in participating by other scientists. Submission of abstracts by invited and volunteering speakers and/or poster proposers should meet the deadline in late November, 2003.

Since the International Geological Congress is very large, funds will not be available to subsidise symposium organisers and invited speakers. However, a Geohost program will be available, mainly to help individual scientists from developing countries to help cover their attendance costs. Information on this will be available on the Congress Web site. Contact the organizers (Savazzi and Reyment) for more information.

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



Meeting REPORTS

SVPCA 50
University of Cambridge, UK *9 – 15 September 2002*

The 50th Symposium of Vertebrate Palaeontology and Comparative Anatomy (SVPCA) was pretty aptly described by its title, as papers covered fish, amphibians, reptiles, birds and mammals from (almost) every continent over a three day period! It was a well attended conference with at least 150 delegates, many of whom had come from overseas. The organisers (David Norman, Paul Upchurch, Leslie Noè, Sarah Sangster and Alison Allen) gave us ample chances for both alcohol and discussions with a reception in the Zoology Museum that provided a welcome opportunity to examine an exhibition of tetrapod specimens with a glass in hand, whilst the Sedgewick was the venue for another sociable evening of wine-tasting and fossil viewing.

There was a total of 54 talks over the three days of which I shall mention but a few:

Norbert Micklich (Darmstadt) gave a very interesting presentation on the fish remains from Messel. A detailed morphometric analysis of fish lengths and scale morphology revealed that the majority of remains were of juveniles rather than representing the full range of sizes in the population. This suggests that Messel was a nursery for young fish, and that contrary to some suggestions, the lake system was not permanently isolated.

The latest instalment of the ongoing hunt for *Leedsichthys* was discussed in a talk by **Jeff Liston** (Glasgow). This giant fish seems to be causing much head scratching, not least because the only recent discovery is below some 15 metres of overburden in a Peterborough quarry. Recent work in museum collections and archives up and down the land has led to the rediscovery of many pieces, including a substantial specimen in the Hunterian Museum, Glasgow.

Mark Wilkinson and **David Gower** (NHM, London) were responsible for the worst pun in the title of a talk, with '*the Caecilian phallus – a systematic tool*?' This presentation looked at the soft tissue of male caecilians and suggested that their morphology might have useful diagnostic or phylogenetic value. First of all though, you need to be able to find and catch your beastie.

David Unwin (Berlin) gave a talk (co-authored with Daniel Elvidge) which highlighted a simple but very effective method of displaying limb bone measurements. They were looking at the morphometrics of pterosaur hindlimbs, using the length of the major long bones—femur, tibia and 3rd metatarsal—and comparing them with birds and bats. Their results were displayed using ternary plots which were very clear and showed that in terms of hindlimb diversity, pterosaurs were more similar to bats than birds.

Chad is an area that has featured widely in recent discussions with the discovery of a new hominoid skull (*Sahelanthropus tchadensis*). What tends to be less widely discussed, but is of equal interest, is the variety of other animals which are also being discovered at these sites. **Jean-Renaud Boisserie** (Poitiers) presented information on the wide range of Pliocene hippo remains which have been found in the Djurab Desert. These fossils suggest that Chad had an endemic lineage of hippos in the Early Pliocene and that members of the family Hippopotamidae may well be of use for biostratigraphy.

All in all, SVPCA is a very enjoyable meeting, in which a very wide variety of topics are covered and people are friendly and approachable. This year's organisers did a great job and were also very cunning in holding the conference dinner after the last day's session—which meant that the final afternoon had a larger audience than usual—perhaps an idea that other conferences could consider?

The 51st SVPCA meeting is in Oxford from 17th to 19th August and should be well worth attending. More information about SVPCA can be found on Richard Forrest's excellent Web site at <**http://www.svpca.org/**>.

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Geological Society of America Annual Meeting
Denver *27 – 30 October 2002*

The GSA Annual Meeting is an enormous affair relative to most scientific meetings. To compare the numbers of talks and delegates to a meeting like the Pal Ass Annual meeting a log-scale would be in order. In addition to the palaeontological sessions, all aspects of geology seem to be covered by at least a couple of sessions. Everything from the impact of geological data to public policy to planetary geology is represented. To appreciate how far geology has gone to becoming "earth sciences", and the sheer range of disciplines that now come under the "earth sciences" umbrella, the GSA annual meeting can't be beaten.

GSA is also an excellent venue to set up job interviews, meetings with colleagues from far-flung corners of the globe. There is also a large graduate school fair, which provides an opportunity to talk to graduate students and faculty from North American universities, and get started on the application process to graduate school.

One slightly "underground" aspect of the GSA meetings is the "Friends" groups. These meetings of kindred spirits are mainly centered around various palaeontological topics. They are an excellent way to meet other people interested in particular topics or taxonomic groups, and to exchange contacts and information. At this point I will shamelessly abuse my position to plug "Friends of the Cephalopods", and encourage anybody out there who is a cephalopod researcher or is at all interested in cephalopods, fossil or living, to contact Neal Larson by e-mail to <**ammoniteguy@bhigr.com**>, and join us.

One major improvement at the meeting this year was extremely efficient handling of computer-based presentations over a centralized computer network. I commend the organizers and technical staff from both GSA and the Denver Conference Center. The ability to edit talks up until the morning of your presentation was a tremendous help, especially if you haven't quite completed all the analyses you mentioned in the abstract you wrote three months previously.

Due to the sheer magnitude of the meeting, I have opted to report on some talks that I personally found interesting. I apologize to anyone reading this whose talk I was at, but skipped over. I haven't quite made it to the point of adopting the strategy of one well-known palaeontologist who attaches a rather puckish note saying "I'm sorry I missed your talk" to his badge. However, this neatly sums up the fact that there is simply too much going on at GSA to take it all in, or write it all up! For a much more complete picture of the talks presented at the meeting visit the section of the GSA Web site dedicated to the meeting, at <**http://www.geosociety.org/meetings/2002/**>.

Charles Ciampaglio (Duke University) got the session "Quantifying Morphology and Morphological Trends" off to an excellent start. He used disparity measures of crinoids and articulate brachiopods to test whether decreasing morphological innovation over geological time could be attributed to either developmental or ecological constraints. In his introduction Ciampaglio gave one of the most lucid and engaging explanations of the use of morphospaces to address evolutionary questions that I have seen. Ciampaglio used the elegant approach of comparing disparity before and after three mass extinctions, making the assumption that ecological constraints are removed by mass extinctions, and any failure to regain pre-extinction levels of disparity would signal developmental constraints.

In most of the cases examined pre-extinction levels of disparity were regained or exceeded after the mass extinctions. From this result, Ciampaglio argued that increasingly more rigid ecological guild structures, not developmental constraints, were the major factor in constraining large changes in disparity through the Phanerozoic.

Mark Webster (University of California, Riverside) gave an excellent, if unsettling, talk re-examining the phylogeny of Early Cambrian ollenelid trilobites, emphasizing the importance of considering the effects of ontogenetic information and within-genus character variability on phylogenetic reconstructions. Webster contrasted a published genus-level phylogeny of Early Cambrian ollenelid with a number of his own analyses that incorporated ever denser and more detailed sampling of taxa.

Webster examined the effects of sampling multiple species within genera and demonstrated that novel, phylogenetically informative characters arose in some species, and that considerable variation and non-independence among characters was detected when denser taxonomic sampling was employed. The talk raised serious issues about sampling and character definition that I think must be addressed, but also pointed to the great promise such studies have for improving the robustness of phylogenetic hypotheses, and for enhancing our understanding of the distribution of variation in clades.

Brenda R. Hunda (University of California, Riverside) presented a careful analysis to challenge the putative heterochronic origins of the "dwarf" Upper Ordovician trilobite genus *Flexicalymeme*. A rigorous geometric morphometric analysis comparing the cranidias of *Flexicalymeme* specimens to larger calymenids from other formations demonstrated that *Flexicalymeme* showed shape as well as size changes, establishing that *Flexicalymeme* was not simply a miniaturized version of larger calymenid trilobites. Further analysis, using size standardization, demonstrated that *Flexicalymeme* and the larger specimens have different ontogenetic trajectories, entirely ruling out heterochrony as the evolutionary process responsible for the origin of *Flexicalymene*.

David K. Jacobs (University of California, Los Angles) presented the second talk I heard in the space of a few weeks last autumn that raised serious questions about the assumptions involved in using molecular clocks to estimate the timing of the metazoan radiation. **Kevin J. Peterson** (Dartmouth College), who followed Jacobs in this GSA session with a presentation on a different topic, gave a critical talk along similar lines to that of Jacobs at the University of Chicago a few weeks earlier.

The first source of bias that Jacobs addressed was the practice of comparing well-sampled clades with poorly known outgroups. This was presented as a source of potentially serious errors in branch length estimation. This could lead to the appearance of longer branches at the base of clades, giving rise to overestimates of branch lengths.

Jacobs then presented an illuminating discussion of the properties of the genomes of model organisms used to assign divergence times to nodes on the metazoan phylogeny. Jacobs made a convincing case that rapid development and small genome size, the very traits that make *C. elegans* and *Drosophila* ideal subjects for developmental research, make these organisms unsuitable for estimating divergence times between the higher-level groups they are used to exemplify. The rapid evolution of the genomes of these organisms can give the impression of much earlier divergence dates than there is any evidence for in the fossil record. This worrying state of affairs was compounded by the fact that vertebrate genomes have a slower rate of evolution, a further potential source of error. Hopefully this will lead to more considered choices of organisms for estimating divergence times in molecular studies.

Ann F. Budd (University of Iowa) gave a timely presentation on database integration, a challenge many researchers are facing across a range of disciplines. Budd discussed a project to merge two databases containing fossil and recent data relating to the coral family Poritidae. The project made use of query structures to created dynamic links between the two databases, avoiding the need for standardized fields. The result was the rapid integration of relevant information from both databases. Budd demonstrated the potential this approach has to save time, money, and effort by eliminating the need to rebuild the databases from scratch. The project was a model for progress in this field, and plans to make the tools available for general use were announced. These tools should be of great use to the growing numbers of researchers who are attempting to integrate information on recent and fossil taxa.

Johnathan D. Marcot (University of Chicago) combined information on molecular and morphological rates of evolution in ruminant artiodactyls to investigate whether any support exists for a putative radiation that has been implicated as a source of problems in resolving the phylogeny of the group. To test this hypothesis Marcot compared morphological rates of character evolution between the background and radiation intervals.

Rates of per-genus character evolution were calculated along branches and then the branches were divided into those that originated during the period of the putative radiation, and those that diverged outside of this period. No significant difference could be detected between these two groups. However, a second analysis, which contrasted the branches that led directly to the families involved in the radiation with the other branches in the phylogeny, did find significantly higher rates of character change in the first set of branches. The talk was an excellent example of the power of integrating molecular and morphological data to test an evolutionary hypothesis.

A.A. Ekdale (University of Utah) gave the most entertaining talk that I heard at GSA this year, although I was rather dubious about his conclusions. Ekdale suggested that palaeontologists

should follow the lead of other fields in which data are converted to sound patterns, and argued that this "sonified" data may enable detection of previously cryptic information about fossils that is not immediately apparent to visual techniques.

Battling technical difficulties with his tape recorder, he presented a couple of examples. The first was ammonoid sutures, and this was his chance to win me over, as the analysis of suture forms is a perennial problem in ammonoid studies. However, sonification failed at this first test for me. The suture came from *Meekoceras*, a Triassic ammonoid I am very familiar with, and I simply could not hear the lobe serrations at all.

Ekdale went on to generate a "soundscape" based on trace fossil data. While the resulting composition was pleasing, after the fashion of a BBC Radiophonic workshop piece, I fear I will be sticking to visual and mathematical data analysis for now. The talk did highlight that it is still possible to use conference presentations to advance novel ideas, and I commend his courage for doing so.

Gregory J. Retallack (University of Oregon) started his presentation with a lengthy anecdote about his ambition as a young man to become a mountain guide. He had to settle for geology instead due to a predisposition to extreme altitude sickness, which was nearly fatal on one occasion.

Having thus secured the undivided attention of his audience he proceeded to discuss the geological evidence for substantive and ecological changes in the Karoo Basin across the Permo-Triassic boundary. The sedimentalogical evidence indicated a shift to warmer, wetter conditions during the Triassic, and an accompanying change in the vegetation in the Karoo. The link to his mountaineering anecdote became clear when he discussed the turnover in the vertebrate fauna in the Karoo. Retallack argued that the Permian therapsids were fairly specialized, whereas the lystrosaurs were relatively unspecialized forms. The lystrosaurs also possessed several anatomical features, also found in modern mammals from high altitude areas, that would have pre-adapted them for the lowered oxygen conditions Retallack believes were prevalent during the Early Triassic. By contrast, the therapsids would have been vulnerable both to ecosystem changes due to their ecological specialization, and potentially lethal complications, similar in nature to those Retallack suffered when he was training as a mountain guide.

Well, that is my highly biased sample of the talks from the 2002 GSA annual meeting. The 2003 meeting is going to be held in Seattle between the 2nd and the 5th of November. Hopefully this article may convince you to make the trip.

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46th Annual Meeting of the Palaeontological Association

Cambridge *15 – 18 December 2002*

Long before the 46th Annual Meeting was due to begin, Nick Butterfield warned delegates that Cambridge was not particularly car-friendly and recommended alternative forms of transport. Despite this, a quartet of Ph.D. students including yours truly decided to take matters into our own hands and drive anyway. Traversing the M6, then the A14 across central England we reached Cambridge quickly and without difficulty by mid-afternoon Sunday, allowing ourselves a certain degree of self-congratulation. Our parking space, not to mention accommodation, would surely not prove too difficult to locate.

One hundred and fourteen circumnavigations of the town later (with plenty of circum and precious little navigation) the smugness evaporated and we elected to dump the vehicle in a multi-storey car park. On Shanks's pony, we ascertained the whereabouts of Gonville & Caius, the Sedgwick Museum *et al*. in a fashion more befitting a mediaeval city of tortuous, rarely uncobbled one-way streets. Unfortunately, the price of gaining a working knowledge of inner Cantabrigian geography was the erasure of our memory of where the car was parked and we now found ourselves stumbling hopelessly around a concrete labyrinth that appeared considerably more multi-storeyed than it had been an hour or so earlier.

Imagining the mocking laughter of myriad East Anglian town planners, we pulled ourselves together, found the car, escaped the clutches of NCP, and drove unerringly to our properly allocated space. With luggage, the walk from Selwyn College (where we now were) to Trinity Hall (where we needed to be) might as well have been a cross-fenland hike from Huntingdon, but we were past caring. For ever doubting the accuracy of Nick's transport recommendations, I apologize profusely, although I fear I may not have been quite so magnanimous at the time.

Never before in the history of human conferences have so many ice-breaker beers been so gratefully drunk by so few, and in such splendid surroundings. The impressively revamped Oak Wing of the Sedgwick Museum formed a perfect backdrop to the traditional PalAss opening ceremony, and the turnout wasn't bad either. Over 300 delegates from the UK, Europe, North America and beyond made this the largest annual meeting ever held and proved beyond doubt that palaeontology is thriving. And when not thriving, palaeontologists are commonly imbibing, such that it was soon deemed necessary to hit the town.

This was done, and I suspect that at least some of the participants were experienced at this sort of thing because the town was not so much hit as mercilessly pummelled. Being a Sunday, English licensing laws dictated that the assault must cease at 10.30pm but, for a section of academia so skilled in unearthing obscure funding sources, finding a lock-in was a pitiful challenge. In the company of a couple of fellow Brummies and a trio of Daves (is there a collective noun?) a tavern displaying the required character states—unlocked door and manned bar—was tracked down and we took a seat.

Now, call us unobservant, but we genuinely didn't notice that our table was in the 'Queen's Enclosure' or that the artwork on the walls was almost exclusively of semi-naked men. It was only when a tall, stocky chap in a floral dress entered the ladies' toilets that we began to wonder if perhaps we'd missed something. Presumably noting our expressions, the amused barman

said, 'You do realize this is a poofs' pub don't you?' to which we rather sheepishly admitted that the thought had just crossed our minds. Clearly we need to get out more, but our naïvety did at least elicit his sympathy and a final round of drinks before he closed the bar.

Monday 16th December

Session 1

So after the confusion of Sunday, the only appropriate antidote was the sanity of a packed schedule of talks on Monday. The Physiology Lecture Theatre was crammed to the rafters for **Nick McCave**'s welcoming address—his 'normal reaction to fossils is to dissolve them', apparently—before **Phil Donoghue** was granted the pleasure of giving the first presentation. Few fossils show animals in the earliest stages of development, but embryos of *Markuelia* are preserved in the Cambrian of China and the Ordovician of North America. Phil showed that *Markuelia* is a stem-group scalidophoran that underwent direct development, refuting previous suggestions of an affinity with halkieriids. Further developmental data such as this will prove very useful in analysing homologous characters in early taxa.

It was no reflection on Phil or the speakers who followed him, but by now I had left the lecture theatre, having come over all queer. Kindly souls continued the note-taking, though, and the next talk was by **Phil Wilby** on some exceptionally preserved Jurassic cephalopods. A new locality in the Oxford Clay of Wiltshire has yielded a mass mortality horizon of phosphatized squid, many aligned in pairs. It appears that a school of coleoids was overcome by anoxic conditions, creating a predator trap where live squid were attracted to feast on the dead ones, only to fall victim themselves.

Charles Wellman then used new microfossil material from the Ordovician of Oman to show that land plants were certainly present before the first (Silurian) megafossils, but their true nature remains unknown. **Norman MacLeod** argued that morphometric analysis certainly can be used to gain further information on character states for cladistic analysis, before **Dolf Seilacher** investigated the reasons behind the shapes of pelagic crinoids. The variety of forms known indicates many modes of life, including passive floaters, active filter-feeders, and even species that utilized tow-nets.

The first session was completed with a change to the schedule as **Henning Blom** looked at the role of paedomorphism in the transition of fish to tetrapods. Skulls of two Greenland species of *Ichthyostega* suggest that the younger *Ichthyostega eigili* is paedomorphic in comparison with *Ichthyostega stensioei* and that this may have been significant in enabling primarily aquatic tetrapods to adapt to life on land.

Session 2a

After coffee, the number of presentations necessitated the employment of parallel sessions, with one lecture theatre hosting talks on marine palaeontology, the other non-marine. As a salty sea-dog I was to be found on board the former vessel, which is no way to introduce **Joe Botting**, who got things going with his studies of primitive sponges. Hexactinellids from the Lower Palaeozoic of Wales did not grow by incremental addition of external elements, as had been previously assumed, but by continuous expansion of the body accompanied by simultaneous spicule enlargement. And on the topic of body expansion, **Steve Donovan** noted that, when hunting Cretaceous trace fossils near Maastricht, he was able to stand with one foot in Belgium, one foot in Germany, and his stomach in the Netherlands. Guaranteed entertainment and enlightenment, even if the subject was boring. Sorry, that was an ichnological joke I simply couldn't resist.

Next, **Susanne Feist-Burkhardt** introduced her work unravelling the diversity of dinoflagellates in the Triassic, followed by **Bill Fone**'s discovery of cystoids in the Silurian of Shropshire. I didn't take any notes during the fifth talk of the session as I decided the audience would probably find the prospect of watching me scribbling into a book for fifteen minutes slightly duller than my presentation on cornulitids from the Wenlock Limestone. Thankfully, **Charlotte Jeffrey** was on hand to shake them from their torpor with an excellent summary of what echinoids were up to during the Palaeozoic. Quite a lot, it transpired, even if 19th Century workers tried to cover it up by giving genera near-identical names. It's strange how unimaginative echinoderm nomenclature can be—does every starfish have to be called *–aster*, every sea lily *–crinus* and every sea urchin *–echinus*?

Into the Holocene we snorkelled with **Steve Kershaw** and some Grecian reefs, presented in unique 'stay awake' colours. A two-stage history of reef growth can be traced, with the periods of colonization and growth separated by subaerial exposure that reveals the importance of local tectonism in counteracting sea-level rises. And the pre-lunch programme was brought to a conclusion by **Oliver Lehnert**. His new perspectives on the problematic palaeoscolecidans publicized the possibility of their use in Palaeozoic biostratigraphy.

Session 3

Due to a misunderstanding with a waiter, our lunch became a rather protracted affair and the first three talks of the third session had been and gone by the time we got back. Thus we snuck into the back of the auditorium to find **Desmond Collins** had partly unveiled *Hallucigenia* and it was motorized. This may have been my own halucination (I knew ham and magic mushroom pizza was a bad idea) but I'm not sure. Regardless, *Hallucigenia* is now known to be an onychophoran that walked on the backs of its claws, and two forms have been identified, possibly indicating sexual dimorphism.

Staying with strange Cambrian creatures, two new oddballs from Chengjiang were described by **Simon Conway Morris**. One is undoubtedly an agnathan fish, but the other is far harder to explain. A yunnanozoan with extraordinary filamentous gills, its body plan does not fit into the craniates and it may be better placed in the stem-group hemichordates. **Dima Grazhdankin** took us even further back in time to the late Neoproterozoic and the application of Ediacaran fossils to resolving Precambrian palaeoecology. Different biotic assemblages reflect different ecological niches, with, for example, *Charnia* having occupied middle shoreface environments whilst *Dicksonia* was grazing on microbial mats in the upper shoreface.

Session 4

The day's final sextet of talks began with **Susannah Porter** who showed that halkieriids were still present in the Middle Cambrian. Her detailed study of their sclerites revealed a central depression in the distal tip that could have been a sensory device, as well as a fibrous, possibly aragonitic structure with an organic covering reminiscent of molluscan periostracum. This was developed further by **Bruce Runnegar** who noted similarities in the aragonitic fibres and growth directions of halkieriid sclerites and the plates of chitons. Are halkieriids and other

sclerite-bearing taxa such as machaeridians actually molluscs? Perhaps, but it depends on the phylogenetic position of aplacophorans, leading to an Eleanor Rigby-esque moment of pondering—all the lonely beasties, where do they all come from?

Likewise, *Mickwitzia* from the Cambrian of Greenland has been the subject of various interpretations, but **Christian Skovsted** has reached the conclusion that it is a stem-group brachiopod. Its shell structure is like lingulids in many ways, but retains setae-bearing tubes only seen in *Micrina*, a problematic fossil that may be the ancestor of brachiopods. Add just one letter 'n' and you can switch to branchiopods, which is precisely what **Rod Taylor** did in presenting his new insights on *Waptia fieldensis*, a possible crustacean from the Burgess Shale. It is shrimp-like and the head region is exquisitely preserved, showing the mouth-part appendages, but without attached limbs its assignment to the Crustacea cannot be confirmed.

Jean Vannier used the fauna of the Maotianshan Shale of China to examine Cambrian ecosystems. Arthropods with highly developed digestive systems and bellyfuls of smaller arthropods proves the presence of predators, with coproliths showing that hyoliths, waptiids and trilobites were also being feasted upon. And the community spirit was kept up by **Rachel Wood** with the first metazoan reef ecosystems from the Precambrian of Namibia. Animals with internal structure and biomineralized frameworks (e.g. *Namapoikia*) are present, but were they sponges or cnidarians? No one's quite sure yet.

The first day's scientific content over with, it was time to switch to the art of socializing, first at a couple of wine receptions, then at the Annual Dinner in the palatial surroundings of St. John's College. If truth be told, the details of the evening are a mite hazy in my mind, quite possibly due to the after-dinner fraternizing in a specially designated room in Caius. They would have been even hazier, though, if it wasn't for us being evicted by the porter and told to go home. We did, after a fashion, but it still didn't save us from feeling slightly worse for wear the next morning.

Tuesday 17th December

Session 5

I know someone has to do it, but **Dave Bond** claimed the unwanted responsibility of giving the first talk of the day after the night before. Whether the session theme of extinctions and transitions was a subtle play on the prospect of a hangover-culled audience I can't say, but Dave's presentation on the late Devonian mass extinction was full of life. There seems to have been a global anoxic pulse during the Late Frasnian, with pyrite-rich horizons in Germany and the US tying in well with the extinction event. **John Marshall** was looking in slightly younger rocks to gain greater understanding of the palaeoclimate changes across the Devonian-Carboniferous boundary. Sediments from Greenland show it was mainly very arid, but with occasional wet periods related to glaciation and deglaciation, perhaps in a pattern to the monsoon-driven lakes formed in Africa during the last Ice Age.

Next up, **Lucy Muir** was no doubt relieved to have fully functional projectors after the fun and games of her presentation last year, presenting her research on the lundgreni (Wenlock) extinction event. It seems to have affected only graptolites, with generalists surviving and specialists kicking the bucket, maybe following the predictions of the K- and r-selection model. Talking of models, **Kate Riddington** used Bathonian-Callovian microfossils to assess Raup and

Sepkowski's hypothesis of extinctions having a 26-million year periodicity. If it is true, there should be an event at this boundary, but, although there is a faunal change, the pattern is not one of clear extinction and can be explained by sea-level change and sequence stratigraphy.

What about the most famous of all extinction events—the end-Permian annihilation of life on Earth? A new fauna from Oman, described by **Richard Twitchett**, goes against the model of global ocean anoxia as it has the extinction but without any evidence of anoxia. 'So what did it then?' asked an audience member, at which point Richard wisely exited stage left. Responsibility was handed to **Paul Wignall**, who argued that there is no convincing evidence of a sudden, synchronous event, but that, at least in the Neo-Tethys, there was a distinct delay, perhaps because that region was separated from major ocean circulation patterns.

Session 6b

Having plumped for a marine parallel session the previous day, I decided to avoid accusations of bias by attending the non-marine talks this time. I was not to be disappointed. **Chris Berry** began proceedings by informing those of us still nursing sore heads that Nurofen was on special offer in Boots, before immediately using the phrase 'pseudosporochnalean cladoxylopsids' in his talk. OK, so it's worth 1,273 points in a game of Scrabble, but that's no excuse for adding to the mental confusion of people like me. To be fair, the rest of Chris's presentation was excellent —there is a huge floral change during the Devonian and new specimens from China appear to represent the transition from simple to complex forms, which is very informative for assessing homologies.

Dinosaur footprints are well-known ichnofossils, but how did they form? **Simon Jackson** used lab experiments on sand deformation to show that more than one morphology can be produced by the same foot, making identification more difficult. Probably not quite as difficult, though, as identifying animals on the basis of a single tooth, which is what **Vicky McEwan** has been attempting. Wisely not wishing to destroy her solitary, Givetian labyrinthodont specimen, Vicky employed tomography to identify it as a polyplocodont and maybe even the earliest tetrapod, although more specimens are needed to verify this.

I'm not sure what the late Rod Hull would have made of **Jesper Milan**'s foray into the palaeontological uses of emus, but I hope he would have enjoyed it as much as we did. Ostrich toes are wrong, and cassowaries are too dangerous, so emus it is if you want to get a modern analogue of theropod trackway formation. That's if you can get the darn birds to walk on the right substrates. **Dave Norman** then disturbed the previously stable phylogeny of ornithischians with the enigmatic genus *Heterodontus*, followed by a search for Jurassic spiders led by **Paul Selden**. Most of our knowledge of fossil forms comes from amber, but a new suite of arachnids from Chinese lake deposits has vastly increased our knowledge of Mesozoic forms.

Nick Sille had the unenviable task of trying to correlate the Eocene-Oligocene boundary on the Isle of Wight with the Italian type section—his sediments are terrestrial, whereas the boundary is marked by change in marine microfossils. Nonetheless, the charophyte *Harrisichara* looks to be a good indicator of environmental changes that might be comparable with those seen in Italy. Last but not least came **Lauren Tucker**, who has been trying to resolve what kind of animal made *Limnopus* trackways in the Late Carboniferous of Shropshire. By the number of toes present, mode of life, body length and manus:pes ratio, Lauren showed it must have been

a temnospondyl, and the technique can thus be used on other footprints to trace the change in tetrapod communities across the Permo-Carboniferous boundary.

Session 7

Adding another excuse to an already impressive litany, I must apologize to **Dave Baines**, **Howard Falcon-Lang**, **Walton Green**, **Jodie Howe** and **Christian Klug**, but due to self-created accommodation problems, I saw only **Heather Wilson**'s presentation in the penultimate session. But to use the word 'only' is to do Heather a major disservice—her use of living millipedes to ascertain the locomotion of *Arthropleura* from the Carboniferous was a revelation. Two different morphologies are known in the ancient trackways, and represent different walking speeds of the same animal, as shown by extant polyxenids. Thus, *Arthropleura* must have had a similarly 'elongatable' body.

Session 8

The final cluster of talks was started by **Moya Smith**, whose work on the dentition of ancient fish shows that teeth originate late in placoderm phylogeny and have occurred more than once in history, before **Abby Brown** outlined the values of eigenshape analysis in resolving the function of origins and function of terrace ridges in trilobites. Abby's methods reveal that phylogenetic groupings give a stronger signal than those united by ecology and open up many possibilities for further application. Arthropod evolution was the subject of **Ruth Dewel**'s presentation, with cladistic analysis indicating previously unrecognized relationships—complex characters are more likely to have been lost repeatedly from a single origin than to have evolved more than once.

Using brachiopod and bivalve microstructure, **Jenny England** uncovered a multiplicity of mineralization methods for creatures with calcium carbonate shells. One might assume that patterns of growth would display relatively little variability, but Jenny proved this is patently not the case—organic content, magnesium levels and mineralogy of shell layers are different even across just these three taxa. The value of soft parts must not be underestimated, either, demonstrated **Lisa Park**. The same species of ostracods from Lake Tanganyika produce wildly different trees depending on whether information is known on the nature of the animals' bodies. Conodont workers know this problem all too well, with countless elements and very few animals, but the value of the elements is particularly great in biostratigraphy. **Linda Wickström** compared the stratigraphical and phylogenetic records of the Silurian genus *Kockelella* and found that they match pretty well, give or take one or two problems, and although the fossil record is incomplete, the ranges of most species of *Kockelella* fit the predicted confidence intervals. So are ghost ranges an artefact of cladistics?

And on that question, this year's presentations were over. Our head honcho, **Derek Briggs** took the stage to commend the staggeringly high quality of talks and posters and announce the winners of the Council Poster Prize and President's Award. In the end, the level of scientific research on display was deemed so high that both prizes were shared. In the poster category, **Marc Jones**' fantastic frogs and the brilliant bivalves of **Nicole Fraser** claimed top billing, whilst the award for best presentation by a speaker under the age of 30 couldn't be given to Heather Wilson without a forged birth certificate so was jointly given to **Jodie Howe** (Cretaceous forests of Antarctica) and some dodgy scallywag whose name temporarily escapes me.

Then, for those of us not rushing back home to finish (or indeed begin) Christmas shopping, it

was time for one final wine reception in the Museum of Zoology, a marvellous location to end a thoroughly enjoyable annual meeting. In fact, I'd caught the conference bug so strongly that, along with one other brave soul, I didn't return to Birmingham afterwards but instead headed deeper into East Anglia and the BSRG meeting at UEA in Norwich. It wasn't as good.

On behalf of everyone who attended, I wish to thank Nick, Jenny and Rachel for their hard work in organizing an excellent few days of top-drawer palaeontology, not to mention the faultless technical work of Craig and Jason and Liz and Kitty's impeccable running of the refreshments. Marvellous.

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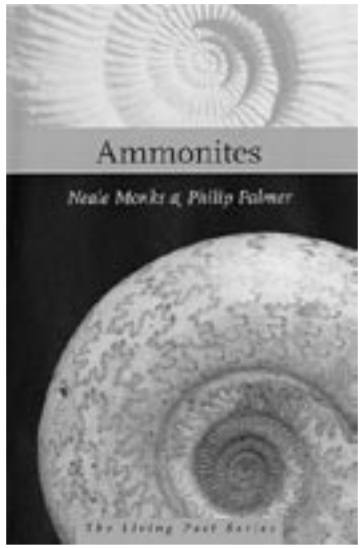
EDITORIAL NOTE: Modesty apparently prevents Liam from conveying to all those not in attendance at the Annual Meeting that he was in fact the complement of Jodie in receiving this year's President's Award, which I believe is only the second occasion on which the award has been made jointly. This happened also at PALASS98 in Portsmouth when Kim Freedman and Michael Gudo were the joint recipients. The proximity of these joint awards must represent some sort of trend—either in the increased quality of papers delivered by the younger researchers in our community, or else an increase in the level of indecision by the President and his panel of judges.

Book Reviews

Ammonites

Monks, Neale & Palmer, Philip. 2000. 159 pp. The Natural History Museum, London, ISBN 0-565-09169-7 (pbk) £15.95



Trilobites notwithstanding, ammonites occupy an iconic place in the popular image of palaeontology surely second only to that of dinosaurs. Unlike trilobites and dinosaurs, ammonites can be readily collected by anyone, young and old alike, nowhere more easily than on the foreshores of our splendid new World Heritage Site in Dorset, or in Yorkshire. Their sculpture and preservation gives them an aesthetic appeal that makes them especially prized by collectors and ensures them a prominent place in every rock-shop and mineral-fair. They differ however from other attractive fossils, *e.g.* sea-urchins or corals, in the enormous diversity of their shapes and sizes. It is hard to imagine a greater contrast than that between the *Titanites* from Portland and the *Harpoceras* from Whitby on sale side-by-side in the fossil-shops of Lyme Regis. They do share with trilobites and dinosaurs the sexy and romantic quality of being extinct, with only one at all closely related survivor on which to draw for analogies, the Pearly Nautilus. Any collector with a modicum of curiosity and an interest in natural history will sense a mystery here and wish to know more. Perusing the shelves under 'Palaeontology' in the bookshops reveals an almost endless array of titles on dinosaurs. There is also a nice book on trilobites. But 'Ammonites'? Nothing. Clearly, a gap to be filled.

This is the gap the present book sets out to fill, a laudable venture, and under what more authoritative imprint than that of the Natural History Museum? It is addressed to the general reader and its text is therefore kept free of detailed references. The general reader is taken to include the student, the enthusiastic amateur or the armchair naturalist, and the emphasis is to be on the biology and palaeoecology of ammonites rather than on their taxonomy. The authors acknowledge the success of the previous exposition at this level, Lehmann's *The ammonites: Their life and their world* (C.U.P. 1981, now out of print) but stress their attempt to take into account much new information and the major changes of interpretation that have followed, particularly a retreat from the view of *Nautilus* as a close functional analogue of the regularly coiled ammonites. And let us say at the outset that the text is beautifully written, in wholly untectonised English.

Have the authors succeeded? Up to a point. There are six chapters: 1 An introduction to ammonites, 2 Ammonite fossils, 3 Ammonite form and function, 4 Aspects of ammonite biology, 5 Ammonite taxonomy and classification, and 6 The extinction of the ammonites: it sounds a good programme. There are some nice historical notes although I missed any reference to the origin of the name 'ammonite' itself and the intriguing connection between ammonites as fossils and the chemist's ammonium chloride, aka sal ammoniac, so graphically described by Lehmann. You will also enjoy the scenario (ch.3, p.54) driving the diversification of the benthic biotas of the "two dimensional world of the late Cambrian": it was the arrival of the cephalopods, folks, which, being jet-propelled, could "cruise along almost effortlessly, and so could search large areas for prey quickly. Like owls snatching mice, death came from above for the bottom living invertebrates of the Cambrian, and it came rapidly and without warning. Of course, it was only a matter of time before life adapted to these new predators … but … these cephalopods were simply the most dangerous animals around." There is much, much more: *Cambrian Park*, Hollywood! But in the absence of references, we are not told whether this script is home-made or imported.

But on closer reading, there are problems. Many relate to detail: "Marine environments have high rates of sedimentation, burying corpses quickly, and increasing the chances of fossilisation" (p.33). Really? And, of modes of preservation (p.35, fig. a), "… body chamber is filled with hardened sediment and the phragmocone … is filled with crystalline calcite. This is the usual mode of preservation in limestones". Wish it were; in rock-shops perhaps. Descriptions of morphological terms such as lappets, rostra, tubercles (p.39–40), dorsal and ventral (Glossary, at end) are hardly adequate: the terminology of form is important, should be precise and can be easily down-loaded from, or at least checked against, the *Treatise*. "Some species [of Goniatites] were widely distributed and lasted for only a relatively brief period of time, making them useful for biostratigraphy" (p.113; ammonites, p. 126): well, yes, ammonites are useful for (ammonite) biostratigraphy. And so on: something every few pages.

The niggles become more serious when we come to the physics of ambient marine water-pressures at depth. The authors start with atmospheric air-pressure as analogy (p.59), comparing Colorado with New York: "Even a visit to … Denver … at 3000 m (9843 ft) subjects the visitor to an air pressure only 2 or 3 percent less than at a sea level city like New York." My friends in 'Mile-high Denver' would be surprised to find that they are living at 3000 m (9843 ft: is that street- or porch-level?), and a change of 2-3% in atmospheric pressure—the difference between, say, 980 and 1010 mbar—is what I experienced where I am sitting, here, between today and last Tuesday. Now, even at 5280 ft, atmospheric pressure is only 82% of what it is at sea-level, and at 3000 m, only 70%: trying to make tea at this altitude, *e.g.* before setting out for the Allalinhorn from the Britanniahütte above Saas-Fee, hopeless. We can agree, however, that some people may "feel a bit faint for the first few days" even in Denver at 1600 m. Then, in the sea it gets worse much more quickly, so that at the abyssal depths of 4000 m, "the ambient water pressure … translates to about 4000 tonnes/m^2 (4400 tons/in^2)." Big square inches; but even at 2.6 tons/in^2, impressive.

Then there are matters of interpretation based not so much on judgement as on failure to take into account just some of those new developments of the last 20 years—or even longer—alluded to in the Preface. First, the old puzzle of what the function was of those complex, fluted septa with their intricate suture-lines for which ammonites are famous. Apparently an adaptation for life in deep water, yet the shells are not commonly found in deep water sediments. It depends on what

you mean by deep [figures of 100–300 m being supported by experimental trials and calculations], but the paradox is real (more on this below). The authors suggest (p. 62) strengthening of the chambered part of the shell against attack by predators as possible explanation, against the point-stresses applied e.g. by its teeth in a shark-bite. But this seems odd when the tasty bits of the meal lived in the bodychamber outside the phragmocone and what evidence of predation there is points to that being just the bit the predators went for, especially around the aperture. But the authors have clearly missed the most compelling explanation, put forward already in 1911 by Pfaff, a structural engineer. The problem is not that of the lateral strength against implosion of the quasi-tubular conical conch—which is easily achieved by rounding, as in *e.g.* a bird's egg, a wine-bottle, or *Nautilus*—but of axial roofing of the chambers in the phragmocone: 10 atmospheres of external water-pressure at depth 100 m trying to drive the animal into the empty chambered shell behind it pressurized at only one atmosphere—the cork-in-the-bottle problem. (And that gas at one atmosphere was not put there by pumping from the siphuncle, as shown in the figure on p.58. It is the gas left behind as the water in which it was dissolved is osmotically removed by the siphuncle while emptying the chambers. On the good approximation that nitrogen and oxygen are chemically inert in water, their concentrations in it are the same as they were when the water absorbed them, *i.e.* at atmospheric sea-level. And that is roughly what is found in the inner chambers of living *Nautilus*, and what is known to every gilled fish).

Two design-strategies come to mind: adapically (conch-inwards) concave septa, like trampolines, generating tangentially tensile stresses at the septal sutures—the mode adopted by *Nautilus*; or adapically convex septa, looking adorally like the vaulted roof of a Gothic church—the mode adopted by the ammonites. The long, tenuous, pointed lobes of their septal sutures outline the rising ribs of the vaults, the broader saddles the crowning arches between them. The total load of water-pressure on the cross-section of the tubular conch has to be transmitted to the load-bearing wall of the conch, as a now tangentially compressive shearing-stress along the circumference of the septum, through an only subsequently cemented suture. But the load increases as the square of the cross-sectional diameter of the conch, whereas the length of a simple circumferential septal suture would increase only linearly with diameter. At constant shearing-strength per unit length of suture, the simplest way of accommodating the quadratically-increasing septal load is to increase the length of the suture by incising and folding it; and Pfaff showed that the total lengths of successive sutures in some typical Jurassic ammonites do indeed increase quadratically with cross-sectional conch diameter.

Then, the ontogeny of the shell (p. 100): "Ammonite shell growth can be divided into three distinct phases. The first is that of the protoconch … . The next … ran from the protoconch … to the primary constriction. … After the primary constriction, the shell morphology changes, acquiring … the nacreous … walls and septa typical of adults. This is the third *and final* stage of growth, during which the ammonite … took up its adult mode of life. … Subsequent growth *is essentially uniform from this point onwards* … ." [my italics]. This overlooks what to me has in fact been the most important development in our interpretation of the biology of ammonites in the last forty years, even more so in the 20 years since Lehmann's book, and is reviewed at some length in one of our very own publications (*Special Papers* **33**, 1985, still in print and very cheap—but hurry). It affects almost every aspect of what is described in the present volume. It is this: that the growth of the shell beyond the primary or nepionic constriction, which marked the aperture of the freshly-hatched ammonitella, falls into *two* quite distinct stages: a *juvenile* stage, covering the growth of most of the

shell, leading to an *adult* stage in which growth had stopped, the final septum had been emplaced and the animal occupied its final bodychamber. We do not know whether sexual maturity was reached only in the adult stage, although there is strong circumstantial evidence that this was so. Neither do we know how much of its life-cycle the fully-grown animal subsequently spent in this adult stage, although there is again evidence suggesting that it was rather little. But the important fact is that we can distinguish the juvenile from the adult stages of growth, for the shell underwent considerable, often drastic changes of morphology. Some are referred to here and there in the text (p.94-5) but more or less *en passant*, including what are called 'compressed septa', the onset of 'deviant ornamentation' and those lappets and rostra. Others, such as prominent peristomal constrictions, an uncoiling of the umbilical seam in regularly planispiral ammonites and other modifications of the bodychamber—long known and amply illustrated in the *Treatise*—are not.

Now, knowing what to look for, the observed occurrence of ammonites takes on a whole new light. Morphologically, the size of the adult turns out to have been a closely-defined character of a species. Dimorphism becomes apparent, and its often bizarre manifestations, leading among them the size-difference between the dimorphs, were what in fact so long delayed the recognition of dimorphism as a general feature of ammonite biology. The frequency of occurrence of ammonites in a succession is highly variable. Some beds can be very rich but the majority are usually almost barren: a difference that can be traced back to ecological factors and that persists even after sedimentary factors have been taken into account. But then, in beds rich in ammonites, these turn out to be almost always adults: where were the juveniles? Moreover, the sex-ratios in these adult assemblages could vary enormously, between almost unisexual extremes either way: at the time of entombment, the sexes could be strongly segregated. Then, the sedimentary facies of beds bearing such adult assemblages were indeed those of shallow water. These observations together indicate strongly that ammonites during their early and intermediate stages of growth *did not live where we now find them*: they migrated during their life-cycle and where we find them is where they died. The paradox of cameral septa designed to withstand high water-pressures in fossils found in shallow-water sediments is therefore resolved, and discussions of functional morphology, ecology and palaeoenvironments have to address juvenile and adult stages separately. And illustrations of ammonites, especially in books such as the present, should always carry marks indicating the onset of the bodychambers. Here none do. Juveniles are known in the fossil record. They tend to occur in very local accumulations, such as the concretions known as the Marston Marble found at one isolated locality in Somerset and illustrated on plate 21, almost all of them microconchs (males); on p.52, mostly macroconchs (females).

The book is illustrated with fine photographs of beautiful ammonites, many in colour. But their value in many cases rises little above that of those in coffee-table books, and the main thing they have in common is that most of the specimens are in the Natural History Museum. Most serious is lack of any indications of size. This is particularly so in pairs chosen to illustrate dimorphism (*Kosmoceras*, p. 96-7; *Aulacostephanus*, pls. 13-14, brown, shown to same size, although Stuart Baldwin's catalogue of his casts of the originals that were as grey as the clays in which they were found, tells us that their size-ratio is in fact 2.4:1). Similarly, the fine drawings to same size of six unidentified ammonites on p. 106, copied without any indication from the Natural History Museum's classic *British Mesozoic Fossils* (1962), show specimens ranging in sizes from 14 to 130 mm. The legends should give identifications in proper form to at least the level of those in *Mesozoic Fossils*, including localities and Formations, for although readers in the 'enthusiastic amateurs' class may not

be expert in taxonomy, a book such as the present should set an example, to guide those wishing to learn; and it has been my observation that the second thing they want to do with new acquisitions is to identify them—as did I when I was young (and still do). The identifications should also be correct: pls. 9-10 are neither *Collignoceras* nor *woolgari,* pl. 20 is not a *Scaphites* but a splendid *Kossmaticeras* with mother-of-pearl test preserved ("Normally, the actual shell is replaced with minerals"). It would also have helped to note that the innermost whorls of the titanic Portlandian *Titanites* on pl. 18 are the work of Man and not of Nature. The failure to mark the onset of bodychambers has already been mentioned: a fine pyritized "Upper" [*recte* Middle] Jurassic *Peltoceras* from the Oxford Clay is selected to show the variocostation of mature ammonites [here the change from ribbing to tuberculation in a macroconch], but the specimen shows only the beginning of the bodychamber and there is no telling whether it is adult. The right-middle figure on p. 106 gives a much better picture of the same genus. Thus underdescribed, the selection of illustrations lacks focus.

Conclusions: although addressed to 'the general reader' and therefore intentionally limited in its scope, a book of this kind should nevertheless have authority, especially if published by an authoritative institution. The authority could range from first level, based on the primary literature interpreted by experts who have written it; through second-level, more general critical reviews of broad areas written by people who are at first level in at least some of the topics; to bog-standard third-level texts intended for teaching introductory courses; to … well, essays written by second-year undergraduates. I am afraid that in my opinion much of the present volume barely reaches level three and too much of it is in that fourth category. It might satisfy those 'armchair naturalists', but is not likely to do much to encourage those 'enthusiastic amateurs' on whom the future of ammonitology is going increasingly to depend. A pity, and I cannot help wondering how many of those boo-boos could have been avoided by even a straight read-through by a publisher's editor. The bibliographic guide to further information at the end can only be described as bizarre, both for what it lacks and what it does contain: 'titles of some books we have enjoyed reading'. Finally, a recall of the penultimate sentence in the Preface: "we hope to show that despite being familiar fossils, ammonites are not well understood at all". Invert that last clause from the impersonal passive into the personal active voice—"we do not understand …"—and it may well be true: if the authors are speaking for themselves.

Some additional titles of general reviews:

House, M.R. & Senior, J.R. (eds), 1981. *The Ammonoidea*. Systematics Association Special Volume **18**, Academic Press, London.
Callomon, J.H. 1985. The evolution of the Jurassic ammonite family Cardioceratidae. *Special Papers in Palaeontology*, **33**, 49-90.
Saunders, W.B. & Landman, N.H. (eds), 1987. *Nautilus*. Plenum, New York.
House, M.R. (ed), 1993. *The Ammonoidea: Environment, Ecology and Evolutionary Change*. Systematics Association Special Volume **47**, Clarendon Press, Oxford.
Landman, N.H., Tanabe, K. & Davis, R.A. (eds), 1996. *Ammonoid Paleobiology*. Plenum New York
Keupp, H. 2000. *Ammoniten: Paläobiologische Erfolgsspiralen*. Thorbecke, Stuttgart.

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Animal eyes

Land, M.F. and Nilsson, D-E. 2002. xii + 221 pp. Oxford University Press. ISBN 0198575645 (hardback), 0198509685 (paperback). Paperback £24.95.

Of the extant animal phyla, around a third have a general sensitivity to light, and about a

further third have eyes capable of producing at least a crude image. Eyes vary greatly in their structure and functioning, with image-forming organs in different organisms being constructed in at least ten different ways. Uniquely among the sense organs, sufficient is known about the physics and chemistry of vision for us to understand in some detail the reasons that eyes are constructed in the ways they are.

Chapter One discusses the origin of eyes. Size is a key factor in vision: visual organs that are very small cannot resolve much spatial detail, no matter how well designed. A few species that attained sufficiently large size to achieve good spatial vision may therefore have become the first macrophagous predators, and thus provided a key trigger for evolutionary radiation in the early Cambrian. Vision has a single evolutionary origin in the sense that opsin was most likely present in the ancestral metazoan, and there are common master control genes that regulate eye development in the living phyla of sighted animals. Spatial vision, however, has evolved independently in a variety of animal groups.

The properties of light that are important for vision, and that provide physical constraints on the ways that eyes can function, are addressed in Chapter Two. Since light normally travels in straight lines, an eye with good resolution can discern both the geometrical features of an object and its location relative to other objects. Some eyes, or parts of them, are sensitive also to wavelength and polarization. Chapter Three develops the theme, by considering the ways in which eyes can achieve adequate sensitivity and good spatial resolution. This chapter includes clear discussions of the problems of diffraction, spherical and chromatic aberration, and of the function of eyes across a range of light intensities.

Chapter Four deals with the evolution of the lens in the eyes of aquatic organisms. The account begins by discussing the simple pigment eye of *Patella*, which is of a type common among the primitive members of many metazoan groups. One way to improve the functioning of such an eye is the pinhole route, seen in its ultimate form in *Nautilus*. The limitations of pinhole optics, however, are such that *Nautilus* is trapped in a visual world that is either unacceptably blurred or dim by the standards of most sophisticated eyes. A functionally better route is to incorporate a lens, and lenses have evolved independently in at least four phyla. The discussion here focuses mainly on coleoids and fish, but animals with more exotic systems are dealt with too. These include certain copepods, whose eyes each contain a pair of lenses arranged as in tiny refracting telescopes. When moved, these eyes scan a fine horizontal line in space, and may enable the

animals to detect the vertically migrating planktic organisms on which they feed.

The evolution of the eye lens on land is the subject of Chapter Five. Because of the difference in refractive index between the internal medium of the eye and air, the cornea becomes an image-forming entity in its own right in terrestrial animals, rivalling the lens in its ability to focus. In land animals that possess them, this opens up a new possibility for the lens: accommodation. The eyes of land vertebrates, including humans, are discussed in this context, with the corneal eyes of annelids and insects being dealt with more briefly.

Chapter Six deals with mirrors in animals. All animal mirrors employ the principle of multilayer interference, whereby light is reflected from a number of thin layers in a stack. Maximum reflection occurs when the difference in the refractive index between layers is high. Mirror eyes are not common, probably because the image they produce is low in contrast. *Pecten* and its close allies, however, have concave reflector eyes, which can produce good images. Many other animals, especially those that live in low light intensities, have mirrors behind the retina. In these, the mirror causes light to pass through the retina for a second time, and so enhances sensitivity. Also discussed here are the functions of biological reflectors in structures other than eyes, since all these functions (display, camouflage) relate to vision in some way.

Apposition compound eyes form the subject of Chapter Seven. These are compound eyes in the stricter sense: each individual lens forms a tiny image, and all the images are then assembled into a mosaic formed from adjacent fields of view. Apposition eyes are well known from diurnal insects, but are by no means confined to those animals. They are typical of many arthropod groups, but occur also in ark shells and some sabellid worms. The eyes of Cambrian animals like *Anomalocaris* were probably of this type too. Although apposition eyes are both common and widespread, visual acuity is poor due to diffraction problems stemming from the small size of the optical units. Improved resolution requires all the units to be enlarged, and the number of units has to rise correspondingly. Eye size thus increases as the square of resolution: an apposition eye with the resolution of a human eye would be a meter across.

From the outside, superposition eyes (Chapter Eight) are almost indistinguishable from apposition eyes. Important differences exist internally and optically, however. In superposition eyes, each optical element acts as a simple inverting telescope. Their collective effect is to produce a single deep-lying erect image in the vicinity of the retina. Size for size, superposition eyes are more sensitive than the apposition type. Not surprisingly, they are common in diurnal insects, and marine crustaceans that live in mid-water depths. There are rarer kinds of apposition eye that use a mirror or mirror/lens combination rather than having a lens alone as the optical element.

There is a distinctly dynamic aspect to vision: most animals with good eyesight have eyes that move, and these eye movements are discussed in Chapter Nine. Eyes may move as the body does, with the head, independently, or because of a combination of all three. Some eye movements occur to compensate for movements of other parts of the body, so that gaze can be stabilized and blurring avoided. Other movements are designed to allow an animal to build up a sufficiently detailed spatial picture of the environment to execute a particular task, to judge direction and distance, or to detect movement in the external environment.

I liked the integrative approach of this book. The ways that physical processes set limits on structure and function are very well explained. Moreover, the authors deal with visual ecology, discussing the specific adaptations of eyes to the lifestyles of the animals that possess them.

The book is clearly written, nicely illustrated and thoughtfully constructed throughout. Where appropriate, boxed sections of text develop the details that underpin some of the more complex topics. These sections will be particularly useful for advanced students and researchers. For the more general reader, there are brief summaries of key points at the end of each chapter. The book ends with an extensive reference list. As well as the alphabetical listing, there are annotated lists of suggested further reading for each chapter.

Animal Eyes is a book in the *Oxford Animal Biology* Series, which aims to provide supplementary texts in comparative animal biology for undergraduates reading biological sciences. The present volume certainly succeeds in achieving this aim. It will be widely consulted also by researchers from other fields who have an interest in vision and optical mechanisms.

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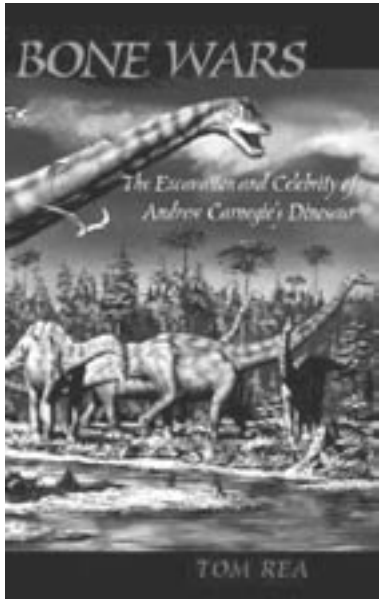
Bone Wars: the excavation and celebrity of Andrew Carnegie's dinosaur

Tom Rea. 2001. 276 pp. University of Pittsburgh Press.
ISBN 0-8229-4173-2 (hbk). £21.50.

The quest for Late Jurassic dinosaur remains and other spectacular fossils from the American West led to an intense and well documented rivalry between those two stalwarts of nineteenth century vertebrate palaeontology, Edward Drinker Cope and Othniel Charles Marsh. This conflict has been the subject of many popular historical accounts, and the scuffles that broke out in the 1870s–1890s (which were both intellectual and physical in nature) are often referred to as 'The Bone Wars'. However, Cope and Marsh were not the only eminent American dinosaur workers active in the late nineteenth century, though most histories of the subject may fool you into thinking otherwise. Several other figures also contributed to the growth of this discipline in North America, but their often groundbreaking labours have rarely been the subject of historical perspectives. Tom Rea's book therefore provides a refreshing, welcome antidote to the Cope/Marsh legend. Although these two influential figures still play essential walk-on parts in his narrative, Rea has concentrated on two of the other principal players in the American dinosaur rush: William Holland and John Bell Hatcher.

The book revolves around the discovery, recovery and display of an almost complete skeleton of the sauropod dinosaur *Diplodocus*, which was unearthed in Wyoming during the expansion of the railroad in 1899. The steel magnate Andrew Carnegie, a man always in search of an appropriately modest memorial, heard of the spectacular scale of the dinosaur and decided that it was just what his newly founded museum in Pittsburgh (which bears his name to this date) needed in order to keep up with the material on show at the American Museum of Natural History in New York. Carnegie duly dispatched his museum director, Holland, to secure the skeleton. Holland, newly appointed to the post, was keen to impress his new boss and set about this task with gusto. A polymath in every sense (linguist, lepidopterist, travel writer and oil painter, among other things), Holland was soon to add palaeontology to his list of accomplishments. A skilled administrator and political player, he had to exercise all of his



talents in acquiring the specimen for the Carnegie Museum and in poaching the leading preparators of the day in order to exhume it from the rock and mount it in the new institution's display hall. Rea provides us with many insights into the kinds of obstacles and frustrations Holland faced along the way, particularly as regarded dealing with local dignitaries who were loathe to part with what they regarded as a valuable commodity. Nevertheless, Holland was ultimately successful, due in large part to the Machiavellian way in which he was capable of operating. He was not always the most tactful of men, however, a shortcoming that led to a number of acrimonious disputes with the highly talented scientists and collectors that often worked under him. For example, Joseph Wortmann, the first vertebrate palaeontologist at the museum, left after a major falling out with Holland over the identification of a new sauropod specimen.

Wortmann's replacement, Hatcher, was hired to complete detailed osteological descriptions of the dinosaur remains acquired by the museum, a task for which Holland had no training (though Holland later produced several detailed and useful papers on the anatomy and biology of *Diplodocus*). Hatcher was one of the most brilliant and energetic vertebrate palaeontologists of his day, and a workaholic to boot. His output included monographs on the Jurassic sauropods in the Carnegie Museum and on the Late Cretaceous horned dinosaurs. He was also deeply interested in mammal evolution and amassed enormous collections of Patagonian Tertiary mammals in a series of expeditions for Princeton University. However, ill health (probably typhoid fever) led to his untimely death in 1903 at the height of his powers: it is tempting to speculate how much more he may have contributed to the subject given his prodigious publication and fieldwork records.

Rea outlines the political and social background of turn of the century America and places these immense discoveries within these contexts. He also draws on documentary evidence to tease apart the personalities of, and the relationships between, Holland, Hatcher and the other men associated with Mr. Carnegie's dinosaur. The text is pacy, well written and a pleasure to read. I heartily recommend this excellent book—a must for all dinosaur-philes, and for those interested in either the history of vertebrate palaeontology or of North American science in general.

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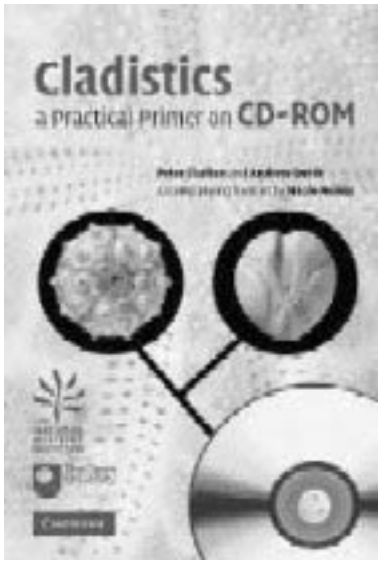
Cladistics: A practical Primer on CD-ROM

Peter Skelton and Andrew Smith. Accompanying booklet by Neale Monks. 2002. Cambridge University Press, Cambridge. ISBN: 0 521 52341 9. £29.95



Finally, it appears that the field of cladistics is getting a choice of teaching tools. One of the latest entries is the subject of this review. It differs from all prior entrants in being CD-ROM based, although the software is accompanied by a booklet containing virtually all of the same material as the CD, albeit in a different format.

I started out by reading the booklet. This approach was dictated by the inconvenience of lugging around a laptop computer at the time I chose to familiarize myself with the work. After the fact, I can say that one could start with the book, or the CD-ROM, and come away with very similar impressions.

The contents of this work are basic and also mainstream. The user is introduced to fundamental concepts in cladistics, and those that I believe most practitioners would agree upon. The authors jump right into the subject with an example of a 3-taxon statement for a horse, zebra, and cow, and show how groupings of these organisms are formed on the basis of novel morphological attributes. It is not long before the logic of DNA sequences as character data is introduced. From my viewpoint, this equivalency of approach represents a desirable feature of the work, because all characters are treated as being methodologically similar, rather than sequences being treated as a distinct class of attributes implying the need for a separate body of analytic methods and tools.

Parsimony is then introduced, to be followed by characters and homology. Again, these presentations are what I would call mainstream. They are not profound in any particular sense, but do a decent job of dealing with concepts, using examples from both morphology and sequence data to illustrate the arguments.

The next chapter, dealing with cladograms and trees, begins with rooting procedures and character polarity. The authors provide definitions for the concepts cladogram, phylogram, and phylogenetic tree. Under this conception, cladograms denote only relative recency of common ancestry, phylograms show degree of evolutionary divergence among taxa, and phylogenetic trees contain information on times of divergence. On the one hand, these distinctions may be helpful to the beginner in understanding that there are different views being expressed in the literature about what branching diagrams have to say about relationships among organisms. On the other hand, the inexperienced reader may have trouble fitting what they find in the literature into the framework presented by the authors of this CD-ROM package. As I see it, the problems will arise because the term "tree" is widely used in the literature for any branching

diagram, irrespective of the method of its derivation or the type of information it is intended to convey.

The final chapter on phylogenetic theory and methods deals with issues labelled as fit and robustness. Like all other portions of the text and CD, there is little effort to distinguish between bad and good, or good and better. The issues are presented without interpretation. With regard to fit, I found little over which I would argue. The attributes and computation of consistency and retention indices are illustrated through the use of clear examples. The presentation for robustness is potentially open to alternative interpretations, however. As used in this work, robustness includes what might alternatively be described as confidence measures, namely bootstrap and Bremer support. It is my view that the use of robustness in this sense is something of an appropriation, but then again, maybe it is actually a good terminological choice, and if picked up by workers in the field broadly, could prove to be useful. I would have liked to have seen a more nuanced presentation of this subject, with some indications of the degree to which such approaches are accepted, and their strengths and limitations. However, as with most other portions of this work, little is offered by way of explanation or interpretation.

From any of the above chapters on the CD-ROM you can access a glossary of terms and definitions that may help to clarify concepts. From the point of view of terminology, I judge the work to be well presented, because terms are used in context. Thus, terms are not presented beforehand with rigid conceptualizations that cannot be adapted to the circumstances in which they need to be applied. In this sense the work will function as an effective learning tool.

The final section presents a series of exercises on how to code matrices of morphological and sequence data. The CD does not contain a computational program, therefore the coding exercise is designed for comparison with a predetermined result drawn from the literature.

The endpaper of the book presents a list of phylogenetic software programs and where to find them. The list of computational packages is a good starting point. However, like much of the literature in the last few years, it does not include the computationally most powerful programs on the market, as opposed to the most feature laden. I have in mind the PC-based computational package NONA written by Pablo Goloboff which is most easily used in conjunction with the matrix and tree manipulation package WinClada, written by Kevin Nixon. These packages can be acquired through the Web site of the Willi Hennig Society mentioned in the CD-ROM package, <**www.cladistics.org**>, but they are not mentioned in the work under review, for reasons that elude me. If one wants to get optimal solutions for large datasets using "unweighted" parsimony, then NONA is the package of choice.

This CD/book combo will not serve as a source to the literature. There is no literature cited. As such the works will not satisfy all needs. There are, however, other works on the market that are more-or-less up to date and which could be used to help fill this gap (Kitching *et al.* 1998; Schuh 2000). Alternatively, one might view this project as having been produced for undergraduate students, where access to the primary literature is not the main objective, but rather the aim is to present concepts and place them in context.

The contents of the CD do not adapt to screen resolution, at least on a PC. Thus, running the package on a high resolution screen produces a rather small image that will require some squinting to read. My guess is that the program was designed to run on an 800 x 600 pixel monitor. Whereas a few of these might still be in use, I would have found the program to be more useful if designed to run at a resolution of 1024 x 768 pixels.

In sum, if you are teaching undergraduates, or want a straightforward tutorial on the basics of cladistics, this might just be the source for you. If you already understand basic cladistics and want to move to the next level, this will not be your work of choice. Nonetheless, some of the technology employed in the preparation of the CD might well be used to develop a higher-level product for use with phylogenetic software packages or more probing classroom tutorials. Considering the current market, this is a reasonably priced product.

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Schuh, R.T. 2000. *Biological Systematics: Principles and Applications*. Cornell University Press, Ithaca. 236 pp.

The Evolution of Plants

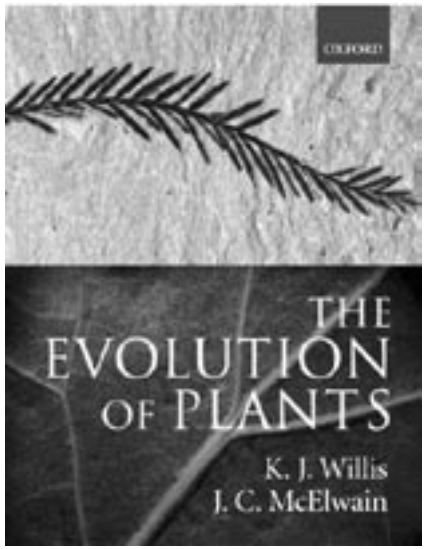
K.J. Willis and J.C. McElwain 2002. 378 pp. Oxford University Press. ISBN 0 19 850065 3 (sbk). £22.99

The blurb on the back cover of this book states that it takes "a fresh, modern approach to a subject often treated very narrowly", further noting that it is "written to be accessible to undergraduates". With this in mind I will consider the book, firstly, as a teaching aid or as a general introduction to palaeobotany, and secondly, as a contribution to the study of plant evolution in its own right.

I find the selection of a suitable textbook one of the most difficult aspects of teaching palaeobotany. I teach separate introductory palaeobotany courses to undergraduate geologists and biologists. The former have problems with the sheer volume of basic plant biology that must be understood in order to glean even a basic understanding of the evolution of plants. In our zoocentric world even the basics of plant morphology and classification are unknown to the majority of undergraduate geologists (and many biologists!). The latter also have a number of problems: coming to terms with deep time, and the fact that evolution and environmental change are played out over these vast spans of geological time; interpreting evidence for plant evolution based on the fossil and sedimentary records with all their vagaries and biases; excesses of geological terminology.

Currently there are a number of outstanding palaeobotanical textbooks on the market. The majority, however, are rather traditional in approach. That is, they are very much encyclopaedic. They tend to rely on fairly detailed morphological descriptions of examples of 'classic' fossil plant taxa, relate these to extant plants, and use this framework to illustrate the evolution of plant life through time. Nothing wrong with this, but it can be very detailed,

very dry, and rely on a thorough botanical background. Many such excellent books (*e.g.* Stewart and Rothwell 1993; Taylor and Taylor 1993; Bell and Hemsley 2000) are superb sources of information for the specialist, but I find them far too detailed to serve as textbooks for most undergraduate modules.



Willis and McElwain avoid producing another book along these lines, which is a good thing because it is an area in which we are well provided for. Instead they have kept morphological descriptions to a minimum, and produced a far more wide-ranging treatment of palaeobotany. Essentially they consider the evolution of floras through time in terms of their environment. In this way the authors do not get bogged down in over-detailed morphological and taxonomic descriptions. They provide a succinct account of the basic plant groups, avoiding too much specialized terminology, and clearly explaining that which is used in the glossary. The book concentrates on the vegetation that dominated different time periods, and this is simply and cleverly done by providing a series of biome maps and relating these (and evolutionary changes over time) to the changing environment. The biomes are related to basic types of plant groups around at a given time, and then relating their palaeogeographical distribution to the environmental setting. Floral evolution is traced through changing palaeogeography, climate and atmospheric conditions (particularly, as one would expect from these authors, changing CO_2 levels).

I consider this book to be an excellent undergraduate teaching aid. Geologists can cope with the simplified botanical aspects (aided by the glossary), whilst revelling in the attention paid to the relationship between vegetation and environmental change. Botanists will not be alienated by over utilization of geological jargon and complex geological aspects. The latter are clearly and simply explained.

As a contribution to the study of plant evolution in its own right, this book has an interesting role to play. Rather like Niklas (1997), it is a book with a point of view. Whereas Niklas attempts to, and admirably succeeds in marrying palaeobotany with modern evolutionary theory, Willis and McElwain stress the interrelationships between plant evolution and environmental change through geological time. It is becoming increasingly clear that many aspects of floral evolution are driven by long term global change (for example: changing palaeogeography as a consequence of plate motion and sea level changes; the huge temporal variation in atmospheric composition, with CO_2 playing a particularly important role). Willis and McElwain stress these interrelationships, and provide a thesis. They consider that land plant evolution may be viewed as "a broadening spectrum of diversity and morphological complexity through time", where "major evolutionary change and innovation was concentrated into relatively short intervals in geological time". They clearly believe that evolution is hierarchical, but because they consider

that the terrestrial flora has been little affected by mass extinctions, dismiss these as the upper tier for land plant evolution. Instead they consider that the upper tier driving plant evolution is physical/climatic parameters (particularly changing atmospheric CO_2 levels) associated with tectonic pulses. This is a book with a point of view, and I constantly found myself reanalysing the relationships between plant evolution and environmental change. Thus this book does serve a scientific purpose. It tells us not only to consider plant evolution in terms of phylogeny and evolution of biodiversity through modern evolutionary theory, but also to consider the role of changing environment in shaping plant evolution (and vice versa). There are chapters dealing with mass extinctions and persistent populations, ancient DNA and the biomolecular record, and evolutionary theories and the plant fossil record.

There are faults with this book. For a start there are far too many typographic errors, which can be very irritating, such as the inconsistent spelling of the all important Warrawoona Group. Hopefully these will be dealt with before the book goes into a second edition. One of my main gripes, however, is reserved for referencing. The book seems to rely on heavy secondary referencing, usually to the classic palaeobotany texts I have discussed above. Time and again one is referred to Bell (1992), Niklas (1997), Stewart and Rothwell (1993), Taylor and Taylor (1993) and Thomas and Spicer (1987). In these days of ever increasing review articles most workers provide distillations of their work or of major topics at fairly regular intervals. Surely it would be more beneficial to refer to these as a route into the literature, rather than the lower level précis provided by text books. I choose as an example my own field—the origin of land plants. This subject has been reviewed *ad nauseam*. However, when it is discussed the reader is usually referred simply to one or other of the more encyclopaedic palaeobotanical texts. When a specific reference is chosen, it is often inappropriate. For example, when discussing the fossil evidence for early land plants we are referred to Graham and Wilcox (2000). This is in fact a paper that reviews matrotrophy and hexose transport and their role in the evolution of the alternation of generations! In the same volume there is a specific review of the fossil evidence for early land plants (here I have to admit my bias—I co-authored the review). I accept that referencing is a problem. Already 33 pages (nearly 10% of the book) are given over to references, but in my opinion more consideration could have been given to those that are used. Also, space could be saved: one diagram, which takes up an entire page, is reproduced twice identically (Fig. 3.18 and 4.25)!

In summary, I view this book as a brave departure from the norm. I find it ideal as a textbook for undergraduate modules delivered to either geologists or biologists. It is relatively well illustrated, written in an easy jargon-free style, and not too crammed with information. As a scientific concern, it is certainly not encyclopaedic, but it is not meant to be—this niche is already well catered for. It does, however, have a point of view—and a very important one at that. The interrelationship between changing environment and plant evolution is slowly dawning. This book provides a neat summary of recent advances, and offers a few new hypotheses that will stir debate for some time to come. It's a book that gets you thinking.

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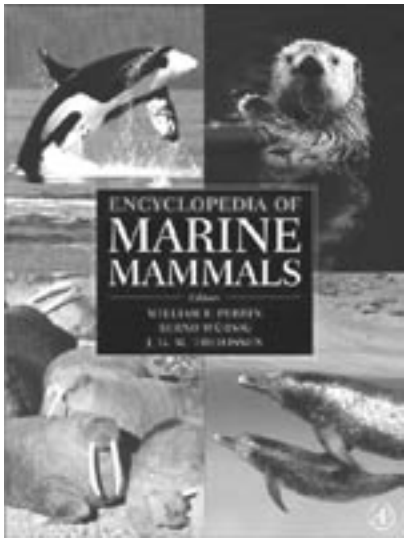
Encyclopedia of Marine Mammals

W. Perrin, B. Wursig and J.G.M. Therrissen. 2002. Harcourt Publishers Ltd. ISBN 0 12 551340 2. £90 (hbk)

One very big problem with writing an encyclopedia of anything is that it is expected, by definition, to be encyclopedic. Certainly, at some point someone will look at the *Encyclopedia of Marine Mammals* and fail to find a term that, according to this hypothetical person, should by all rights deserve a separate entry within this book. All encyclopedias are doomed to fail in this way to some degree, but this encyclopedia sets for itself an even tougher task. According to its editors, *Encyclopedia of Marine Mammals* is meant for both professional and non-professional audiences, which means the terms discussed within include both basic and advanced concepts that cover a wide range of topics, from basic biology to cultural anthropology. Despite these difficulties, this book does contain a wealth of well-organized information that will be useful to a variety of marine mammal enthusiasts.

The general organization of the book is similar to that of many encyclopedias, with ample cross-referencing in several formats. The table of contents lists entries alphabetically and also by subject area. When one looks at the individual entries, the emphasis on accessibility to the non-professional is clear. Although families and higher taxa are listed by scientific name, species are listed by their common name. Other topics cover fairly broad areas. Each entry has its own author, which does lead to many stylistic differences between entries on similar types of topics. For instance, for entries about various taxa, the treatment of taxonomy and systematics varies considerably in its extent from entry to entry. This can be especially troublesome when you consider that only common names of species are included as entries. As an example, the entry for the Australian Sea Lion (*Neophoca cinerea*) includes no information about even to what family it belongs. To someone familiar with mammals but unfamiliar with pinnipeds, it may not be clear whether this is an otariid (as its common name correctly suggests) or a phocid

(as its generic name incorrectly suggests). Fortunately, there is a list of marine mammal species at the back to clarify such issues. In most regards, though, the entries are accessible and informative. All of the entries also include a list of references, which alone make them worthwhile reading.



The use of common names is clearly for the benefit of non-professionals, as are the entries on general topics, like evolutionary biology. These entries will be of little use to the professional, but their utility for non-professionals will in many cases be limited, because these entries attempt to describe broad topics in a short amount of space. In the case of the entry for evolutionary biology, it is very general and focuses on how the importance of evolution, and marine mammal evolution in particular, is (or isn't) reflected in the Science Citation Index. Although numerous other entries refer to phylogenies, there is no separate entry for phylogeny, although under the entry for systematics there is a discussion of phylogenetic methods. While they may have little appeal for professionals, these general topic entries are important for bridging the knowledge gap for non-professionals.

Who, then, will want to buy this book? Due to its cost and abundance of highly technical information, I don't think that non-professional marine mammal enthusiasts will comprise the primary market for this book. I would, however, highly recommend its purchase for any library. In addition, marine mammal specialists will also be very interested in this book. Most specialists usually work on a particular taxon (*e.g.*, the three editors work on cetaceans) or area (*e.g.*, ecology) and are likely to be unfamiliar with other marine mammals or some other aspects of their biology. The entries and references in this book are a valuable introduction to new areas for the specialist. Similarly, anyone teaching a course that involves significant discussion of marine mammals (*e.g.*, mammalogy) will find this book to be a valuable resource, whether in the library or on an office bookshelf. (Alas, I received this book for review just days after teaching the cetacean lectures for my Mammalogy class.) It's also a wonderful starting point for graduate or undergraduate students doing any kind of research on cetaceans. Any marine mammal specialist who makes ample use of this book will find deficiencies, whether they be topics without entries or entries that are too superficial, incomplete, or out of date. (The recent discoveries of fossils in Pakistan that clearly link cetaceans to artiodactyls were apparently reported after this book went to press.) These deficiencies, however, are more than countered by the wealth of information that is found in this book.

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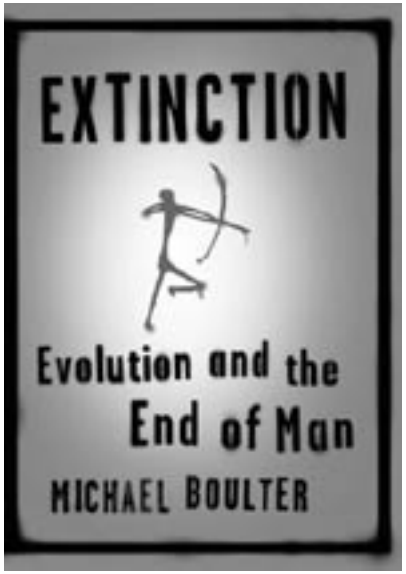
Extinction. Evolution and the end of man

Boulter, M. 2002. 209 pp. Fourth estate. ISBN 1-84115-695-7 (hbk). £15.99

Is palaeontology relevant to the modern world? Can we use the past to predict the future? There is a growing trend among palaeontologists to compare the present-day environmental and biodiversity crisis with ancient greenhouse episodes and mass extinction events. Two main conclusions are often drawn from such comparisons: (a) that life, in some form, is bound to survive the present-day crisis and (b) that humanity, as we know it, probably will not.

These are also the conclusions of Boulter's book: a personal (and often pessimistic) view of man's impact on the planet. However, in order to reach this end he covers a tremendous amount of ground: archaeological examples of man's ability to alter the environment, a potted history of life on earth, details of his own mathematical analyses of the fossil record, a history of Tertiary climate change, *etc*. All in less than 200 pages! An inevitable consequence of such an approach is that coverage of the different subjects is variable and annoying discrepancies and shortcomings are rife.

Unfortunately, the first quarter of the book is the worst. It opens, well enough, with a discussion of man's influence on the landscape in the last few thousand years, revolving around an account of Tirefour Broch, an Iron Age fortification in Scotland. Then the author moves on to describe the history of life on Earth, and the errors begin to appear. Discrepancies in absolute age estimates are common, for example the Permian/Triassic boundary is placed at either 250 or 245 million years ago depending on which page you happen to be reading. Careful editing (and up to date references) would have helped here. One of the worst passages is a description of ancient food chains, where we are told, for instance, that during the Jurassic "dinosaurs ate the ammonites". That's a new one on me! An error likely to infuriate vertebrate taxonomists is the statement that during the Triassic there lived "sharp-toothed dinosaurs called nothosaurs". A few pages later we find a graph of dinosaur family diversity through time (the author's "original compilation") showing that saurischians appeared at the Permian/Triassic boundary, and that several families of ornithischians were present in the Permian! It is inexcusable that a Professor of Palaeobiology should make such mistakes.



After such a poor start I came very close to discarding the book. This would have been a shame, because (inevitably?) the latter part is much better. Chapter 3 is an interesting discussion of Per Bak's theory of self-organised systems and how this can be applied to the fossil record, as the record of extinctions appears to obey a power-law. This is followed by a

demonstration that the increase in family diversity over the Phanerozoic approximates to an exponential curve. After a succinct, and readable, account of Tertiary climatic history (Chapter 4), we return to database analysis in Chapter 5. This section is mostly concerned with the author's efforts to find a single mathematical formula which can describe the 'spindle-shaped' evolutionary history of groups of organisms. He presents this equation on page 149, and then follows it with a few examples using data from the *Fossil Record 2*. The readership is left in no doubt that the only worthy pursuit for palaeontologists is database analysis. However, the ever-present niggling errors in both text and graphs tend to lessen the impact of the author's work. These include the discrepancy between the date of origin of agnathans in text and figure, the lack of a key for the main equation, *etc*. More thorough editing was clearly needed.

The final two chapters deal with man's impact on the environment, from prehistoric days to the present-day, and on the possible future. One nugget of particular interest was the final figure of the book, showing the difference between the predicted diversity of North American mammals in the absence of external factors (from the author's equation presented earlier), and the actual diversity of the last few thousand years caused (presumably) by man's activities. These two chapters are pessimistic but particularly enjoyable (!) and after all the earlier niggles the book ends well.

It is difficult to suggest an audience for this book. Certainly, there are too many factual errors (some of which have been outlined here) to recommend it to non-specialists or students, despite the easy reading style. The 'Notes' section (a 'further reading list' that is not referenced in the text) is an odd mixture of out-dated textbooks and recent specialist articles. However, I feel that specialists would be frustrated, as I was, with certain passages of text. A thoroughly edited version, with better references and a few more explanatory figures is needed. As it stands, my advice is to enjoy the first ten pages, then skip to chapter 3. If you are more interested in the results of Michael Boulter's database analyses, rather than his personal views of the current biodiversity crisis, then stick with his research articles.

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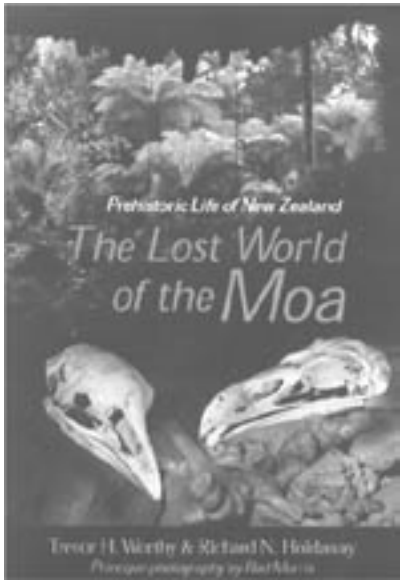
The Lost World of the Moa: Prehistoric life of New Zealand

Trevor H. Worthy and Richard N. Holdaway. 2002. 718pp. Indiana University Press; ISBN: 0-253-34034-9 (hbk) US $89.95 (equivalent to £58 or €89).

Worthy and Holdaway present a comprehensive review of New Zealand's rich and diverse fauna throughout its history in this epic 718 page book. The book starts by leading us gently into the subject in hand with a brief introduction to the geological history of New Zealand (also known as 'Aotearoa' to the local Māori, meaning 'land of the white cloud'), followed by a description of the present climate, geography, fauna and flora of the islands. Succeeding this comes a short review of the fossil record of New Zealand, from poorly preserved Cretaceous remains to the amazing avifaunas of the Late Quaternary.

Next, a fascinating history of early palaeontological discovery in New Zealand is presented. Richard Owen's work on the Moa is celebrated along with, perhaps less well known workers

such as Walter Baldock Durrant Mantell (son of Dr Gideon Mantell of *Iguanodon* fame), Johann Franz Julius Haast and Walter Reginald Brook Oliver (it seems that, the prerequisite of being a successful moa researcher is to have at least four, preferably unusual names!). Accompanying this historical perspective are some wonderful pictures of palaeontological digs from the 1800s (many a beard and silly hat—it is nice to know that some things remain the same in palaeontology!).



A section focusing on the etymology of the word 'moa' follows. As taxonomists, it is easy to misinterpret the meaning of a word whose origin does not derive from the classic Latin or Greek; this section describes how a misunderstanding of the Māori early on led to the large birds native to New Zealand being named 'moa', a word used throughout Polynesia for the domestic fowl (*Gallus gallus*). I was interested to find that the original name of the Moa was 'Te Kura' (from the Māori for red bird) and that legends exist of these birds, as tall as doorways living in caves guarded by lizards, permanently standing on one leg! It is interesting to hear these alternative accounts of the birds through the native people of New Zealand, passed down through the generations. Also contained within this section (and throughout the book) are the drawings from Owen's original papers on the Moa from the 1870s and 1880s—these really are a joy to look at, as such beautifully detailed scientific illustrations are rarely published in journals today.

The bulk of the book from here on in (as you may expect from the title) is concerned with the Moa itself. Its anatomy is discussed (in such detail as one might expect from an anatomical paper) and evolutionary hypotheses are deliberated. The authors also look at the palaeobiology of these animals; such questions asked are: how heavy were moa, what were the proportions and posture of these birds, what was their mode of locomotion and their habitat? It is good to see that every avenue of the animal is being explored; the book does not simply concentrate on cataloguing fossil taxa, but also tries to reconstruct them and fit them into the wider pictures of evolution and ecology.

Other animals of the New Zealand islands are systematically discussed in a similar manner to that of the Moa; from New Zealand's most famous living bird—the Kiwi, to diverse and unusual duck faunas. Giant eagles and other birds of prey are considered in almost as much detail as the Moa. Rails, shorebirds, parrots and passerines are the other New Zealand birds centred on in this book. The topic moves on to bats, lizards and frogs next (including the bizarre mystacinid bats which seem to have taken the role that rodents and shrews have on more familiar continents; feeding on the ground and even burrowing down into the leaf litter).

After a chapter on the likely ecology throughout New Zealand's past, the book moves on to another large section—extinction. Holdaway is a specialist in extinction biology (especially the

human induced kind). In this final chapter the authors give another historical perspective on 'who or what killed the Moa and nearly everything else?'. Views past and present on why this extinction event occurred are presented, with the conclusion (surprise, surprise?) that human intervention—be it direct or by the introduction of mammals to the islands—was the most likely cause (it seems that we are always made to feel guilty about these sorts of things—I, for one, have never even set foot on New Zealand and have never been known to attack any sort of native wildlife!).

This book is billed as 'a landmark work' and a 'masterwork'. Although I am in little doubt that it is a well written book and a rich source of information on the subject of extinct and extant New Zealand fauna, it seems to me that these claims may be a little exaggerated. For a book to be a masterwork it needs to have few or no flaws. The main flaws in this book are its photographs, drawings and diagrams (with the exception of the old photographs of digs and the drawings from Owen's papers of course). The picture editor seems to have rushed this, what should have been one of the most important elements. Out of focus pictures with badly cut-out backgrounds are common and many of the photographs of *in situ* cave deposits are difficult to decipher (admittedly I have never experienced the difficulties of speleological photography myself!). This brings me onto the drawings; badly sketched in pencil, they do no justice to the hard work of researching and writing a large review book such as this. Indeed the drawing on the opening pages is so badly scanned that you can see the handwriting scrawled on the original's reverse! Surely it is not so difficult to get decent reconstruction artists and photo editors in New Zealand? A couple of hours with a computer and a decent photo manipulation package would have vastly improved this book!

Another major problem with this book is the price (presumably this is not the fault of the authors), even though this is a large hardback book, I do not believe that it is worth the £60 or so that the publishers are asking. Only those seriously interested in New Zealand palaeontology should or indeed would buy this book due to the large expense involved.

In short, this book is not exactly bedtime reading (I should know, I tried), but interesting if you have a curiosity about New Zealand palaeontology and its history. It will probably become invaluable for those with serious research interests in the area, although the pictures do let the book down. If the goal of this book was to '… summarise all that is presently known about these incredible birds' then they have succeeded! This book is the easiest and quickest way of getting information on moa or any other extinct animal from New Zealand's Quaternary.

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Mammoths, Sabretooths and Hominids: 65 Million Years of Mammalian Evolution in Europe

Jordi Agustí and Mauricio Antón. Columbia University Press, New York. 2002. Hardback, dustjacket. 313 pages. Illustrated. ISBN. 0-231-11640-3. £27.50.

This book is a related volume to the book 'Big Cats and Their Fossil Relatives' by Alan Turner and Mauricio Antón, produced by the same publishers in 1999. It has the same look, similar plan and may be aimed at the same readership—the semi-popular portion of the academic market. It looks at the evolution of European land mammals after the KT extinction event and covers palaeoclimates, palaeoecology of plants and animals, migrations, faunal turnovers, taxonomy. Also covered are brief functional interpretations of the species involved and also appropriate details of continental movements (the author simplifies the latter and gives good reasons for this in the preface). As such it is an excellent and very detailed overview of this tremendously important, interesting but neglected area of vertebrate palaeobiology. Its main thrust is the interplay between changing climates and the alterations in European mammalian faunas that resulted, both at the community and individual level. Europe is taken to mean the region between Iberia and the Urals, a sensible restriction. The main author (Agustí) states having to restrict his phylogenetic and systematic treatment except in especially significant places (*e.g.* when the origin of a genus has major palaeobiogeographical importance); hence dedicated systematists need not involve themselves with this book too much. The book is divided into seven chapters: Palaeocene, Eocene, Oligocene, Early-Middle Miocene, Late Miocene, Pliocene and Pleistocene.

The fly-leaf states that "Evolutionary developments are rendered in magnificent illustrations of the many extraordinary species that once inhabited Europe, detailing their osteology, functional anatomy, and inferred patterns of locomotion and behaviour". In my review of 'Big Cats and Their Fossil Relatives' by Alan Turner and Mauricio Antón (PalAss Newsletter, Summer 1999), I made mention of the brilliance of Antón's illustrations. At first glance the same phenomenal standard appears to be attained in this book. But all is not as it seems, so before a general review of the book is made, issue must be taken with some major inherent problems.

One of the biggest (and most publicised) selling points of both these books is the integration of anatomical and whole-body reconstructions of the highest standards, with the text. Antón's wonderful illustrations and his tremendous reputation as a draughtsman are perhaps *the* major elements of these books. But given the obvious difficulties in representing an extinct animal errors in the illustrations are to be expected. However, it is the *nature* of the errors and what they represent in terms of the claims

of the publisher that makes them important: Figure 4.8 shows comparative body reconstructions of the gigantic hyaenodontid creodont *Hyainailouros* and the immense amphicyonid (bear-dog) *Amphicyon giganteus*. I've seen the (huge) skulls of these guys and they are completely different from those of any modern carnivore; yet the resulting reconstructions look like oversized woolly-coated Alsatian dogs and Polecats! Figure 4.10 is a musculo-skeletal reconstruction of the extinct proboscidean *Deinotherium*. The skull of this huge animal is vastly different to that of the modern elephant yet the resulting reconstruction rendered is practically identical to that of a living elephant, this is despite the 'care' taken in reconstructing the underlying musculature. Figure 5.6 is a reconstruction of the hyaenid-like percrocutid *Dinocrocuta*; again the immensity of its skull is not reflected in the product. It is too dog-like, the osteological illustration is not robust enough and—horribly—the fleshed out lower jaw is actually *thinner* than the bony mandible! In life this must have been a weird and powerfully built creature indeed.

So, it gradually becomes apparent that the bold claims for the illustrations are set on shaky ground. That the musculo-skeletal reconstructions are—in many cases—not perfectly truthful (as far as can be achieved) in attempts is further indicated by another example. Figure 3.9 is of the nimravid *Eusmilus bidentatus*. Nimravids used to be called 'palaeofelids' and were the first modern mammalian sabre-toothed predators; recent phylogenetic analyses place them firmly in the *dog* branch of the Carnivora. Figure 5.21 is the sabrecat *Machairodus giganteus*. The skulls of these predators (*Eusmilus* and *Machairodus*) are *radically* different from each other yet the resulting reconstructions—apart from conjectural coat patterns—are almost identical! Anatomists know of the problems in reconstructing the musculature of a mammal, but in view of the claims of the publishers, it should be expected that proper attempts might be made rather than lip service. A final example illustrates my point: Figure 5.10 is an illustration of the skull, muscle reconstruction and life appearance of the giant suid (pig) *Microstonyx major*. The muscle reconstruction shows a slip of muscle originating from the top of the snout and inserting on the top surface of the bony excrescence just behind the canine of the upper jaw: a muscle that moves nothing? This piqued my curiosity; I teach comparative anatomy to the Veterinary Science students in Bristol and have never seen this muscle arrangement. I checked the literature and then looked at skull preparations in our dissecting room, I also examined the (similar) skull of the African Bushpig; this discrete muscle is not to be found. So if this is the case regarding the supposed accuracy of the muscle reconstructions, then the much-vaunted claims of the publisher for the standard and veracity of many of the illustrations in the book are not to be trusted too much. Radically different animals are shown as too alike, weird animals are shown as too similar to modern carnivores and so-called muscle reconstructions are not truthfully applied. The illustrations also suffer from lacking a difficult-to-attain effect: that of the bulkiness seen in really big mammals. As in the illustrations of *Hyainailouros*, *Amphicyon giganteus*, *Dinocrocuta*, *Machairodus giganteus*, and *Amphicyon major* the coat is closely applied to the body, showing its outline. In life the 'extra' bulkiness seen in big mammals rarely seems to be achieved by 'palaeoartists'. This book is no exception. *Amphicyon giganteus* was immense—larger by far than any bear, yet the life reconstruction makes it look like an oversized Stoat!

Given Antón's reputation, are there any good illustrations? Of course, he redeems himself in dozens of places with draughtsmanship of the highest order; this is not in question, the veracity of the illustrations *is*. Figure 4.21 (*Amphicyon major*) and Figure 4.24 (various chalicotheres) really attain the difference between these (bizarre) extinct and modern (familiar) mammals. Figure 4.25

is of the nimravid sabre-toothed predator *Sansanosmilus*; here the 'dog' element in the nimravid phylogeny is brilliantly integrated into the cat ecomorph of this beast—a real triumph; it is unique in my experience. The same is true for Figures 1.2, 1.3 (*Arctocyon*, the predatory, archaic Late Cretaceous precursor of many Cenozoic mammals), 5.4 (showing the non-bone crushing Jackal-sized hyaenids *Protictitherium crassum*), 6.2, 6.3 (*Chasmaporthetes*, the 'hunting hyaena'), 6.10 (*Homotherium* the 'scimitar-toothed' cat), 6.13 and 6.13 (*Pachycrocuta brevirostris*, the giant hyaena). All of these beasts must have been drastically different from our modern mammals, and this is magnificently achieved in all these cases. This is not a trivial criticism, the so-called accurate reconstructions of 'renowned artists' such as Greg Paul and Ely Kish (both dinosaurophiles) are anatomically risible; yet they hold a major position in the field of palaeoart and have done so for years. It is nothing short of the perpetuation of mistakes and inaccuracies. I write with knowledge of this, having recently collaborated very closely with the renowned artist John Sibbick in reconstructions of mesonychids, creodonts and gorgonopsids (all weird and presenting problems of analogy) for various books and mainstream journals.

Enough of criticisms of the disagreement between the claim for the unique truthfulness of the reconstructions and the actual outcome in many instances. I give this harsh censure because of its significance to the entire project that the book represents and its potentially prominent place in the pantheon of illustrated palaeobiology books. But what of the book as a whole? In truth it is quite well written and perfectly readable and it deals nicely with a highly interesting subject. But I find there are problems here as well. There are many little errors such as that on page 4 where the text reads "…occlusive surface forming a serrated slicing blade. This was perhaps used for *crushing*…" (my italics). Since when, biomechanically, do serrated slicing blades 'crush'? As with 'Big Cats and Their Fossil Relatives' (Alan Turner and Mauricio Antón), there is no introduction to the terminology *e.g.* hallux (the anatomical term for the 'big toe') is encountered as early as page 4 but there is no definition. This is okay if the readership truly is meant to be purely academic but its general composition suggests a large 'popular' audience. On page 7 the interpretation of the term condylarth is given as "articulated condyl". Not only is 'condyl' actually spelled 'condyle' but also the translation actually means 'knuckle joint'. (From the Greek for knuckle—*Kondylos* and *Arthron* for joint). A criticism I had with the 'Big Cats and Their Fossil Relatives' book was that there was less than decent integration between text references to figures and the figures. This is also the case with this book. Figure 4.1 is first mentioned on page 87, but is not encountered until page 94—and this is in the *next* chapter! Figure 5.5 is mentioned two pages previous to encountering it but this text mention gives no real reference to it. Reference between this illustration and the text is found—a mere thirteen pages further into the book. Sometimes the text description of a Figure does not match the actual illustration. This occurs on page 155 where the text description of the sabrecat *Machairodus aphanistus* reads "…the neck was longer and with a strong musculature, as shown by the great development of the temporal crests. The forelimbs were very robust, with huge claws, …while the hind limbs were relatively long…" But the illustration shows a gracile cat with a short neck and slim front limbs with moderately sized paws. There is also a random use of journal-style, bracketed text references—these are only used for details of palaeoclimatology. But all aspects of the book would benefit from being able to match salient details with the appropriate reference; I find this usage most puzzling.

My criticisms are those of a comparative biomechanicist and anatomist; it would be interesting to find out what the palaeoclimatologists might think of this book. But I'll say one thing—they'll be outraged to know that despite the utterly copious text references to various geological and chronological stages and horizons (*e.g.* Vallesian) *there is no stratigraphic, chronological or palaeoclimatological chart!* In a book such as this, this omission is unforgivable. I got fed up having to go back to references such as Harland *et al*'s 'A Geologic Time Scale' to check relations between various stages. As for the text; although written well enough, the sub-headings are inadequate and eventually I got lost in the plethora of generic and species names and their migratory comings-and-goings to and from different continents. The text seems to run breathlessly on, and just as you've got a hold of what happened to the carnivores in the Early-Middle Miocene, so then you immediately encounter Artiodactyls, Perissodactyls, Proboscideans and hominids and all of their doings. I'd have been happier with a data book and working it out for myself.

So, how to sum up this book? It is great for high-quality pretty pictures of extinct animals, it's an obfuscatory read, extremely dodgy for accurate musculo-skeletal reconstructions, excellent for information (if you can find it), lacking in one or two essentials (charts) and fills a niche in terms of its subject matter. I got the feeling that Columbia University Press thought that just by putting in the three 'popular' words of mammalian palaeobiology—mammoths, sabretooths and hominids—into the title, they would produce a good book. Well they'll get a book that no doubt sells well because of this, but it isn't that good. Jordi Agustí and Mauricio Antón are respectively a justifiably renowned academic and artist, but they were not well served by Columbia University Press; marks out of ten: 4. At least at a price of £27.50 you'll not be much out of pocket.

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Reconstructing Behavior in the Primate Fossil Record

eds J. Michael Plavcan, Richard F. Kay, William L. Jungers and Carel P. van Schaik. 2002. Kluwer Academic/Plenum Publishers, New York. ISBN: 0 306 46604 X. £85.00.

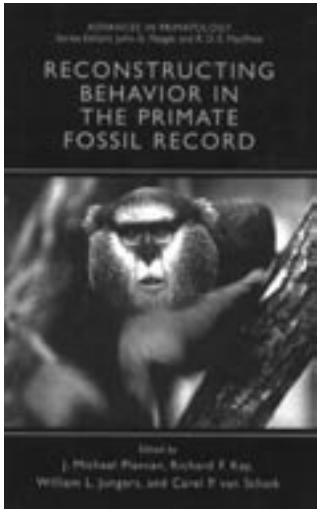
The description and classification of fossils are the foundation of palaeontology. Building on this, the morphology of extinct species, combined with knowledge of the taphonomic processes that individual specimens endured, and of the context in which they were deposited, can yield fascinating insights into a range of behavioural, life-history and ecological parameters that pertained to those species. In recent years, a wealth of new approaches aimed at teasing behavioural information from the fossilised remains of extinct species have been developed and investigated. An authoritative review of some of those developments is timely and should prove to be a great asset.

Reconstructing Behavior in the Primate Fossil Record is the latest addition to the outstanding *Advances in Primatology* series edited by John Fleagle and Ross MacPhee. It reviews the basic principles that underlie current reconstructions of behaviour in the primate fossil record and provides some good examples of how those principles can be applied to specific cases. The chapters are written by well-known specialists in the field of primate evolution. They review

broad theoretical issues as well as the various types of evidence that can be used to infer behaviour in extinct species.

The first contribution, by Ross, Lockwood, Fleagle and Jungers, addresses the concept of *adaptation* and its relevance to the reconstruction of behaviour in fossils. It discusses diverging opinions on how adaptations, as a concept, should be defined, before reviewing ways in which we can aim to identify adaptations in the fossil record. A central theme in this introductory chapter is the relative importance of phylogenetic inertia versus that of stabilizing selection for the maintenance of character traits. Ross *et al*. clearly see this as a crucial issue, stating in their closing paragraph that "If phylogenetic inertia is a relatively unimportant phenomenon, then the distinction between the historical and non-historical concepts of adaptation are mostly semantic. If, however, stabilizing selection is not important in the maintenance of traits in lineages over time, then we can be pessimistic about our chances of identifying adaptations in the fossil record." (p. 35). Some may disagree, but Ross *et al*. make the well balanced case that recent statistical methods that aim to correct for phylogeny in comparative analyses, while addressing a very important issue, are not the final solution as which they are sometimes perceived. This first chapter sets much of the theoretical framework for the remaining chapters.

The following chapters review specific types of evidence and generally provide useful introductions into their respective subjects. Behaviour in fossils is inferred on the basis of results from experimental functional analyses (Chapter 2, Hylander & Johnson), ontogenetic data (Chapter 3, Ravosa & Vinyard; Chapter 4, Godfrey, Petto & Sutherland), comparative analyses of socioecology (Chapter 5, Nunn & van Schaik), as well as from palaeoenvironmental and palaeocommunity data (Chapter 6, Reed). Two chapters provide broad reviews of two of the most commonly addressed subjects in palaeoprimatology, the reconstruction of dietary habits in fossils (Chapter 7, Ungar) and the potential link between sexual dimorphism and social behaviour (Chapter 8, Plavcan). Before closing with a concluding chapter by the editors, the book also includes two case studies, where multiple lines of evidence are used to provide a more comprehensive picture of the biology of extinct species. The first brings unexpected insights into the habits of the oldest known New World monkey, *Branisella boliviana*. (Chapter 9, Kay, Williams & Anaya). The second opens a window into the fascinating world of the giant extinct lemurs from Madagascar (Chapter 10, Jungers, Godfrey, Simons, Wunderlich, Richmond & Chatrath).



A range of factors that influence the reconstruction of behaviour and the recognition of adaptations in fossil species are discussed throughout the book. They include authoritative discussions of issues which most will at least be aware of: the general application of a comparative approach when inferring, *e.g.*, form-function relationships in fossils, the effect that phylogenetic history can have on the validity of reconstructions of behaviour in fossils, as well as the significant influence of allometry on an animal's biology and, therefore, its importance in the reconstruction of behaviour from morphology. Significantly, some of the chapters also address issues that are less frequently discussed in the literature. Standard errors can influence the validity of inferences from comparative relationships, but are frequently not given the necessary attention. There is also a "biological error" component that affects the reconstruction of behaviour. The relationship between morphology and behaviour is often relatively loose since the plasticity of behaviour is higher than that of morphology. With regard to reconstructing dietary behaviour, Jungers *et al*. (Chapter 10) point out that "… morphological evidence alone is probably conservative and often underestimates the full range of feeding behaviors practiced by extinct organisms." As discussed by Peter Ungar (Chapter 7), non-adaptive evidence, such as micro-wear patterns on teeth, can significantly complement information gained from adaptive morphologies.

A further difficulty is introduced by the fact that extant comparative data does not necessarily give a comprehensive account of past form-function relationships. As a result, analyses based on extant data alone can be misleading even when the association between form and function is exceptionally strong in the modern comparative sample. A related problem is well illustrated in Chapter 9, in which the adaptive profile of *Branisella boliviana*, the oldest known primate from South America, is reconstructed. Drawing from various types of evidence, the authors come to the conclusion that the locomotor behaviour of *Branisella* included a significant terrestrial component. Given the age of *Branisella* and the fact that all modern New-World monkeys are exclusively arboreal, this conclusion is highly counter-intuitive and should remind us that the range of past adaptations within a taxon can exceed that seen in its modern representatives.

Reconstructing Behavior in the Primate Fossil Record is a blend of theoretical considerations and applications of tried and tested, as well as more tentative, approaches to the reconstruction of behaviour in fossil primates. While some of the approaches presented may stretch the currently available evidence to its limits, on the whole the book succeeds in striking a good balance between the enthusiastic pursuit of insights into the habits of extinct species and the necessary caution that should underlie such an endeavour. I found this book to be a great source of ideas and I can thoroughly recommend it to anyone with an interest in primate evolution.

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Trilobiten weltweit. Die Welt der Dreilapper und ihr Spiegelbild in der Philatelie *(Trilobites worldwide. The world of trilobites and their reflection in philately)*

Ernst, H.E. and Rudolf, F. 2002. 118 pp. Dr Friedrich Pfiel, München. ISBN 3899370031 (hardback). Euro 32, US$ 41.70.

This book on trilobite stamps is the first of a series, with companion volumes on stamps featuring ammonites and fossil fish already planned. The present volume includes illustrations of the forty-eight stamps and sheets featuring trilobites that have been issued to date, by twenty-two countries. Species from all the Palaeozoic systems are represented, with about half from the Cambrian. As well as the stamps, the authors include all known special cancellations and postal stationary illustrating trilobites. Some of these were issued alongside the stamps themselves,

but many are unrelated, and were produced to promote palaeontological and geological meetings.

Following a forward by Bob Owens, there is a ten-page introduction to trilobites, covering major aspects of morphology, ontogeny and mode-of-life. Though brief, this introduction is written at undergraduate textbook level, and may be a little more technical than is really necessary in a book of this kind. Throughout, the book is set in double-column format, with German text to the left, and English to the right.

The major part of the text deals with the stamps: each is reproduced in colour, and at its original size. For each stamp or cover, details are given of the source and date of publication, and the taxonomic identity of the species concerned. The stamps are arranged by illustrated species, following the higher classification of the second edition of the *Treatise*. Each species has a brief systematic description, and its stratigraphical and geographical distribution are outlined. In some cases, there are notes on taxonomic matters as well. Again, in places, I found the technical content rather more advanced than necessary. The text is accompanied by colour photographs of the species represented on the stamps, or of closely related ones. The quality of these photographs is good, but more detail would have been visible in black and white photographs of whitened specimens. At the end of the systematic section, several pages are devoted to stamps and postmarks featuring illustrations of trilobites too generalized for exact determination. There are separate lists of philatelic and palaeontological references, and the book ends with a list of trilobite stamps and postmarks arranged by country of origin.

Although slim, this is a handsome book: hard-bound, nicely set, and printed on good quality paper. It is also authoritative. Ernst has a long-standing interest in philately, focused particularly on stamps with a fossil theme. Rudolf works in scientific publishing, but also publishes on trilobites in the primary literature. Given the huge popularity of philately as a pastime, and the fact that trilobites rank alongside ammonites and dinosaurs as favoured fossil groups among amateur palaeontologists, this book will find a ready market.

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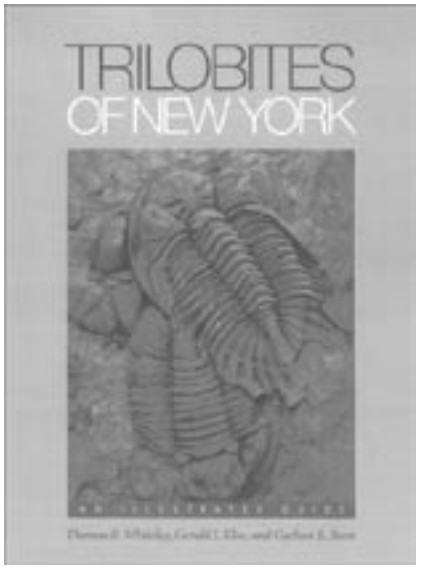
Trilobites of New York: an illustrated guide

Whiteley, T.E., Kloc, G.J. and Brett, C.E. 2002. xvii+203 pp., 175 pls. Cornell University Press. ISBN 0801439699 (hardback). US$ 55.

The book opens with a forward by Rolf Ludvigsen, who briefly reviews the history of research on New York trilobites. These have a published record spanning more than a hundred and seventy years, beginning with DeKay's (1824) description of *Isotelus gigas*. Green's (1832) monograph on the trilobites of North America dealt with the thirty-two species known to him. About 80% of these came from New York State, and strata of Cambrian to Devonian age there have continued to provide a rich source of trilobites, including some specimens with appendages. Research on these fossils has been undertaken by workers as distinguished as Hall, Walcott, Whittington and Eldredge. As Ludvigsen notes, however, the professionals have always been outnumbered by amateur palaeontologists. Like the academics, amateurs tend to specialize taxonomically, stratigraphically or geographically. *Trilobites of New York* is designed to provide a nearly complete compilation of the trilobites of the State, supported by wider ranging reviews of trilobites as a whole, and of the relevant geology of New York.

The first part of the book (Chapters 1-3) includes a short history of research, discussion of taxonomic nomenclature, and an introduction to the Trilobita. General morphology, ontogeny and mode-of-life are all well covered. The text is written at first-year undergraduate level, and would be accessible to any reader with a reasonable level of scientific literacy. Chapter Four occupies about a third of the whole text, and provides an authoritative and up-to-date review of the geology and geological history of New York State, covering the last billion years. This chapter is supported by numerous field photographs and palaeogeographical maps, and is written at a slightly more advanced level. It will be of interest to all those with an interest in the geology of the region, not just to palaeontologists. The trilobite species are listed in Chapter Five, arranged by family, and presented in *Treatise* order of higher taxa. Brief notes are given on these, as well as the species. Details of type material are given where known, but there is no specific locality information. The final part of the text includes one particularly useful appendix that tabulates trilobite taxa against both age and environment. A second appendix briefly addresses photography and image processing. There is also a glossary of technical terms, as well as separate trilobite and general indexes.



Many will be attracted to this book principally for the hundred and seventy five black-and-white photographic plates. The quality of these is mostly in the range good to better. At their best, the photographs are truly excellent: Plate 34 for instance, showing the odontopleurid *Kettneraspis callicera*, is quite exceptional. Some specimens are illustrated

unwhitened, to show features only visible because of colour variations. In other cases, unwhitened material has been used to convey a better impression of a specimen's 'primary' appearance. I can understand why this was done, but some loss of detail inevitably results. Some individual illustrations can be criticized: the whitening is uneven on Plate 41, Plate 73 lacks contrast, the specimen illustrated on Plate 129 is fairly nondescript, and a few images (*e.g.* Plate 30) have been over-enlarged. But in a book of this overall quality, such criticism is carping. There are some plates in which there is a good deal of wasted background space, however. This is a pity: use of more composite plates would have allowed more material to be illustrated. Where composite illustrations are included, they are used effectively.

This is a well-written book produced to the highest standards. I think many Palaeozoic palaeontologists will want to have a copy, not just those with an interest in American trilobites. Although really an aside to the main thrust of the work, I think the review of New York geology and geological history will be very widely consulted.

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Upper Devonian (Famennian) conodonts of the Palliser Formation and Wabamun Group, Alberta and British Columbia, Canada

David I. Johnston and Brian D.E. Chatterton. Palaeontographica Canadiana No. 19

This work by Johnston and Chatterton contains a wealth of conodont recovery data, 36 plates of figured condonts, and the descriptions of 12 new form element species and 22 taxa described in open nomenclature, including two genera. It brings to mind the massive works of Druce on Devonian and Carboniferous Australian condonts published by the Bureau of Mineral Resources. If those blue books are not on your shelf, if Famennian, *Mehlina*, *Palmatolepis, Polygnathus, Polylophodonta,* Palliser and Wabamun have no meaning, or you have no personal fascination with phosphatic microfossils from an extinct chordate that continues to be treated as an invertebrate, then this volume, while valuable, will likely gather dust on the book shelf.

Johnston and Chatterton have put together a very brief text of six pages that is distributed through twelve text figures of location maps, stratigraphic columns, that given their scale and minimal detail may not have great utility to sedimentologists utilizing the work or those visiting the field to replicate samples, core yield diagrams, two charts of stratigraphic nomenclature and correlation, as well as a conodont range chart. The range chart proved a puzzle. First, a text statement: "These zones are usually defined by the first occurrences of species in this work, …" This begs the question which zones are not defined by the first occurrence of a taxon, as well as the qualifier that other taxa can be used to recognize the zones. But the opportunity was lost to define zones by the consistent use of a first occurring taxon that was unsoundly followed by Ziegler and Sandberg (1984, 1990). Secondly, if the zonation utilized is well established and samples are adequate, then any range extension should be legitimate; why then the queries? This can be checked by using graphic correlation techniques, which the data set seems well enough documented to perform.

The general text covers general stratigraphy, sample protocols, conodont zonation, biostratigraphy, and palaeocology. The biostratigraphic section has the most gems, especially the detail that the members of the Palliser Formation are diachronous and that the top of the Palliser is younger to the north. The palaeoecology section offers a hint of what can be accomplished by comparing sea-level data independent of conodont biofacies, but then is crushed by the current paradigm: "…faunas of the palmatolepid biofacies that are characterized by certain species of *Palmatolepis* that are apparently adapted to more restricted environmental conditions." It is clear that the Upper Devonian conodont genera *Palmatollepis-Polyugnathus-Icriodus* do not follow a neat offshore to nearshore biofacies progression at all times and in all places. Documentation of species level taxa that fit, or do not fit, a usable biofacies pattern needs to be established for further utility. Future works that may address this problem are promised and they will make an attractive boxed set when released.

The lengthy but abridged systematic palaeontology section will prove the most controversial part of the monograph. First, Johnston and Chatterton have taken a rather liberal approach to their concept of some taxa, in several cases illustrating a wide variety of morphotypes, all based on P_1 (Pa and I) elements, e.g., *Palmatolepis crista*. There is no consideration of the multielement apparatuses following the leads made by Klapper and Foster, 1993; Metzger, 1994; and Schülke, 1999 for species of *Palmatolepis*. This is compounded by the illustration of some taxa that do not seem to be typical of the species to which they are assigned, e.g., *Palmatolepis lobicornis* and *Palmatolepis minuta*. Assessment of the entire apparatus would increase confidence in the species assignment. The authors have also departed from the practice of recognizing subspecies, elevating all of the subspecies to the species rank, albeit still recognizing the taxonomic groupings informally. This is in direct contrast to Schülke (1999) who placed some species that have been long recognized into subspecies due to the similarity of elements in the apparatus, e.g., *Palmatolepis glabra tenuipunctata*. *Palmatolepis minuta* has a long history and has been given significant attention (Branson and Mehl, 1934; Ziegler, 1962; Metzger, 1994; Schülke, 1999). A study that changes taxonomic standing of this and other taxa should address the resultant shifting of rank utilizing all possible information. Furthermore there are even some specimens that are only identified temporally, *e.g.*, "included in the concept … for the time being, …" (p. 28) in regard to *Palmatolepis minuta* specimens. Given the broad concept of some taxa it may prove difficult to utilize the range charts, but the indication of sample and stratigraphic level of illustrated specimens will allow recognition of these morphotypes in other localities and possible refined correlation. As such this is a very valuable contribution.

The illustrated specimens in the plates are extensive and complement the systematics, in several cases illustrating numerous morphotypes and sizes of a taxon with upper, oblique, side, and lower views. Most of the images are well aligned and the reproduction is high quality, although very high contrast on some plates compared to others, *e.g.*, Plates 30–33. Significantly and of great value, Johnston and Chatterton have illustrated growth stages of several taxa, *e.g.*, *Palmatolepis subtilis*, as juveniles often prove the most abundant specimens, albeit difficult to identify with confidence. This may be the case for some juveniles illustrated which may defy consistent identification e.g., *Pa. ovata*, *Pa. minuta*, and *Pa. crista*.

The references are current to 1998, as well as a study by Savoy *et al.* (1999) and an over referenced abstract (Johnson and Chatterton, 1999). Appendices give locality information and

tabulate the sample yields and fauna distribution of all the conodonts in the study, so there is the data. The taxonomic index at the end is a nice addition.

The monograph will prove valuable to Upper Devonian Famennian conodont workers as a reference, especially the images of bispathodid, icriodid, mehlinid, palmatolepid, polygnathid, polylophodontid and two new genera of conodonts, as well as to western North American stratigraphers working in the Famennian platform strata. This study will serve as the stratigraphic framework for works that address the sequence stratigraphy and palaeoecology of organisms in the Famennian of western Canada.

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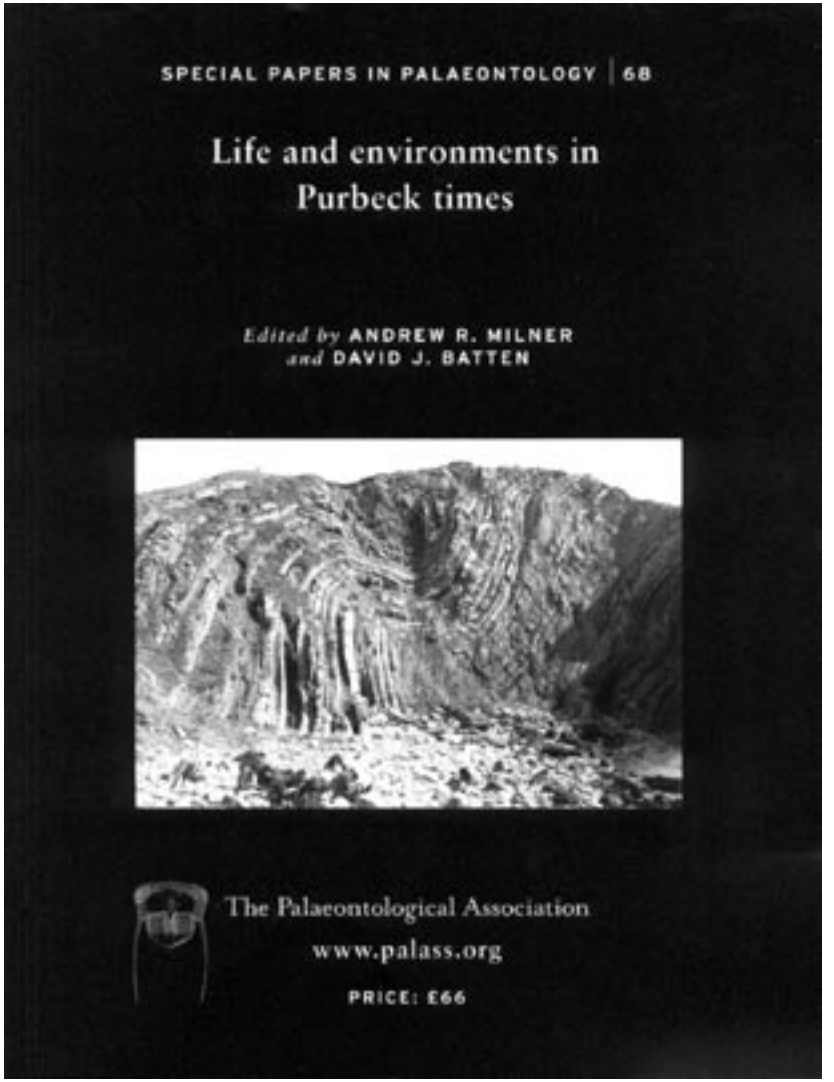

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