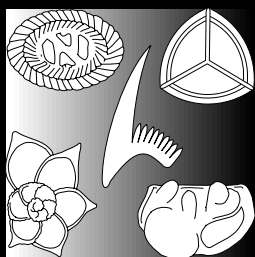


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# *Newsletter of Micropalaeontology*

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Edited by Phil Donoghue

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British  
Micropalaeontological  
Society

# British Micropalaeontological Society Foundation Members 1999

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## Editorial

**A**s you will note from the Secretary's report, I will not seek re-election as *Newsletter Editor* when my current term expires at the forthcoming AGM. As a result, the Society is currently seeking a replacement editor; if any of you feel like taking up the challenge, please contact one of the members of the Committee.

The cover illustration is from Mark Purnell (Leicester) and depicts a range of conodont elements on the head of a pin.

**COPY DEADLINE** for newsletter #61 will be Monday November 1st 1999.

**Philip Donoghue** <pcjd2@le.ac.uk>

## Secretary's report

### Directory of members

A new Directory of Members is to be issued this year, and is to be mailed to the membership with the December edition of the Newsletter. It is our intention that membership to specialist groups will be itemized in the Directory, as well as on the Website. A form is included in the Newsletter requesting Email address details from the membership as well as Specialist Group affiliations, together with a request for permission to publish Email details on the Website.

### Publicity Officer and Newsletter Editor

The current Publicity Officer, Maxine Huselbee, and Newsletter Editor, Phil Donoghue, are standing down from their posts at the 1999 AGM. Nominations for their replacements (together with name of proposer and seconder) should be sent to the Secretary by 17th October 1999.

### Annual General Meeting 1999

The 1999 AGM will be held on Wednesday 17th November 1999 in the Gustave Tuck Lecture Theatre, University College London commencing 2.00 pm. Items for inclusion on the agenda must be notified to the Secretary by 17th October 1999. Following Society business, two talks will be presented.

#### Molecular View on Origin, Macroevolution and Speciation of Foraminifera

Jan Pawlowski, Université de Genève

#### The Role and Application of High Resolution Reservoir Biostratigraphy in the Hydrocarbon Exploitation of the Cusiana and Cupiagua Fields, Llanos Foothills, Colombia

Stephen Lowe, BP Amoco

Following last year's successful experiment, a wine reception with poster displays will take place after the AGM in the South Cloister. Members wishing to submit posters should inform the Secretary by 17th October 1999, together with a title of their poster (and abstract if possible).

### Lyell 2000

The BMS is organizing the inaugural Lyell Lecture as part of the Geoscience 2000 meeting in Manchester on Tuesday 18th April 2000. Professor Hans Thierstein (Geological Institute, ETH-Zürich, Switzerland) has accepted the Committee's invitation to deliver the lecture on the theme of Plankton Evolution and Climate Change. In addition, the Secretary, on behalf of the BMS, is convening a half-day symposium during Geoscience 2000, also on the theme of Plankton Evolution and Climate Change. To date, the following have expressed their willingness to participate:

Paul Bown (University College London): Calcareous nannoplankton

Paul Pearson (Bristol University): Planktonic Foraminifera

Jim Riding (British Geological Survey): Dinoflagellates

Alain Le Hérisse (Brest University): Acritarchs

Grant Bigg (University of East Anglia): Climate modelling

Sue Rigby (Edinburgh University) and Barrie Rickards

(Cambridge University): Palaeozoic macroplankton

To be confirmed:

Peter Doyle (Greenwich University): Mesozoic macroplankton

Hans Schrader (Bergen University): Diatoms

Dave Lazarus (Humbolt University): Radiolaria

Pat Holligan (Southampton University): Modern phytoplankton

### Honorary membership

The Committee has invited three recently retired micropalaeontologists to become Honorary Members of the Society in view of their outstanding service to the BMS. It is hoped that Professor John Neal, Professor Bernard Owens, and Professor Brian Funnell will each be presented with a plaque to mark the occasion at the AGM.

**Dr James Powell**, BMS Secretary, *Dinosystems*, 105 Albert Road, Richmond upon Thames, Surrey TW10 6DJ

## Request for permission to list email addresses in the Directory of Members & on the BMS website

I hereby give the British Micropalaeontological Society permission to list my Email address in the Society's Directory of Members and on the Society's Website.

Surname:

Initials:

Email address:

Specialist Group(s):

Please send your permission to the Secretary (ajp@dinosystems.co.uk) or return this form to him at the following address:

**Dr James Powell**, BMS Secretary, *Dinosystems*, 105 Albert Road, Richmond upon Thames, Surrey TW10 6DJ, England, UK

## Treasurer's report

**T**he membership subscription invoices were distributed to all individual/student members in late February. Many thanks to all who have promptly responded. To those members who have paid using credit cards, please note that we will not routinely send an acknowledgement by post in order to mitigate our administrative costs. If you require a receipt and/or credit card counterfoil please let me know. If you have not yet paid your 1999 subscription, please do so as soon as possible. Please note that we intend to send the invoices out in late November henceforth.

May I also ask members to check your address details held by the Society. There have been several instances recently of minor changes to postcodes etc. which have resulted in mailings going astray. If you change address, or wish to resign from the Society, please take the time to let the Secretary or Treasurer know.

We have had a good response to the Deed of Covenant scheme thus far. If you are a UK taxpayer, please consider covenanting to BMS. It is a practical way of helping the Society at no cost to yourself. There has been a significant increase in members who have subscribed to the BMS Foundation this year. We warmly thank all who have made donations to the Foundation.

BMS continues to enjoy relatively good financial health and we should go into 2000 with reasonable reserves. Again, if you know of colleagues involved in our subject who are not BMS members, please suggest they join us.

Jim Riding

## New members

**W**e warmly welcome the following new members who have recently joined the Society: Richard A. K. Attewell, Robert Austin-Smith, Davide Bassi, Raimond Below, Stig M. Bergstrom, Anna D'Atri, Mags Duncan, Jayne Dunn, P. J. Jones, Jason Jordan, Katerina Kouli, David Leigh, Simon W. G. Newman, Uyop Said, James Stanyer and Adrian M. Wood.

## *A Stereo-Atlas of Ostracod Shells* comes to an end

**D**ue to a number of factors the editors of *A Stereo-Atlas of Ostracod Shells* have decided that the time has come to cease production. The reasons are many (economic, production problems, obtaining copy). The situation has been under review for the past 3 years and it has finally become impractical to continue with the atlas in its present state.

After 25 years of production, changes in the academic and industrial sectors have meant that fewer researchers are engaged in taxonomic work and this has been reflected in the number of manuscripts submitted and subscriptions to the *Stereo-Atlas*.

Approximately 700 species are described in the *Atlas*, many of them type species of their genus. We hope that the *Stereo-Atlas* will continue to be an invaluable resource for ostracod workers. The editors wish to extend their thanks to all past editorial board members, authors, reviewers and subscribers for their time and support.

To mark the final issue, a cumulative index has been produced and was distributed to all subscribers with volume 25. Additional copies of the Index can be obtained from the address below.

## Cumulative Index of *A Stereo-Atlas of Ostracod Shells*

Additional copies can be obtained by sending a cheque for £5.00 payable to *The British Micropalaeontological Society*, to

**Ian Boomer** Department of Geography, University of Newcastle, Newcastle NE1 7RU, UK.

<ian.boomer@ncl.ac.uk>

## Farewell to *A Stereo-Atlas of Ostracod Shells*

**A** *Stereo-Atlas of Ostracod Shells* (ISSN 0952-7451) was launched in 1973 with the late Peter Sylvester-Bradley and his then postdoctoral associate, David Siveter, as editors. Peter Sylvester-Bradley was F.W. Bennett Professor of Geology in the University of Leicester, England. He was, by any standards, an exceptional individual who contributed fully to local, national and international scientific endeavours. The *Stereo-Atlas* was his brainchild and was typical of his innovative style. The initial hope of the editors was to generate enough interest to publish for two years and then take stock. Volume 25 (for 1998) has appeared; sadly, this is the last in the series, as the decision has been taken to cease publication.

The original aims of *A Stereo-Atlas of Ostracod Shells* were simple enough, to harness and disseminate the scientific revolution which the scanning electron microscope (SEM) provides to micropalaeontology. As Peter Sylvester-Bradley declared in the opening article of the very first issue, this "New Palaeontography" places priority on the illustrations as a language easily communicated and understood by the international palaeontological community. To that end the *Stereo-Atlas* was designed with a unique format: a high illustrations-to-text ratio, an emphasis on stereo-photography and a policy of producing plates about as good as technology can achieve.

Initially produced under the imprint of the Department of Geology at the University of Leicester (1973-1975) and then for one year (1976) by Broadwater Press (Welwyn Garden City), from 1977 to 1981 it was published jointly by (the then) Robertson Research International (Llandudno, Wales) and the British Micropalaeontological Society, London, since when it has appeared solely under the aegis of the B.M.S. The (then) British Museum (Natural History), London and the Department of Geology at the University College of Wales, Aberystwyth also provided invaluable logistical support in the early years of publication. From 1981 to 1996 the production of the *Stereo-Atlas* was entrusted to BPC Blackpool Ltd (and its predecessors), to whom a great debt is owed for the quality of publication, especially the plates. Latterly the *Stereo-Atlas* has been produced by Moulton Printing of Blackpool. Over the years all of those who served as an editor, treasurer, or have been closely involved with the day-to-day running of the *Stereo-Atlas* have, perhaps appropriately, been mainly former students or former research associates of Peter Sylvester-Bradley: John Athersuch, Ray Bate, Ian Boomer, Cyril Haskins, David Horne, Alan Lord, Bob

Lundin, John Neale, Lesley Sheppard, David Siveter, Robin Whatley and John Whittaker.

Palaeontological research demands high quality, consistent taxonomy and *A Stereo-Atlas of Ostracod Shells* has gone a long way to supporting that goal in the field of ostracod research. Rigorous taxonomy is no less important today than it was when the journal first appeared in 1973. However, times and demands on researchers and their research programmes change. More recently, ostracod research has concentrated on neoteny, genetics and applications such as shell chemistry and palaeoenvironmental, biostratigraphical and palaeobiogeographical utility. Whilst the scientific need for taxonomy remains as paramount as ever it is clear that today less research, and particularly less research funding, is a fact of life in this branch of our science. This has recently been reflected in the reduced numbers of manuscripts received for the *Stereo-Atlas* and also in the lack of new subscribers. Furthermore, institutional libraries are coming under increased financial pressure to stop taking specialised journals and, in trying to tap a limited "niche market" this has especially affected the *Stereo-Atlas*. Production matters relating to "economies of scale" have also, lately, provided additional problems. It is therefore with considerable sadness that the editors feel it is time to cease production of the *Stereo-Atlas*.

Since the first issue of the *Stereo-Atlas* appeared twenty-five years ago nearly seven hundred species have been described in its pages, many of them type-species of their genera. In latter years the quality of the illustrative stereo-pairs, which are its trade-mark, surpassed that of most palaeontographical works. *A Stereo-Atlas of Ostracod Shells* certainly made its mark and can fairly claim to have been true to its aims.

As a valedictory, a comprehensive Index of all twenty-five volumes has been compiled by Robin Smith and will be distributed free to all subscribers with the last issue.

Happily, *A Stereo-Atlas of Ostracod Shells* will be wound up without any financial burden to the British Micropalaeontological Society. Indeed, we expect a modest surplus to be available to be donated to the B.M.S. for publication purposes - ostracod papers, of course!

**John E. Whittaker**

(Chairman, British Micropalaeontological Society)  
The Natural History Museum, London January 1999

## New web address for the BMS website

**T**he BMS Website has been overhauled and updated, it can now be found at:

<http://www.bmsoc.org>

The files associated with the site are still hosted at the Natural History Museum and can be accessed via the old address of [http://www.nhm.ac.uk/hosted\\_sites/bms](http://www.nhm.ac.uk/hosted_sites/bms). However, I'm sure you'll agree that the new address is a much more manageable way to access information about the society without needing to give out a long URL for our website. The new format also permits easier changes to the website such as committee membership and group meetings. Another advantage is that we now have an e-mail forwarding system. If you need to contact members of the committee then you can do so by sending a message to:

\*committee member\*@bmsoc.org and substituting chairman, secretary, journal, newsletter, publicity or webmaster for \*committee member\*.

We hope to make more information available through the Web site such as membership lists etc. The information on the site can be updated as soon as new information is received. It is up to the group chairs and secretaries to see that the Webmaster receives the necessary information in some electronic format. The preferred method is as an html or an MS Word document attachment (both as PC format), emailed text is also suitable.

The other news about the website is that Ian Boomer will have taken over the running of the site from Giles Miller by the time you receive this newsletter. Copies of this newsletter will also be available in PDF format via the website.

**Ian Boomer** <[ian.boomer@ncl.ac.uk](mailto:ian.boomer@ncl.ac.uk)>  
& **Giles Miller** <[cgm@nhm.ac.uk](mailto:cgm@nhm.ac.uk)>

## HOLOSTRAT launched

**I**magine that you are interested in the carbon isotope stratigraphy of a particular section or interval. Or perhaps you want to learn about its bentonites, or graptolites, or geochronology, or any other aspect of stratigraphy. Where do you go for information? You might have a comprehensive and well-ordered collection of literature that you know thoroughly, or you might undertake a library search or talk to colleagues. But new and exciting possibilities for compiling and integrating

stratigraphic information are created by the launch of HOLOSTRAT, a joint venture between the British Geological Survey (BGS) and the Stratigraphy Commission of the Geological Society of London. HOLOSTRAT establishes an area on the BGS website (<http://www.bgs.ac.uk>) for the geological community at large to obtain information on the stratigraphy of the UK, literally putting that information at your fingertips. (See the article by Peter Allen and Peter Rawson, *Geoscientist*, November 1998, p. 14).

The first contribution to HOLOSTRAT is now available on the BGS website, and is a compilation of files relating to the type Ludlow Series in the Welsh Borderland. You can reach it by clicking the Free Downloads button on the BGS Home Page, and then following the path through 'HOLOSTRAT'. The compilation contains a series of hyperlinked PDF (Portable Document Format) files, so you will need Adobe Acrobat Reader to view them, but Acrobat Reader is freely available as a download from the Adobe website, and we have provided plenty of opportunities for users of HOLOSTRAT to obtain it.

The PDF files may be viewed on-line in your web browser, or if you prefer can be downloaded as either a self-extracting executable or a zipped file. Once you have opened the Ludlow volume, you can investigate any of the many aspects of Ludlow stratigraphy that it contains. An introductory page contains links to files on chronostratigraphy, geochronology, lithostratigraphy, methods of correlation (biostratigraphy, bentonites, chemostratigraphy) and important sections, while additional links between files relate various aspects of Ludlow stratigraphy to each other, and to maps, vertical sections and other diagrams. A holostratigraphical chart shows the relationships between the various methods of correlation (mainly biostratigraphical), and contains links to a file that explains the relationships displayed. References are included for each section, but are also compiled in a bibliography.

The structure of HOLOSTRAT means that it can grow and develop as revised and/or additional information becomes available, and our hope is that, over time, HOLOSTRAT will become a major reference source for information on UK stratigraphy. The Ludlow volume is the first to be completed, but other compilations in preparation, dealing with aspects of Albian and Oxfordian stratigraphy, are likely to be put up later this year. The provision of stratigraphic information in this form is novel, and we would like as much feedback as possible. So please take a look at HOLOSTRAT, even if Upper Silurian stratigraphy is not your primary interest, and let us know what you think of it.

**Stewart Molyneux** <[s.molyneux@bgs.ac.uk](mailto:s.molyneux@bgs.ac.uk)>  
*British Geological Survey*

## Conodont Group

Perhaps the most significant news since the last newsletter is that there has been a flush of appointments to permanent jobs. Phil Donoghue and Ivan Sansom have been appointed to lectureships at Birmingham, and Sarah Gabbott to one at Leicester. Congratulations to all concerned. Phil, Mark, Ivan and Paul Smith, gave presentations at the Systematics Association meeting on early vertebrates, organised by Per Ahlberg in April. A good meeting merging palaeobiology, developmental biology and evolutionary genetics was enjoyed by all, and was marred only by the hopelessly unreliable projectors (Phil Donoghue strikes again).

Howard Armstrong's project on mid-Ordovician conodonts from limestone clasts in LORS conglomerates of the Midland Valley is now coming to an end with a couple of papers submitted and two in prep. Lu Tingqing from the Petroleum Institute, Nanchong is here on a research visit for 6 months and is working on Arenig and Caradoc conodonts from cherts in the Southern Uplands. He has recently turned his attention to conodonts from the Irish Sea Platform and other islands in the lapetus and running the Durham SEM. Alistair Bowden has now moved jobs and is mapping with the BGS. He continues on his Carboniferous project as time allows. Caroline is busy writing up.

Phil Donoghue is off to Paris to look at osteostracans with Philippe Janvier in May, to Stockholm to look at osteostracan and placoderm brains in a June, and to Chicago to look at osteostracans and heterostracans later in the summer.

Giles Miller reports that he is off to Estonia this summer to collect from the Silurian of Saaremaa with Tiit Märss. Together, they are also going to be writing a paper with Henning Blom (Uppsala) on anaspid fish scale microstructures. Giles will also take the opportunity to look at Viive Viira's Silurian conodont collections.

At Birmingham, Ivan and Paul are busy writing up the Harding Sandstone and *Anatolepis* material, and Karen is well underway writing up her thesis.

Many of you will already have received news of the 1999 Pander Society Newsletter via con-nexus. But for those of you who have not yet subscribed, the 1999 Pander Society Newsletter is now available on the worldwide web at: <http://www.le.ac.uk/geology/map2/pander/index.html> (the UK website) and <http://opal.geology.utoronto.ca/pander/index.html> (The North American website). Please note the new addresses of the front page of the Pander website and update your links and bookmarks.

Mark and Dick are hoping that they can circulate this edition of the Newsletter electronically to most

members of the Pander Society. If you access the web pages you can download the whole newsletter by following the instructions provided there. If you have any difficulty with this please contact Dick Aldridge, the Chief Panderer, at <pandersoc@le.ac.uk> and you will be sent you a hard copy of the Newsletter. Please note that unless you request one, you will not be sent a hardcopy of the Newsletter.

Paul Smith <m.p.smith@bham.ac.uk>

## Foraminifera Group

By the time you receive this Newsletter the BMS Forum Group Spring Meeting will have likely just taken place. Abstracts from the meeting are provided below and the entire technical program is available on the BMS Web Site. This year's programme continues the tradition of the past several years of (essentially) doubling the size of the previous year's programme with, of course, ever increasing scope. Indeed, if the current growth trend continues we will need to consider moving to a full-day meeting format.

In other news, work progresses on the Proceedings of the Fifth International Workshop on Agglutinated Foraminifera, which is being edited by Malcolm Hart and colleagues. A total of 24 papers have been submitted, and the book promises to be one of the largest IWAF volumes so far. The Grzybowski Foundation will print and distribute the proceedings volume, orders for which are currently being accepted (contact <m.kaminski@ucl.ac.uk>).

Congratulations are due Rachel Preece, who submitted her Ph.D. thesis dealing with Miocene Foraminifera at University College London. Rachel has moved on to greener pastures at Chevron Overseas Petroleum, where she is currently posted at the London Office.

No fewer than four BMS members are currently on board the German R/V Sonne, in the South China Sea where they are collecting deep-sea foraminifera.

Sadly, the BMS Foraminiferal Group marks the passing of a colleague who had made an early and important contribution to the study of Kimmeridgian Foraminifera. Dr. Adrian Lloyd passed away in London on August, 8, 1998 after a short battle with cancer. Although he was not an active member of the group, in recent years he had been teaching a short course in statistics for Micropaleontology students at UCL, where he lectured Palaeontology for many years. Adrian was honoured with an Honorary Professorship at the Univer-

sity of Bucharest, and a species of epistominid foraminifer is named after him. He is survived by his younger brother Quenton (in whom Adrian installed a passion for natural sciences), son Nick, and daughter Jackie. He will be missed by those who had the pleasure to know him.

**Norman MacLeod** <N.MacLeod@nhm.ac.uk>  
& **Mike Kaminski** <m.kaminski@ucl.ac.uk>

## **The control of variable c-flux and o<sub>2</sub> content on the deep-water benthic foraminifera of the Central Red Sea**

ALMOGI-LABIN, A., Geological Survey of Israel, Jerusalem 95501, Israel (almogi@mail.gsi.gov.il), SCHERBACHER, M., Institut und Museum für Geologie und Paläontologie, University of Tübingen, D-72076 Tübingen, Germany, and HEMLEBEN, CH., Institut und Museum für Geologie und Paläontologie, University of Tübingen, D-72076 Tübingen, Germany

Living and dead benthic foraminifera were studied in six short cores (multicores) recovered from the Central Red Sea in order to characterize the fauna and evaluate the ecological parameters that control its distribution pattern. The cores were taken between 366 and 1782 m representing the different deep-water masses, covering the well-developed oxygen minimum zone (OMZ) as well as the intermediate and well aerated deep waters. Compared to other regions in equivalent water depths the Red Sea is in position of moderate to extreme oligotrophy. The oligotrophy results from the decrease in C-flux to the sea floor with the increase in water depth coupled with the anomalous high bottom-water temperature (21.7°C). The variable C flux - O<sub>2</sub> concentration influences the density, the vertical distribution pattern of the group and its assemblage composition. The living benthic foraminifera are concentrated in the upper 2 cm at the OMZ, deeper levels at the margins of the OMZ and again mainly at the top of the sediments at the deepest site. Species density decreases with water depth unlike the diversity of the group that is more or less uniform. Only the deepest site is significantly impoverished both by extremely low abundance and anomalous diversity. Additional information on the control of the environment on the benthic foraminiferal assemblages might be gained by studying the distribution of the dead shells at the same set of samples. This enables us to more accurately determine the thickness of the mixed layer, the turnover rates of various species and also to characterize the environment based on time averaging rather than momentary indication of the living fauna.

## **Stratabugs: biostratigraphy data management software**

ATHERSUCH, J. & BRITTON, P. D., StrataData Ltd, 17 The Bothy, Ottershaw Park, Ottershaw, Surrey, KT16 0QG, stratadata@dial.pipex.com

StrataBugs is a biostratigraphic data management system available for Unix and PC platforms and runs in a windowed environment controlled via pull down menus and lists for maximum user-friendliness. Fossil occurrence data may be entered using a membrane keyboard fitted with overlay menus and data are verified against a taxonomic database. In addition, facilities are provided for recording interpreted geological data such as ages, biozones, lithostratigraphy, sequences, palaeoenvironments and graphic lithology and for displaying all of these data against wireline log traces on screen or hardcopy. Data can be exchanged with other databases via a number of data exchange applications or imported into desktop publishing packages to built correlation panels. Version 1.5 of StrataBugs is Year 2000 compliant.

## **Quaternary history of the polar front in the Scotia Sea, Antarctica: foraminiferal and stable isotope evidence**

HALE, R. E., School of Ocean and Earth Science, University of Southampton, Southampton Oceanography Centre, European Way, Southampton, SO14 3ZH, R.E.Hale@soc.soton.ac.uk.

A number of cores from the Scotia Sea, Antarctica have been sampled through the Quaternary period for microfossil and stable isotope analysis. The cores are taken from various locations to the north and south of the Antarctic Polar Front (APF). Benthic foraminifera were counted and identified and the number of foraminifera per gram of sediment was calculated as an indicator of productivity. The planktonic foraminiferal species present were counted to observe changes downcore and the abundance calculated. Carbon and Oxygen stable isotope analysis was carried out using the planktonic foraminifera *Neoglobobulimina pachyderma* (sin).

The dominant benthic species were found to be *Eilohedra weddellensis*, *Epistominella exigua*, and *Nuttallides umbonifera*. These are all important bathyal and abyssal species known to be associated with Antarctic Bottom Water (AABW). The abundance of planktonic and benthic foraminifera can be seen to decrease



downcore until completely absent in some samples from the last glacial interval. Productivity also appears to be greater in the cores from north of the Polar Front and therefore it can be seen that both benthic and planktonic carbonate production are related to the position of the APF. Carbonate production dominates to the north of the Scotia Sea where the Carbonate Compensation Depth (CCD) is deeper and the water is saturated with  $\text{CaCO}_3$ . Stable isotopes results show the  $\delta^{18}\text{O}$  values becoming more positive downcore accompanied by a general decrease in  $\delta^{13}\text{C}$ . The  $\delta^{18}\text{O}$  values are greater in the more southern core where the water temperatures are much colder.

The results seen are typical of a recovery from glacial conditions but may also indicate a movement of the Polar Front to a more northerly position during glacial times than at present. In core KC064 there is also evidence of a reversal to colder conditions during the Holocene for a short period of time, seen as a dramatic decrease in productivity.

**Keywords:** *Polar Front, benthic foraminifera, stable isotopes, glacial interval, productivity.*

## Biofacies distribution and systematics of benthic foraminifera from the Kimmeridge Clay, Dorset, England.

HENDERSON, A. S., MacLEOD, N. and CULVER, S. J., Department of Palaeontology, The Natural History Museum, Cromwell Road, London, SW7 5BD.

A series of benthic foraminiferal faunas from the Kimmeridge Clay were identified for the purpose of testing hypotheses relating to their composition, structure and persistence. A comprehensive sampling scheme was applied and over 280 samples from core and outcrop were examined for their benthic foraminiferal content. On average, 200 specimens were identified from each sample to provide an overall database of over 55,000 individuals. The majority of assemblages consisted of almost entirely small agglutinated taxa; often very poorly preserved. Most species encountered are very susceptible to deformation, with the degree of deformation being inconsistent from sample to sample. Species also exhibit a wide range of compaction morphologies. Initial analysis has therefore concentrated on generic distribution.

Although generic level biostratigraphy for Kimmeridgian foraminifera exhibit long-ranging distributions throughout the Kimmeridge Clay sampled interval, there are several different occurrence patterns evident within these data. Using simple presence/absence data seven biofacies can be recognised along with three major

taxic associations. Six of the seven biofacies are distinguished on the basis of relatively rare taxa, suggesting that sample size/spatial scope may play a crucial role in correctly interpreting Kimmeridgian faunal data. In addition these data show two major faunal turnover intervals (across the rotunda/pallasoides zones and within the eudoxus zone). Three minor faunal turnovers horizons are also recognised between these major disturbance events.

In total over 145 species were identified, from 37 genera. Overall the fauna is dominated by seven genera ("*Texulariopsis*", *Trochammina*, *Kutsevelia*, *Ammobaculites*, *Epistomina*, *Lenticulina* and "*Eoguttulina*"). There is a general inverse relationship between the trochamminids as a whole and the "textulariopsids", which although coinciding with lithological breaks is not purely substrate controlled. A large number of species previously unrecorded from the Kimmeridge Clay were identified along with several new species, which are at present in open nomenclature pending further investigation.

**Keywords:** *Polar Front, benthic foraminifera, stable isotopes, glacial interval, productivity.*

## Techniques for manipulating digital sem images using basic software tools

HYLTON, M.D., Department of Geological Sciences, University of Plymouth, Drake Circus, Plymouth, Devon, PL4 8AA, mhylton@plymouth.ac.uk; HOWARD, J.F., Oxford University Computing Services, 13 Banbury Road, Oxford, OX2 6NN, john.howard@computing-services.oxford.ac.uk.

With the advent of electronic publishing (e.g., *Palaeontologia Electronica*) and the World Wide Web, the use of digitally generated images has become an essential part of the research process. Recent advances in PC and SEM technology has allowed the capture and storage of high resolution digital imagery. Proprietary software then allows the editing of these images and inexpensive printers can produce high quality hard copies of plates suitable for publishing purposes. This presentation will cover the experiences of the first author during his work with Lower Jurassic foraminifera using such technology, explaining the processes used, some of the limitations met and the quality of output that is obtainable at a low cost. A portfolio containing examples of such images will be available for delegates to examine.

## **Kimmeridgian agglutinated foraminifera, relict or primary? Results of observations from palynological preparations and dissolution experiments**

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During studies of micropalaeontological preparations of the Black Stone Band and the *Hudlestoni* Zone indicate that the foraminiferal assemblage is dominated by agglutinated foraminifera. Yet during palynofacies studies it has been found that the foraminiferal test lining assemblage is far more diverse. Dissolution experiments were undertaken, and it was found that a proportion of the test linings found belonged to hyaline, calcareous, genera. In fact some surprising facts came to light, among these, that the hyaline test linings found most abundantly belonged to those species with aragonite tests. Incorporation of these results into a wider picture allows a greater insight into the ecology and environment during this period of deposition.

**Key words:** *Kimmeridgian, agglutinated, aragonite, dissolution, palynological.*

## **Foraminifera as indicators of earthquake induced coastal flooding in the Gulf of Atalanti, Central Greece**

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In April 1894 a series of earthquakes caused major coastal changes along the coast of the Atalanti area. Contemporary accounts report slumping, tsunami inundation and coastal subsidence. Estimates of co-seismic subsidence caused by the earthquakes vary from a few decimetres to 1.5 metre. Cores were taken from the saltmarshes along a stretch of coast effected by the earthquakes. Stratigraphic and foraminiferal analyses together with radiometric dating ( $^{210}\text{Pb}$  and  $^{137}\text{Cs}$ ) were used to reconstruct the coastal changes and the extent and magnitude of co-seismic subsidence. While no evidence of marine inundation was found in cores 5 km away from the fault line, the foraminiferal assemblages in cores closer to the fault show a rapid change from

supra-tidal to marine conditions. One of the most abundant species in the sediments is *Rosalina globularis*. In almost every sample specimens were found with a floating chamber on the umbilical side as well as specimens without. The occurrence of a floating chamber has been reported to be a phase of the reproduction cycle that only appears in September and October. Hence, the absence of specimens with floating chamber can be used as indicator for rapid deposition.

**Keywords:** *benthic foraminifera, tsunami, subsidence, earthquake, saltmarshes*

## **Benthic foraminifera from the uppermost Maastrichtian at Nazilów (Poland) and Stevns Klint and Nye Kløv (Denmark)**

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Analysis of uppermost Maastrichtian benthic foraminifera from three different locations, all situated within the northwestern European chalk sea, was carried out. The three outcrops represents a transect from an inner shelf or nearshore (Nazilów, Poland) to mid-outer shelf environments (Stevns Klint and Nye Kløv, Denmark). Taxonomy and quantitative distribution of the benthic foraminifera were examined. The Late Maastrichtian assemblages are highly diversified (Fisher Alpha Index 10 to 20 at Stevns Klint and Nye Kløv, and 5 to 11 at Nazilów) with a total of 212 taxa. The benthic foraminiferal associations are homogeneous in morphostructure and dominated by rotalids. The Textulariina and the Lagenina constitutes less than 5% each. The results reveal two distinct faunal associations. The foraminiferal association at Nazilów is characterised by a high abundance of epifaunal morphotypes such as *Cibicides*, *Lingulogavelinella*, and *Alabaminoides*, and high frequencies of infaunal morphotypes (e.g., *Pyramidina*, *Præbulimina*). The prominent taxa are evenly distributed throughout most of the profile except at the top where profound changes occurred. The faunal composition at Stevns Klint and Nye Kløv are very similar. Both areas are characterised by faunas with a high abundance of epifaunal morphotypes such as *Cibicides*, *Cibicidoides*, *Paralabamina*, *Anomalinoides*, and infaunal morphotypes (e.g., *Bolivinooides*, *Bulimina*, *Præbulimina*, *Pseudouvierina*, and *Pyramidina*). The two faunas display a gradual change towards the Cretaceous-Tertiary boundary. However, as for all three assemblages, shifts in

proportion of taxa and not generic and species composition occurred. Previous suggestions of a relationship between benthic foraminiferal changes and sea-level variations are not supported by the data from the three studied locations. None of the foraminiferal associations points conclusively to a specific depth range. Other data including P/B ratio, epi- infaunal ratio, diversity and distribution of morphotypes are in support of very stable benthic foraminiferal associations.

**Keywords:** *Benthic foraminifera, uppermost Maastrichtian, K-T boundary, Denmark, Poland*

## Micropalaeontology as an aid to understanding the sequence stratigraphy, correlation and reservoir architecture of the Mid-Cretaceous Mishrif Formation of Dubai

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This presentation will present preliminary results of a micropalaeontological and sedimentological study of the mid-Cretaceous Mishrif Formation of Dubai, sponsored by the Dubai Petroleum Company.

Within the aims of this project, we are attempting to improve correlation and sequence stratigraphic understanding by recognising parasequences. Parasequences can be recognised from shallowing-up water depth cycles, interpreted from trends in the composition of microfossil (foraminifera, algae, macrofossil debris) assemblages in combination with sedimentary features observed in core and thin-section. These combinations of micropalaeontological and sedimentary features can be termed biofacies. The stacking patterns of parasequences can be interpreted in terms of systems tracts, which together with the recognition of maximum flooding surfaces and sequence boundaries from micropalaeontological and sedimentological data, enables a full sequence stratigraphic interpretation of the succession. This, in turn, permits a better understanding of reservoir architecture and connectivity, so influencing production strategy from oil fields producing from the Mishrif Formation in Dubai.

Key bioevents within the stratigraphic distribution of larger foraminifera are used to provide correlation lines across the study area, whilst parasequence patterns between these horizons provides scope for further high-resolution correlation. The areal distribution of biofacies between correlation horizons allows for detailed

depositional modelling of the Mishrif Formation and its evolution through time.

Key microfossils being used in this study are larger foraminifera (e.g. the *Praealveolina* lineage, *Cisalveolina*, the *Dukhanian-Chrysalidina* lineage, *Dicyclina*, *Cuneolina*, and the nezzazatids), green and red algae and macrofossil debris (e.g., rudists). The occurrence of planktonic foraminifera in certain horizons provides useful stratigraphic control and indication of major relative sea-level rise.

**Keywords:** *foraminifera, Mishrif Formation, parasequences, reservoir architecture, carbonate sedimentology*

## Foraminifera: dead or alive?

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Non-vital staining, especially with rose Bengal, has been widely used in ecological studies to differentiate between unstained (presumed to be dead) and stained (presumed to be living at the time of collection) tests of foraminifera. Doubts have been expressed about staining methods because of the possibility that dead individuals may retain undecayed cytoplasm for weeks or months after death; when stained such individuals would be recorded as living. To assess the importance of this, it is necessary to examine rates of mortality, and the modes of generation of empty tests (whether due to reproduction, growth stages, i.e., leaving an empty tests during growth, or death). It can be argued that reproduction, tests from growth stages, and death through predation lead to tests devoid of cytoplasm (and therefore not susceptible to staining). Whereas reproductive 'deaths' may affect only a small proportion of the population of each species (due to high pre-reproductive mortality), predation in oxygenated environments may be responsible for the major part of that pre-reproductive mortality. In oxygenated environments only death through disease or adverse environmental conditions is likely to lead to dead individuals having tests containing cytoplasm (i.e., forms which will stain and mistakenly be considered as living). In dysaerobic/anoxic environments, predation may be excluded so foraminifera die through other causes and thus more tests with dead cytoplasm may be potentially available for staining. Therefore, for most environments, the problem of staining dead individuals may be overstated.

## Bioerosional structures: possible traces of predation in modern and fossil foraminiferal communities

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Previous studies of bioerosional structures found on modern foraminiferal tests indicate that micro-scale penetration is a common phenomenon in marine environments.

Bioerosional structures, previously observed only in calcareous species, are now reported amongst agglutinated species as well. It is assumed that at least some of the bioerosional structures observed on the foraminiferal tests are the result of predation by one or several unknown predators, one which may be planktonic. Based on the morphology of these bioerosional structures, it is possible to establish at least twelve different informal morphogroups. The distribution of these groups seems to indicate the existence of a bathymetrical or a geographical zonation. Furthermore, it is suggested that one of the possible planktonic predators may be species specific, as one of the morphogroups is only observed in *Orbulina universa*. Preliminary investigations of *Floresina amphiphaga* preying on *Amphistegina gibbosa* have shown that the morphology of the apertural face of *F. amphiphaga* is reflected in the borings observed on the test of *A. gibbosa*. Further studies of this relationship in modern and fossil populations of *F. amphiphaga* and other species of *Floresina* may reveal whether this is characteristic for this genus and if the trophic level has changed through time. Similar bioerosional structures to those mentioned above and some previously undescribed, have been observed in Pleistocene material.

It is here suggested that the study of bioerosional structures may contribute to the ongoing discussion concerning the trophic level of the foraminifera, and eventually lead to a greater understanding of predation pressure in modern and fossil environments.

**Key words:** *Bioerosion, foraminifera, predation, planktonic, benthonic*

## A new miocene microperforate planktonic foraminifer with an exceptionally high level of intraspecific variability

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A new genus and species of microperforate planktonic foraminifera, which is known from the Miocene of a variety of drill sites in the tropical Pacific, Indian and Atlantic Oceans, is described. It shows an unusually high level of intraspecific variability in chamber shape and arrangement, aperture position and test ornament. Some specimens possess supplementary sutural apertures which may have bulla-like coverings, and rare specimens have areal apertures. Others possess a composite tooth-plate reminiscent of certain Cretaceous genera. The species first evolved in early Miocene Biochron M3, and probably became extinct in middle Miocene Biochron M7. A morphometric study from Site 872 (west Pacific) demonstrates that populations tend to be unimodal in their morphology, and substantial shape change occurred during their evolution, relating to the height of the trochospiral and degree of involution of the test. A stable isotopic comparison with other coexisting species indicates that the species was shallow-dwelling planktonic in habitat. A strong positive correlation between test size and  $\delta^{13}\text{C}$  indicates a probable association with photosynthesizing symbionts.

The species seems to have evolved from the long-ranging species *Globigerinita glutinata*, with which it fully intergrades near the bottom of its stratigraphical range. It raises an interesting if difficult question: why are some species of planktonic foraminifera so very variable in characters that would normally be used to distinguish genera?

## Small agglutinating foraminifera from the Equatorial Atlantic margins – niche endemism

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Examination of Miocene mid bathyal material from offshore Cabinda, Angola, and the Agua Salada Basin, Venezuela reveals a distinctive agglutinated niche fauna. Components of this fauna consist of small (~0.05 mm), compressed taxa with evidence of intricate inner structures.

Provincialisation of the benthic fauna between the Venezuelan and African localities is apparent. Offshore Cabinda this faunal group comprises members of the

Family Pavonitinae. Conversely, in the Agua Salada Basin a new species of the genus *Popovia* dominates the same niche. Additional benthic taxa from these two localities display comparable palaeoenvironmental signals.

These small, compressed, agglutinated forms are considered to be low oxygen indicators. The development of septula in the Pavonitinae and chamberlets in *Popovia* force an increase in surface area to volume ratio facilitating gaseous exchange in oxygen minima conditions. In addition, the phylogeny of *Popovia johnrolandi* n.sp. indicates an increasing complexity of inner structure arrangement with time, possibly in response to reducing oxygen availability.

**Keywords:** *Miocene, bathyal, oxygen, Angola, Venezuela.*

## **The benthic foraminiferal proxy for bottom-water oxygenation estimates: constraints and application in the Northeastern Atlantic**

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Dissolved oxygen and food availability are the most dominant factors in controlling the abundance and distribution of benthic organisms. Both factors are linked in a way that an increase in organic carbon flux leads to a decrease in dissolved oxygen in near bottom and pore waters. For estimates of ancient deep-water oxygen concentrations, an approach is made to improve the precision and robustness of the benthic foraminiferal proxy against variations in organic carbon flux. A better calibration of benthic foraminiferal oxygen indices is achieved by the development of a recent ground truth data base by using the World Ocean Atlas from which the oxygen content at a given sampling location is calculated. The resulting estimates are in good agreement with in situ measurements of bottom-water samples. The suite of key species indicating oxic, suboxic, and dysoxic environments is reassessed by studies on the depth distribution of endobenthic foraminifers in near-surface sediments. It appears that several species previously regarded as oxic or suboxic indicators may tolerate a wider range of oxygen concentrations. The depth distribution limits of many endobenthic species coincide with the high-oxic, low-oxic and suboxic boundary values in pore-water oxygen however. Dysoxic indicators are absent at their usual microhabitat depth in the sediment where their nutrient resources not come up to certain threshold

values. A case study to test the benthic foraminiferal oxygen proxy was made on two late Pleistocene records from the Portuguese Margin. The palaeo-oxygen estimates obtained from multiple regression analysis and Benthic Foraminiferal Oxygen Index (BFOI) model are generally in good agreement but diverge before and around Heinrich events H1 through H4, where a significant drawdown in deep-water oxygenation is inferred from benthic C-13 minima and trace fossil assemblages. This suggests that further improvements of the methods are required to achieve more reliable estimates for non-analogous situations.

## **Biostratigraphy and palaeobathymetry of the Foula Subbasin (west of Shetlands)**

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The Foula Subbasin is part of the Faeroe Basin, which is located on the North Atlantic margin, West of Shetlands (UK). From the Foula Subbasin ditch cuttings of 3 wells were processed for microfaunal analysis. The samples (> 125 mm) contain abundant and diverse agglutinated foraminifera, calcareous benthic and planktonic foraminifera, diatoms and radiolarians. Based on assemblages from Well 205/10-2B, a preliminary biostratigraphic framework for the Campanian to Palaeocene is proposed and a palaeobathymetric history is inferred. The Campanian and Maastrichtian calcareous mudstones have been correlated using the last occurrence events of index species. The correlation of the Palaeocene sediments is based on lithology interpreted from well logs. The agglutinated assemblages are subdivided into morphogroups which are defined on basis of the foraminiferal test shapes, and are thought to reflect differences in life position and feeding habit (i.e. form and function). Using modern faunas as an analogue, relative proportions of the morphogroups may be used as an indication of palaeobathymetry. Morphogroup distribution in the Campanian and Maastrichtian mudstones indicates deposition in a lower bathyal environment, while the Palaeocene sediments are deposited in a middle to upper bathyal environment.

**Keywords:** *Foula Subbasin, Campanian - Palaeocene, biostratigraphy, morphogroups, palaeobathymetry*

# specialist group reports

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## Ostracod Group

### Sex and bugs at Medway

Sex? Well, ostracods (the "bugs" in question) are famous for it: in spite of their miniscule proportions, some male ostracods have sperm several times their own body length, making them among the largest in the animal kingdom. Yet it is lack of sex that makes certain ostracods remarkable; the darwinulids have apparently reproduced without males (parthenogenesis) for over 100 million years. In this they are practically unique, not to mention being an embarrassment to current evolutionary theory which says that parthenogenetic lineages are doomed to rapid extinction - for this reason the darwinulids are referred to as "ancient asexual scandals". This was the subject addressed by three of the speakers at the "3rd Wapping Seminar on Ostracoda" (so named for historical reasons - the School of Earth & Environmental Sciences was formerly based in Wapping) held at the Medway University Campus on December 18th 1998. Giampaolo Rossetti (University of Parma, Italy) discussed the question "Have ancient asexuals really persisted for such a long time without sexual reproduction?" and concluded that they had, probably thanks to evolving a "general purpose genotype". Koen Martens (Royal Belgian Institute for Natural Sciences, Brussels) considered links between reproductive mode and habitat stability in ancient lake ostracods, while his colleague Isa Schoen reported on studies of biodiversity and molecular phylogeny in ostracods from the ancient lakes Baikal and Tanganyika. John Whittaker (Natural History Museum, London) extolled the virtues of ostracods in archaeological investigations in the UK, drawing on examples from the famous Boxgrove excavation in Sussex, as well as Holocene and interglacial palaeoenvironmental reconstructions of the Medway region. Sue Hull (University College Scarborough) outlined her current research on the ecology and population genetics of marine intertidal ostracods. University of Greenwich ostracod research was represented by Alasdair Bruce, reporting his PhD research on the evolution of the Fleet in Dorset over the last 5000 years, and David Horne, who reviewed palaeoenvironmental interpretations of Purbeck-Wealden (140 to 120 million years ago) ostracods. Animated discussions continued over lunch in the "Drunken Sailor". The seminar was brought to a close by Isa Schoen with skilful, light-hearted consideration of the genetic basis for polymorphism in the dragons of Pern (any Anne McCaffery fans out there?), followed by a demonstration of the NODE GIS ostracod database by David Horne and his former post-doctoral visitor from Italy, Gianmarco Paris. The seminar was convened by Dr

David Horne and Dr Ian Slipper of the School of Earth & Environmental Sciences.

Dave Horne

### Next Ostracod Group Meeting

The next Ostracod Group meeting will take place on the weekend of the 17th-19th September 1999, and will be convened in Cambridge by Mick Frogley and David C. Horne of Cambridge University and Nicola Johnson at the British Antarctic Survey.

The first full day (18th September) will be a day of talks, and titles are therefore requested on any aspect of current studies utilising Ostracoda. Students are particularly encouraged to present their work. The format of 15 minute presentations with 5 minutes for discussion will be used.

The Sunday morning will be an excursion to visit Quidenham Mere, where there will be the opportunity to collect live specimens as well as to take some Lateglacial/ Holocene core material.

Anyone who is interested in participating should contact Ian Slipper 0181 331 9824 or e-mail <I.J.Slipper@gre.ac.uk> Further details on accommodation will be available nearer the time, but we will endeavour to keep the cost at a reasonable level.

Ian Slipper <I.J.Slipper@gre.ac.uk>

## Silicofossil Group Report

This is our inaugural year, and decisions have to be made about the direction of this multidisciplinary group and what meetings to organise etc. As we go to press, our first meeting will be held in Bath on the 8th of September, 1999, to be convened by Simon Haslett. If you are interested in attending there is registration form in the newsletter, or contact myself or Jenny Pike. As with previous meetings, held under the auspices of the Foraminifera Group or as Miscellaneous Microfossils, the subject coverage of the Silicofossil Group is still very broad, encompassing Radiolaria, Diatoms (both marine and non-marine), Sponge spicules and Silicoflagellates. This approach I feel adds to the interest at meetings, where people get the chance to hear about techniques from other fields than their own (Biology vs. Geography vs. Geology). So, if you are interested in attending the first meeting to held some-

# specialist group reports

time late in the year, please let either myself or Jenny know and we will contact you once we have final details organised. We have had an offer of a talk on radiolaria from Norm MacLeod, even before we have organised our meeting. For those who know Norm as a foraminiferal researcher, he started life working on North American Jurassic radiolaria! Once the BMS web link is up and running we will post information about the meeting. As the opportunities for collecting fossil radiolaria and diatoms are somewhat limited in the UK, we will be exploring the possibility of having a field meeting abroad next year (e.g. Portugal, Germany), maybe in conjunction with another BMS group.

With regard to the membership of the Silicofossil Group I appreciate that many Silicofossil workers are not necessarily aware of the BMS. Diatom workers are a good example, often working through Geography departments. Could we take this opportunity to ask BMS members to spread the news of the existence of a Silicofossil Group?

To this end, Jenny will be contacting the various Diatom societies and I have approached the International Association of Radiolarian Paleontologists (InterRad) to disseminate information about our group. Our meetings will be open to all. In fact, at the last Siliceous Microfossil meeting I organised at UCL a few years ago, a palynologist managed to attend by evading the tight security and even wrote a report of the meeting for the BMS newsletter (Bill Braham certainly gets around!).

John Gregory <john@jgregory.demon.co.uk>

**No reports were received from the  
Nannofossil & Palynology Specialist Groups**

## SILICOFOSSIL GROUP INAUGURAL MEETING

Wednesday 8th September 1999, Bath Spa University College

Convenor: Dr Simon Haslett

Following the formation of the Silicofossil Group at the 1998 AGM, and the success of previous meetings held under a number of different banners in Cardiff, Norwich and London, it is time to host the Inaugural BMS Silicofossil Group Meeting!! If you would like to present a talk on any aspect of siliceous microfossils, or attend the meeting, please return the Registration Form to Jenny Pike at the address below by 15th August 1999.

### REGISTRATION FORM

VENUE: Stanton Lecture Theatre, Faculty of Applied Sciences, Bath Spa University College

DATE: Wednesday 8th September 1999, 10.30am - 5.00pm

NAME:

ADDRESS:

Tel. No.

Fax No.

Email

( ) I wish to attend the meeting

( ) I wish to give a presentation

PRESENTATION TITLE:

Convenor: Dr Simon Haslett  
Quaternary Research Unit  
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Bath Spa University College  
Newton Park, Bath, BA2 9BN  
Tel: (01225) 875544  
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Return Form to: Dr Jenny Pike  
Department of Earth Sciences  
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Tel: (01222) 875181  
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Email: pikej@cardiff.ac.uk

# forthcoming meetings

**G**eological Association-Mineralogical Association of Canada, GAC-MAC Annual meeting, Sudbury 1999, Sudbury, Ontario, Canada, Wednesday-Friday May 26-28, 1999. Symposium — impact events and extinctions: a Special Session in honour of Glen Caldwell. Organizers: P. Copper (Laurentian U.), O.A. Dixon (U. of Ottawa), Jin Jisuo (U. Western Ontario). Sponsored by the Paleontology Division of the Geological Association of Canada

Sudbury, the site of a double extra-terrestrial impact, the 1.8 billion-year-old Sudbury Basin, and the 37 million-year-old Wanapitei crater, indenting the northeast margins of the older structure, is an appropriate host to a special symposium on the controversial relationship between meteorite impacts, mass extinctions, and the evolution of life. Did impacts alter the course of the history of life on Planet Earth. Are impacts a regular and periodic feature and component of planetary surface processes, like others? Or, are impacts extra-ordinary processes which dramatically change the global biota, and re-set the evolutionary clock? Contributors to this symposium, whether they be for or against impact origins of some or all mass extinctions, should reflect not only on the timing and chemical-stratigraphic signature of impacts, but also on any atmospheric and oceanic events which may, or may not, have changed life, particularly as recorded in the five best known mass extinctions, the Late Ordovician, Late Devonian, end-Permian, end-Triassic and end-Cretaceous.

Those wishing to contribute a paper to a special Festschrift commemorating this symposium must submit their papers by May 28, 1999 for publication (contributors need not present an oral paper or poster at the sessions).

Contact: Dr. Paul Copper, Department of Earth Sciences, Laurentian University Sudbury, Ontario, CANADA P3E 2C6 tel (705) 675-1151 fax (705) 673-6508 email: [pcopper@nickel.laurentian.ca](mailto:pcopper@nickel.laurentian.ca) or Dr. Jisuo Jin Department of Earth Sciences University of Western Ontario London, Ontario, CANADA N6A 5B7 tel (519) 661-4061 fax (519) 661-3198 email: [jjin@julian.uwo.ca](mailto:jjin@julian.uwo.ca). Deadline for abstract submission - January 15, 1999. Check the Sudbury '99 website for details and electronic submission instructions: [www.laurentian.ca/www/geology/gacmac99.htm](http://www.laurentian.ca/www/geology/gacmac99.htm)

**E**uropean Palaeontological Association Workshop, Lisboa, Portugal 15-18th July 1999, will address the links between fossil assemblages and sedimentary cycles and sequences. To receive the first circular contact CEPUNL - Rogerio Bordalo da Rocha, Qunita da Torre, P-

2825 Monte da Caparica, Portugal (tel 351-1-2948573, email [cepunl@mail.fct.unl.pt](mailto:cepunl@mail.fct.unl.pt)). Online information can be found at <http://www.si.fct.unl.pt/~w3cepunl>

**I**nternational symposium on the origin of animal body plans and their fossil records, Kunming, China, June 20-25, 1999. The symposium will be held at the Hot Spring Hotel on the east shore of Fxian Lake, near Kunming, PRC, under the auspices of the Chinese Academy of Sciences. The proceedings will be in English and contributed papers will be published in a special volume in the year 2000.

The origin of basic patterns of anatomical organisation, or body-plans, is a central question in evolutionary biology. The relatively sudden appearance of all major animal phyla in the fossil record, the Cambrian explosion, focuses attention on how, and how rapidly body plans evolved. The aim of this symposium is to bring together interested scientists to evaluate the broader significance of recent research in a variety of fields. For example, the nearby Chengjiang fauna is superbly preserved, and provides an unusually complete record of early Cambrian fossils. Its proximity in time to the Cambrian explosion makes it equally relevant to understanding the origin and evolution of animal body plans.

The finding of 580 million year old fossil animals in phosphate deposits in Weng-an, Guizhou, may also help to shed light on these issues. The Weng-an fauna includes eggs and embryos, preserved in sufficient detail to make inferences about the developmental patterns leading to the emergence of early body plans. This symposium takes an integrated, interdisciplinary approach to the study of the origin and evolution of animal body plans. The organisers encourage not only palaeontologists and evolutionary biologists, but also morphologists and developmental and molecular biologists, to attend and contribute. For example, this international gathering would be an excellent opportunity to report on insights into the role of Hox genes in body plan formation. The presentation of a variety of theoretical perspectives is especially encouraged.

The program will include opportunities to visit the fossil sites of the Lower Cambrian Chengjiang fauna; to study sections of the Cambrian/Precambrian interface at Meishucun, Jining; and to visit the Field Station of Early Life Research Centre, which will hold an exhibition of the Early Cambrian fossils from Chengjiang and Hai-kuo as well as the Weng-an biota from Precambrian phosphates, Guizhou.

Participants may also choose to make an optional pre-symposium excursion June 17-19 to the Precambrian



fossil site at Weng-an, and to the Lower Cambrian fossil site at Zhijing, Guizhou, and/or a post-symposium excursion June 26-30 to Dali and Lijiang (in northwestern Yunnan, a region of attractive scenery which is home to the rich culture of the Bai, Naxi and other minority peoples).

If you are interested in participating, (observers are also welcome) and would like to receive further information, please respond, as soon as possible, either to Paul K. Chien or our Chinese host Prof. Junyuan Chen, by email, fax or mail. Prof. Paul K. Chien, Department of Biology, University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117, USA: [fax]+415-422-6363; [tel]+415-422-6755; [email]chienp@usfca.edu Prof. Junyuan Chen, Field Station of Early Life Research Centre, Sanjiacun, Jinning, Kunming 650612, P. R. China: [fax]0871-788-1037; [tel]0871-788-9575; [email]chenjy@jlonline.com

**I**nternational Workshop on Ichnotaxonomy, Bornholm, 03.-09.08.98. The first International Workshop on Ichnotaxonomy (WIT) was set up to discuss several problems in the taxonomy and nomenclature of tracefossils, which is currently in an unsatisfactory state. A small group of active ichnologists working on burrows, borings and tracks of various environments gathered on the island of Bornholm (Denmark) for a week to find a preliminary consensus which is presented below. We now invite all other scientists concerned with the subject to critically assess our conclusions and submit their own ideas. For further details contact Markus Bertling, Geologisch-Palaeontologisches Institut und Museum, Pferdegasse 3, D- 48143 Muenster, Germany. E-mail: bertlin@uni-muenster.de; fax: 49 - 251 - 83 248 91; tel: 49 - 251 - 83 239 42.

**4** 7th Symposium of Vertebrate Palaeontology and Comparative Anatomy (SVPCA), Edinburgh, Scotland 8-11 September 1999. The symposium will be preceded by the 8th Symposium of Palaeontological Preparators and Conservators, 7th September 1999. Both meetings will be hosted by the National Museums of Scotland in central Edinburgh, and organised by the staff of the Department of Geology and Zoology. There will be a reception in the new Museum of Scotland. The independent Dynamic Earth interpretive centre will be open by then; it is the provisional venue for the conference dinner. There will be the usual day field trip on the 11th. For further details please contact Mike Taylor, Department of Geology and Zoology, National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF: [fax] 0131-220-4819; [email] mat@nms.ac.uk

**H**ENNIG XVIII: the eighteenth meeting of the Willi Hennig Society will be held in Göttingen, Germany, 12-17 September 1999. This is the first meeting of the Willi Hennig Society in Germany, where the founder of cladistics, or phylogenetic systematics, Willi Hennig, was born in 1913. Therefore, the scientific meeting will begin with presentations on the early history and the roots of phylogenetic systematics. All correspondence concerning registration, scientific program, poster presentation etc. and the post conference tour should be addressed to Rainer Willmann at the Institut für Zoologie und Anthropologie, Berliner Str. 28, D-37073 Göttingen, Germany (fax: +49-551-395448; email <rwillma1@gwdg.de>) or Thomas Bartolomaeus at Zoomorphology and Systematics, Biology, University of Bielefeld, Postfach 100131, D-33501 Bielefeld, Germany (email <t.bartolomaeus@biologie.uni-bielefeld.de>). Registration forms can be obtained online at [http://www.gwdg.de/\(gtroest/HennigXVIII.html](http://www.gwdg.de/(gtroest/HennigXVIII.html)

**V**II International Symposium on Mesozoic Terrestrial Ecosystems, Buenos Aires, Argentina, 26th September to 2nd October 1999. For further details please contact The Secretary to the Symposium, Museo Argentino de Ciencias Naturales "B. Rivadavia", Avda. Angle Gallardo 470, 1405 Buenos Aires, Argentina; Tel/Fax: 54-1 983 4151.

**I**GCP 406: Circum-Arctic Palaeozoic Vertebrates Meeting "Lower-Middle Palaeozoic Events Across the Circum-Arctic" Riga/Jurmala, Latvia, September-October, 1999. All interested Palaeozoic workers are invited to attend the two-day 1999 annual meeting of the IGCP 406 project which will be held in conjunction with (immediately before or after) the 4th Baltic Stratigraphic Conference in Riga and/or Jurmala, Latvia. The 4th BSC is planned to be held on September 27-30, 1999. After the scientific sessions of BSC a two-day field trip (October 1-2) is proposed to the most exciting outcrops of Devonian rocks in Vidzeme (north-eastern Latvia).

Presentations to the IGCP 406 meeting are welcome on any topic related to the palaeontology, paleoecology, stratigraphy, palaeogeography, etc. of Ordovician through Devonian vertebrate fossils, as well as their associated fauna and flora and related geological subjects. For this meeting, contributions on the theme "Geological and Biological Events Across the Circum-Arctic" in connection with palaeogeography and stratigraphy are especially encouraged. Contributions on geochemistry are also welcome. We invite suggestions for topics of conference workshops.

# forthcoming meetings

Abstracts of conference papers should be submitted before March 30, 1999. The text (in English, no more than 2 pages, including illustrations and references) should be sent by e-mail as ASCII files or as plain text on a DOS-formatted diskette. If you use special or national letters, or you want to add illustrations, please send a hard copy separately. Estimated costs: registration fee: 10 LVL (Latvian lats; approximately 18 USD). The fee will be collected during the meeting at the registration desk. Accommodation: see the First Circular of the 4th BSC. The medium cost of meals in Riga is ca. 5-10 LVL/day. Limited financial support from IGCP is possible. If you are interested, please inform us as soon as you can.

A two-day (October 1-2) excursion after the BSC conference to the most exciting outcrops of Devonian rocks in Vidzeme (north-eastern Latvia) is planned (see the First circular of the 4th BSC). Estimated cost: 40 LVL (early registration, before April 30, 1999) or 50 LVL (late registration, after April 30, 1999, if free places will be available). The cost of the trip is approximate; it will be given more exactly in the second circular. Deadlines Preliminary registration - December 10, 1998 Abstracts - March 30, 1999. Please let us know if you need an official invitation. For further details contact: Ervins Luksevics, Latvian Museum of Natural History, K.Barona 4, Riga LV-1050, LATVIA. E-mail: [ldm@com.latnet.lv](mailto:ldm@com.latnet.lv); fax: (371) 7220092.

**Third International Symposium On Lithographic Limestones** to be held in Bergamo (Italy) on August 28-september 9, including Pre-Symposium excursion to Central-Southern Italy. For further details contact Dr. Silvio Renesto, Dipartimento di Scienze della Terra, Universiti degli Studi di Milano, via Mangiagalli 34, I 20133 Milano, Italy. Fax +39-02-70638261; e-mail: [<renesto@imiucca.csi.unimi.it>](mailto:renesto@imiucca.csi.unimi.it)

**Inaugural BMS silicofossil group meeting** Wednesday 8th September 1999, Bath Spa University College, Convenor: Dr Simon Haslett. Following the formation of the Silicofossil Group at the 1998 AGM, and the success of previous meetings held under a number of different banners in Cardiff, Norwich and London, it is time to host the Inaugural BMS Silicofossil Group Meeting!! If you would like to present a talk on any aspect of siliceous microfossils, or attend the meeting, please return the Registration Form to Jenny Pike at the address below by 15th August 1999.

**7th International Symposium on Fossil Algae** Nanjing, China, 13-17th October 1999 + excursions. Themes cover a wide range of studies on benthic algae,

cyanobacteria and stromatolites through time, including taxonomy, biostratigraphy, evolution, palaeoecology, sedimentology, ultrastructure, and biomineralisation. Pre- and post-symposium excursions will visit Jixian (Proterozoic), Jinan (Cambrian), and Guilin (Devonian). For details contact Xi-nan Mu, Nanjing Institute of Geology and Palaeontology, Academia Sinica, 39 East Beijing Road, Nanjing 210008, China (fax +86 25 335 7026, email [<algae@pub.nj.jsinfo.net>](mailto:algae@pub.nj.jsinfo.net)).

**Where worlds collide:** faunal and floral migrations and evolution in SE Asia-Australasia University of New England, Armidale, Australia 29 November - 1 December 1999. The conference will be structured into themes, of which the following have thus far been suggested: Palaeozoic/Mesozoic geology and biogeography; Cenozoic geology and biogeography; primate evolution and biogeography; hominoid migration and dispersal; plant evolution and dispersal in the region, Wallace's Line; and human dispersals, culture contacts and change. Further details from Ian Metcalfe, Convenor, Where Worlds Collide Conference, Asia Centre, University of New England, Armidale NSW 2351, Australia.

## **Palaeontology Down-Under — Interlinked Meetings for the year 2000**

Under the auspices of the International Palaeontological Association, the Australasian Association of Palaeontologists, the Macquarie University Centre for Ecostratigraphy and Palaeobiology and IGCP Projects 410 and 421.

### **Preamble:**

Five interlocking events - 3 conferences, 2 IGCP meetings and associated excursions have been programmed to follow on from the Australian Geological Congress (3-7 July, 2000, University of Technology, Sydney). The conferences and meetings are:

1. **Australasian Palaeontological Convention-2000** (APC-2000) - including a celebration honouring Professor Barry W. Webby.
2. The **Third International Symposium on the Silurian System** (Sir Frederick McCoy Silurian Symposium).
3. The **Second Australasian Conodont Symposium (AUSCOS-2)**.
4. **IGCP 410 Meeting** (The Great Ordovician biodiversity event: implications for global correlation and resources).
5. **IGCP 421 Meeting** (North Gondwana mid-Palaeozoic bioevent/biogeography in relation to crustal dynamics).

### **Venue:**

Orange, NSW, 260 km west of Sydney, in the heart of the most instructive Ordovician, Silurian and Early Devonian sequences in eastern Australia.

# forthcoming meetings

## Program:

### Pre-Conference Excursion

Sat 8 July: Bungonia Group and the Silurian of the Yass Synclinorium.

Sunday 9 July: Wellington: Silurian (Llandovery-Wenlock): Quarry Creek, Borenore (graptolites/conodonts/corals).

Monday 10 July: Wellington and Orange: Late Silurian-Early Devonian - Wellington, Eurimbla and Nubrigyn (autochthonous and allochthonous sequences: channel deposits, carbonate fans, intermittent platform exposure and grand-scale platform-margin collapse).

### Conference

Tuesday 11 July: First day of papers - parallel sessions: APC-2000 - general themes; AUSCOS-2 - Cambrian, Ordovician and Silurian conodonts.

Wednesday 12 July: Second day of papers - parallel sessions: APC-2000 - general themes; AUSCOS-2 - Silurian, Devonian and younger conodonts.

Thursday 13 July: Excursion interlude: Three alternatives will be offered: 1. Day trip to Cliefden and Bowen Park; Late Ordovician shelly faunas/ conodonts. 2. Day trip to Wellington. Pliocene-Holocene biodiversity: Wellington Caves phosphate mine / caves vertebrate fauna; Western Plains Zoo (Dubbo); Lake Burrendong Arboretum. 3. Wineries of the central western New South Wales.

Friday 14 July: Third day of papers - parallel sessions: APC-2000 (Mesozoic and Cainozoic papers) ; Sir Frederick McCoy Symposium papers. Evening: Conference Dinner

Saturday 15 July: Papers for APC-2000/AUSCOS-2/McCoy Symposium continued and Meetings of IGCP410 and IGCP421.

### Post Conference Excursion (Part 1)

Sunday 16 July: Tamworth via Scone, Timor and Nundle: examination of Timor and "Crawney" limestones, (shelly faunas, conodonts; autochthonous and allochthonous sequences).

Monday 17 July: Cambrian-Devonian of the Tamworth Belt: Woolomin, Loomberah, Tamworth Hospital Quarry (shelly faunas, conodonts, mainly allochthonous sequences).

Tuesday 18 July: Autochthonous Early and Middle Devonian limestones at Sulcor, Attunga and Yarramanbully (shelly faunas, conodonts; autochthonous and allochthonous sequences); Goondiwindi (via Moree Artesian Spa Baths).

Wednesday 19 July: Biloela. Mid-Palaeozoics at Monto (briefly) en route.

Thursday 20 July: Gladstone: Devonian-Early Carboniferous of Mount Morgan-Rockhampton-Raglan area (Mount

Etna, Horrigan Creek, Mt Holly (conodonts, corals; autochthonous vs allochthonous stratigraphy).

### Post-Conference Excursion (Part 2)

Friday 21 July: Depart Gladstone 11am for Heron Island by catamaran for Sir Frederick McCoy Symposium Carbonate/Build-up Workshop - focussed on carbonate sedimentation and reef-structuring organisms. Convenor: John Jell.

Saturday 22 July to Monday 24 July: three full days on Heron Island.

Tuesday 25 July: Depart Heron Island

### PUBLICATIONS:

We are presently negotiating for a number of publications:

1. A festschrift in celebration of the contribution Prof. Barry Webby has made to Australian and international palaeontology, possibly combined with:
2. A collection of papers of a general nature (Contributions by young-career researchers are especially encouraged).
3. The AUSCOS-2 volume of conodont papers.
4. The Sir Frederick McCoy Silurian volume

For those interested in attending one or more of these events please register on-line at:

[http://www.es.mq.edu.au/MUCEP/auscos/online\\_form1.htm](http://www.es.mq.edu.au/MUCEP/auscos/online_form1.htm)

To receive the second circular (late 1999), please register as soon as possible, preferably before October, 1999.

Details about the costs of conference and excursion packages can be found at the conference home page at: <http://www.es.mq.edu.au/MUCEP/auscos/auscos.htm>

**Glenn A. Brock and Peter Cockle**

[<pcockle@laurel.ocs.mq.edu.au>](mailto:pcockle@laurel.ocs.mq.edu.au)

**■ CVM-6: 6th International Congress on Vertebrate Morphology**, Friedrich-Schiller-University, Jena, Germany. Co-chaired by J. Matthais Starck and Martin S. Fischer, July 2001. Details: <http://www.zoo.uni-jena.de/icvm-6.html>

## Workshop on Arctic Dinoflagellate Cysts

An informal Workshop on Arctic Dinoflagellate Cysts was held at GEOTOP, Université de Québec à Montréal from March 15 to 19, 1999 (1). This workshop focused on the systematics of recent dinoflagellate cysts from the arctic and subarctic regions and their applicability for paleoenvironmental reconstructions. Participants from Canada and several European countries (Norway, Denmark, Germany, France, United Kingdom and Netherlands) who are currently working in the polar regions attended.

The major goals of this workshop were to initiate a joint approach to the standardisation of the taxonomy of cold water dinoflagellate cyst taxa and to establish a common modern ecological database for the Arctic region. During recent paleoceanographic and paleoclimate investigations in the Arctic Ocean and adjacent subarctic seas, several undescribed dinoflagellate cyst taxa were recorded which apparently have an ecological affinity for polar environments. Since the early studies of Rex Harland and co-workers in the Beaufort Sea some 20 years ago, little progress has been made on the taxonomy of polar species. Therefore, at the workshop, we made a start on the restudy of the major Arctic taxa to improve the taxonomy of the obviously closely related described and new taxa.

The knowledge of the ecology of Arctic species is still based on a relatively small data set from widely distributed areas within the Arctic region. Based on our taxonomic revisions, it is intended to study a new set of surface sediment samples from the Arctic shelf seas and to describe the distribution of taxa with respect to sea-surface conditions. The new data set will be used to enlarge the modern reference database developed for the northern North Atlantic and adjacent basins using standardised laboratory procedures and taxonomy (2) into the Arctic ocean and circum-Arctic seas. The next "rendez-vous" of the group has been set for Spring (late April) 2000.

During the workshop the participants discussed the taxonomy of *Algidasphaeridium? minutum* and related taxa; *Pentapharsodinium dalei*; a new taxon with possible affinities to *Polykrikos*; *Spiniferites frigidus*; together with *Operculodinium centrocarpum* and related morphotypes. In addition Rex Harland gave a talk on 'Dinoflagellate cysts from the bottom of the world' and Martin Head on 'Pliocene dinoflagellate cysts from Great Bahama Bank, ODP Hole 603 and eastern England', during the very busy but most enjoyable week.

For more information about the workshop please contact:

Jean Louis Turon [turon@geocean.u-bordeaux.fr](mailto:turon@geocean.u-bordeaux.fr)  
André Rochon [rochon@agc.bio.ns.ca](mailto:rochon@agc.bio.ns.ca)  
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(1) see the announcement of the Workshop in the GEOTOP Web Page <http://www.unites.uqam.ca/geotop/>. The Workshop was sponsored by GEOTOP and the Chaire de recherche en Environnement Hydro-Québec-UQAM-CRSNG. Thanks are also due to Leica for the loan of microscopes.

(2) Rochon, A., de Vernal, A., Turon, J.-L., Matthiessen, J. and Head, M. J. In press. Distribution of Recent dinoflagellate cysts in surface sediments from the North Atlantic and adjacent seas in relation to sea-surface parameters. American Association of Stratigraphic Palynologists, Special Contribution Series.

Rex Harland <[rexharland@email.msn.com](mailto:rexharland@email.msn.com)>

## The north Gondwana margin in Iran

The fourth meeting of IGCP421, north Gondwanan mid-Palaeozoic bioevent/biogeography patterns in relation to crustal dynamics was held in the Islamic Republic of Iran. The scientific sessions were held at the University of Isfahan on December 13 and 14, 1998. The meeting was attended by 56 delegates from 10 nations with large contingents from Australia and France. Many undergraduate students from the University of Isfahan attended the scientific sessions and mixed with conference delegates during breaks. Forty eight papers and posters were presented on a broad range of middle Palaeozoic themes with a number of microfossil groups featuring prominently in the program.

Conodont faunas (14 papers) received the most attention, with brachiopod faunas (9 papers) being the

most preeminent macrofossil group. Microvertebrate faunas (5 papers) and general middle Palaeozoic sedimentology and stratigraphy (5 papers) were also recurring themes throughout the meeting. Other groups and topics covered by presentations included corals, ammonites, palynomorphs, stromatoporoids, trilobites, crinoids, tectonics and diagenesis/metamorphism.

The most gratifying aspect of the scientific program was the volume of papers (21 in total) concerned with the previously poorly known middle Palaeozoic of Iran. Most of this represents new data which will underpin the project's ambitious biogeographical analysis. The volume of papers stemming from this meeting will go a long way towards filling a lacuna of data.

We can be thankful for this partly to the conference organiser, Dr Mehdi Yazdi of the University of Isfahan who has developed an enthusiastic band of students making important new Palaeozoic discoveries (mainly conodont data). This has been achieved despite such difficulties as having no access to sodium polytungstate for laboratory separations because of the high cost. All acid insoluble residues are completely hand picked.

The abstracts volume for the meeting contains a useful bibliography, compiled by Tony Wright (University of Wollongong) listing much of the known palaeontologic data on the middle Palaeozoic of Iran. The meeting concluded with a planning session for the next two meetings in Morocco and Pakistan, both scheduled for 1999. The meeting also resolved to compile a middle Palaeozoic correlation chart for the Asian sector of north Gondwana for presentation at the meeting in Pakistan.

There was a preconference field trip was to the Tabas area in the central east of Iran examining Palaeozoic sequences of the Shotori Range. The Devonian Bahram and Shishtu Formations, the Carboniferous Sardar Formation and the Permian Jamal Formation in the Howz-e-Dorah area, the Shishtu and Sardar Formations of Kale Sardar and the Carboniferous and Permian of Shergesht were all examined with ample macrofossil collecting opportunities and some significant new finds.

There were two post conference field trips. A one day trip close to Isfahan enabled delegates to inspect sections at Char-Riseh and Zefreh, both pertained to recent student work chronologically underpinning the sequences with new Late Devonian conodont data. This was followed by a four day field trip to the Kerman area to examine primarily Devonian sequences that are yielding new macrofossil data.

The logistical difficulties of organising an international conference and field trips in a nation that has

been isolated from much of the rest of the world for many years are immense. The hunger for international scientific collaboration was obvious; three Universities, the Geological Survey of Iran and numerous mines welcomed delegates and participated in the venture by organising local IGCP421 meetings, discussion groups, tours, or by simply hosting a function. Some delegates were interviewed by a range of media organisations, all were welcomed into laboratories, shown numerous specimens, engaged in endless discussion by eager students, and overwhelmed by hospitality. The success of this venture was a great illustration of the value of UNESCO's IGCP program.

**Andrew Simpson** *Geology Museum, University of Queensland, Australia*

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## The fossils of the Hunsrück Slate: marine life in the Devonian

C Bartels, D.E.G. Briggs & G. Bräse. Cambridge Paleobiology Series, Cambridge University Press, Cambridge, 1998, xiv+309pp. ISBN: 0-521-44190-0 (Hbk)

At least in the UK, palaeontology has come back into scientific fashion somewhat in the last couple of decades. There are a number of reasons for this, but one of them is certainly the wealth of new discoveries and re-discoveries of material from Konservat-Lagerstätten. Of course, we palaeontologists have always recognised the thrill of these spectacular fossils, but more widely they have perhaps been regarded merely as pretty curiosities. Nowadays, however, it is increasingly becoming recognised that exceptionally preserved fossils not only enhance our understanding of ancient taxa but also have the potential to revolutionise our ideas on the pattern of evolutionary history. The basis of all this knowledge, of course, lies in painstaking study and meticulous description, and it is important that the results of this fundamental work are made as fully available as possible. Hence, several books in recent years have summarised the outcome of work on important Lagerstätten such as the Burgess Shale, the Chengjiang biota (both Cambrian), the Solenhofen Limestone (Jurassic) and the Santana (Cretaceous).

Germany seems particularly well-blessed with conservation deposits (although for its size, the UK does pretty well, too), and among its gems is perhaps the best-known of Devonian Lagerstätten, the Hunsrück

Slate. The first paper on this biota was published in 1862, but it became widely recognised in the late 1960s and early 1970s, when Wilhelm Stürmer produced and publicised a series of spectacular X-radiographs of the fossils. In 1990, Christoph Bartels and Günther Bräsel produced a book in German summarising the discoveries, and now, in collaboration with Derek Briggs, an extended and revised version is available in English. And a pleasant book to own it is, too. Full of stunning photographs and radiographs showing remarkable details of fossil organisms, just a flick through the pages conveys an excitement that can move even the most seasoned of palaeontologists.

The book is divided into three parts. The first covers general aspects such as the geological history of the slate, its depositional environment and the mode of preservation of the pyritised fossils. The second, and major, part covers the fossils themselves, and a third section deals with collection and preparation of the specimens. Crinoids are the most common fossils, but are accompanied by asteroids, ophiuroids, arthropods, sponges, corals, conulariids, bivalves, gastropods, nautiloids, goniatites, hyoliths, tentaculoids, brachiopods, bryozoans, algae, annelid worms, chondrophores, comb jellies and fishes. Plants washed into the depositional basin are also preserved, and there are trace fossils produced by epifaunal and infaunal organisms. So, at first glance, the biota substantiates the book's subtitle - this really does look like an open window on marine life in the Devonian. Not much appears to be missing, until, of course, we look for the microfossils, and there the book has little to reveal to us.

The only microfossils on which any work seems to have been done are the spores, for which a substantial list of species is recorded. But the directory of taxa at the end includes only "Acritarchs gen. et sp. indet." under the protists, and ostracods are not listed, although a few are mentioned in passing in the text. Of foraminifera, chitinozoans, scolecodonts, conodonts or other vertebrate microfossils there is no record. Indeed, the authors admit (p. 266) that in research on the Hunsrück "smaller taxa, particularly microfossils, have been largely neglected". This is unfortunate, because we cannot tell whether this paucity of data means that these groups are not represented or whether the authors have simply not bothered to tell us that they are there. As a full record of an ancient marine ecosystem, then, this example must currently be regarded as deficient. There is a wider point here, because potential microfossil evidence in a number of other celebrated Lagerstätten has been similarly ignored.

This general shortcoming may, however, present a golden opportunity. There is evident potential for micropalaeontological studies on a number of well-known conservation deposits, and perhaps we should also be searching for occurrences of exceptional preservation in situations where microfossils dominate the biota. Of course, some notable studies have been completed in this area, and there are ongoing investigations such as the research on bradoriids from Chengjiang. But it is clear that we can serve the dual purposes of improving the palaeoecological and evolutionary data retrievable from Konservat-Lagerstätten and of enhancing the profile of micropalaeontology by mounting more microfossil studies in deposits such as the Hunsrück Slate. The ball is in our court.

**Richard Aldridge** *Department of Geology, University of Leicester, Leicester LE1 7RH, UK <ra12@le.ac.uk>*

## **Taxonomy and Biostratigraphy of Middle and late Triassic Elasmobranch ichthyoliths from Northeastern British Columbia**

Johns, M.J., Barnes, C.R. & Orchard, M.J. (1997). *Geological Survey of Canada Bulletin 502*, 235 pp., 38 pls. Ottawa

**B**ulk collecting of microvertebrates from a range of sedimentary rock types has been made possible through a range of chemical extraction techniques and subsequent concentration of the phosphatic residues. Whilst the prime area of interest has often been taxonomic, the durable nature of vertebrate hard tissues and an emerging appreciation of their histological and morphological features has led quite logically to a consideration of their potential in biostratigraphy. Fossil shark remains are excellent candidates in this field since a single fish could give rise to literally thousands of individual microvertebrate specimens. This is because the skin is covered with a shagreen of tooth-like scales, and the dentition consists of teeth which ascend the jaw in a conveyor belt like motion, being shed during feeding after a relatively short functional life. Some Recent sharks are ubiquitous in shallow shelf seas whilst others have a more restricted feeding ecology. Thus they have varying degrees of facies independence and wide geographical distribution. "Why is the Phanerozoic not rife with examples of microvertebrate zonal schemes?" I hear you cry. As always, things are not that simple! The problem is that scale morphology varies dramatically over

the body of a single shark, and tooth morphology varies along the length of the jaw, between upper and lower jaws, with age and sometimes also sex. Recent taxonomic papers have carefully elucidated dental variation within species with redescription of many well known and a large number of new microvertebrate faunas. This, together with recent advances in understanding of scale variation have set the scene for this timely paper by Johns, Barnes and Orchard.

Monographic in its approach, this publication is an outgrowth of Johns' M.Sc. thesis, for which she won an academic prize. A wealth of data, much of which is presented in appendices, is accompanied by a lucid text. The background geological setting to the sample area is clearly explained, followed by a valuable introduction to elasmobranch scales and teeth. This section is worth consulting by any prospective researcher into microvertebrate faunas.

While using traditional taxonomic practice for the teeth in their samples, a form taxon system and utilitarian descriptive code is employed for scales. It could be argued that this approach leads to unnecessary proliferation of taxonomically meaningless categories when a plethora of form genera and species are erected as binomens, but if this were not done and the utilitarian codices alone were used the text would become impossible to follow. The authors have therefore followed in the footsteps of Gunnell (1930) and Pomesano Cherchi (1967) who ascribed generic and species names to Carboniferous and Triassic elasmobranch respectively.

One undetermined species of the hybodont shark *Acrodus* is described, together with one new species of *Polyacrodus*, and six species of the primitive neoselachian shark, *Synechodus* (three new species, and three unspecified), considerably extending its range.

The ground-breaking part of the work is heralded by a very detailed analysis of scale morphology and the consequent identification of 19 form genera and almost 50 form species. All of the dental and scale material is beautifully and extensively illustrated with due consideration to a range of views and the range of variation shown by each taxon. An analysis of the stratigraphical distribution of the ichthyoliths then permits the construction of a provisional local zonal scheme for the Ladinian, Carnian and Norian. These are concurrent-range zones defined on the first and last appearances of common to abundant ichthyolith types. There is the added advantage that the ichthyolith zones are correlated with the ammonoid and conodont zones previously described for the area. The entire scheme is comprehensively summarised in a folded figure insert.

In conclusion, this mammoth work is a valuable contribution to microvertebrate literature and a seminal application of elasmobranch scales to biostratigraphy. Well written, beautifully illustrated and packed with information, it is a worthwhile tome to adorn the bookshelves of micropalaeontologists and stratigraphers alike.

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## Calcareous nannofossil biostratigraphy

Bown, P. R. (Ed.) 1998, 320pp, *British Micropalaeontological Society Publications Series*, Kluwer, ISBN 0-412-78970-1. £79.00/US\$127.00 (£59.00/US\$95.25 to BMS Members).

To begin with, I asked myself "How did I, a foram. specialist, get the job of reviewing a nannoplankton atlas?" On reflection it's probably not such a ludicrous idea, particularly when the book concerned presents such an excellent introduction to the black arts of nannofossil alchemy aimed at a complete novice like myself.

The first sentence says it all "This book was primarily written as a practical guide to the use of calcareous nannofossils in biostratigraphy" - and that's exactly what it is. I started with the grand idea of reading the book cover to cover, but even I'm not quite so naive. Nevertheless, I did complete both the first two chapters and these provide probably the most comprehensive introduction to nannofossils I've had the privilege to read. Chapter 1, **Introduction**, covers the life cycle, morphology, function, ecology and even the rationale covering the taxonomy of coccoliths. My compliments go to Paul Bown and Jeremy Young for producing such a readable account.

The same two authors also collated Chapter 2, **Techniques**. Considering that my day to day contact with nannofossil preparations is witnessing the simple process of crushing a minute piece of sediment on a glass and

smearing the resultant suspension across the said slide, I hadn't realised there was quite so much to it all. Doctors Bown and Young appear to have considered every sample type from drill cuttings to living cultures with all the inherent subtleties of dealing with each. This chapter, unlike all the others, lacks any illustrations which is something of an oversight. In an extremely well illustrated book which contains 66 full page plates, including over 2000 individual specimen photographs in both transmitted light and SEM, I was surprised that there were no simple line drawings or photographs to enhance the text.

The next seven chapters, written by a range of authors, work systematically through the geological column from the Triassic (Paul Bown) to the Quaternary (Nicky Hine & Phil Weaver) and the basic format of each chapter is reassuringly consistent throughout. Each presents the important references, the Biostratigraphy, with full definition of zones, discussions of Global Correlation, Magneto-biochronology, Biogeography and an Atlas of Species.

Chapter 3, **Triassic** (Paul Bown) is of necessity short, given that nannofossils are first recorded from the Late Triassic (Carnian) and then only ten taxa are worthy of illustration from two well defined zones. Nevertheless, all organisms have to have their origins sometime.

Paul Bown and Kevin Cooper provide a thorough review of **Jurassic** nannofossils, defining twenty zones with further twenty-one subzones. It is in this chapter that the more "global" nature of this book becomes apparent, when compared with its predecessor (Lord, 1982), which was more an atlas of British nannofossils. Even by Jurassic time there is evidence of provincialism in the nannofloras described to date. It is obvious, however from this chapter, that the database on which nannofossil workers are dependent is somewhat thin. This book provides such a comprehensive picture that it is easy to make the mistake that every thing is now well defined in terms of taxonomy and zonal schemes. This is certainly not the case and there is considerable room for further research. Paul Bown has used the opportunity of this chapter to include a description of the "Calcareous nannofossils from the Upper Kimmeridgian – Volgian of Gorodische, Russia". This section is the proposed lectostratotype for the Volgian Stage and therefore a detailed distribution chart for the nannofossils recorded is certain in time to be a well thumbed part of the book.

A well informed team of Paul Bown, Dave Rutledge, Jason Crux and Liam Gallagher have written a separate chapter on the **Early Cretaceous**, possibly the result of the nannofloras becoming so well established in European carbonates at this time. Twenty seven zones have been defined, together with fourteen subzones

(total 41 units) which leave the nannofossils providing slightly better definition than the thirty five ammonite zones. I would venture to add that I'm sure there are considerably more nannofossils than ammonites in most samples available for study (see p.88).

This is probably a good place to have one of my perpetual moans. If you're talking "time", you're dealing with a philosophical concept and you have got to use the terms "Early" and "Late". You should definitely not use "Lower" and "Upper". These are rock unit terms and should be kept as such. The editorial decision was obviously taken in this book to use "Lower" and "Upper" throughout. I'm sorry, but I just can't accept it. What is worse, there is a mixture of "Upper upper" and "Upper-most". The first looks and sounds like a misprint and the second is simply wrong, it should be "latest".

There is a curious mixture of regular print and italics in this chapter, with ammonites in the former and nannoplankton in the latter. Surely it is normal practice to put all fossil names in italics, so why are the nannoplankton singled out?

Having got those two comments out of the way I'll return to the Early Cretaceous with the observation that I would have expected to see some mention of the affinity of *Cyclagelosphaera margarelli* with the dysaerobic facies sporadically developed during the Early Cretaceous. This is well documented by Mutterlose and Harding (1987) and certainly known from the North Sea sections available to at least two of the authors.

As a final note on this chapter, I applaud the willingness of the authors to acknowledge "precise level uncertain" when it comes to defining the stratigraphic ranges of some species (see p.97). This is far better than making assumptions based on an insufficient database which imply a false accuracy and can hinder stratigraphic definition in the long term.

I had awaited the publication of a new zonation for the **Late Cretaceous** for a long time and the chapter presented by Jackie Burnett (with contributions by Liam Gallagher and Matt Hampton) was well worth the wait. There is an excellent review of past literature and a useful introduction to the global provincialism recognised in Late Cretaceous oceanic sediments. This has necessitated the definition of zones applicable to "Boreal", "Tethyan" and "Austral" provinces making interpretation of the text occasionally difficult, nevertheless the provision of numerous well drafted zonal diagrams improves the ease of understanding zonal definitions.

It is within this chapter that the absence of plate numbers on the actual plates becomes a problem, with a large part of the description of Plate 6.2 opposite Plate 6.1. It's at this point that I reveal the one bit of in-



formed assistance I had with this review. Looking carefully at Figures 1,2 and 3 (all *Amphizygus brooksii* apparently) on Plate 6.2 it's notable that the specimen in Fig. 1 is a different taxon to Figs. 2 and 3. I have to assume that the other 14 plates are free from inaccuracies, but I can't claim to be able to recognise this myself, a little inside information goes a long way.

Osman Varol authors the **Paleogene** chapter which is slightly shorter than most, but an excellent example of quality over quantity. It's the only chapter where I've actually spotted typing/printing errors (i.e. "PALEOGE" and *N. cruciatus* becoming extinct twice on Figure 7.3) which I regard as the deliberate errors included to keep reviewers awake.

It's inevitable that the "Thanetian" Stage remains unzoned due to the non-calcareous nature of the sediments and a well defined zonal succession is presented for the Danian and Selandian Stages. However, why is it that it appears to be only nannoplankton workers who insist on using a Selandian Stage, when most other stratigraphers since Berggren *et al.* (1985) have successfully managed with only the Danian and Thanetian? Varol also uses the Lattorfian Stage for the earliest Oligocene or is it Lattorfian (p.205), or is this another deliberate typing error?

I recognise that most of Varol's database is derived from North Sea sections, as illustrated in the diagrams from this chapter, however it would have been useful to have had greater reference to the onshore sections on the margins of the North Sea Basin. There is a listing of the main references for the outcrops, but no comparison of nannofloral ranges as recorded in the offshore and onshore sections.

The **Neogene** chapter by Jeremy Young is satisfyingly concise and extremely well constructed. The diagrams are to be congratulated on their clarity, showing as they do the evolutionary nature of the phylogenetic lineages. They are visually impressive and enhanced by the addition of the simple line drawings of the index taxa. Jeremy has introduced lettered intervals in an attempt to bring the succession into manageable units, particularly as the use of both Martini's and Okada & Bukry's zonal nomenclature to divide the text could have made life very complicated. The system works, however the addition of the letters in an unheaded column on the diagrams is a little unclear.

There is some very useful discussion on the taxonomic problems attached to certain groups and this, together with the 300 good quality photographs make this a major contribution to the book.

The last chapter (**Quaternary**) by Nicky Hine and Phil Weaver is suitably concise covering as it does only

the last two million years. Nevertheless it provides a clear synthesis of the great amount of research that has been carried out into this Sub-era.

This chapter defines the standard Martini/Okada & Bukry/Gartner zones for the Quaternary, and in addition to this provides an enlightening description of the use of "Acme intervals" in various boreholes from the North Atlantic. The integration of the nannofossil stratigraphy and oxygen isotope data is not new, but it is certainly worth the update it is given and the comments on it's high level of stratigraphic resolution.

This "black book" finishes with an extremely comprehensive reference list (almost 900 references cited) and a clear taxonomic index for all taxa in the text and figured. It is a book long in gestation but well worth the wait. The fact that the first print run is already sold out speaks for itself. All I can do is to plead with the new publishers (Kluwer Academic Press) to move rapidly on to a second printing. Like many of its predecessors in the BMS publications series, this book has already become a "standard" for all micropalaeontologists, including those like myself, who believe that the best thing for nannoplankton is to rinse them off the outer walls of forams. in order to clean them up.

Go out and buy a copy, if you can find one.

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## Catalogue of the type, figured and cited fossils in the Geological Survey of Ireland

Parkes, M. A. and Sleeman, A. G. 1997. Geological Survey of Ireland, 124 pp. ISBN 1-899702-15-6

If Carboniferous and Devonian miospores or Devonian megaspores are your forte then this catalogue will certainly be of interest to you. A substantial part of this catalogue is of miospores and other fossils described by Ken Higgs and co-workers including Streel, Clayton, Russell, and Scott.

The collections of the Geological Survey of Ireland consist essentially of Irish Lower Palaeozoic and Carboniferous invertebrates, with a significant proportion of plants and invertebrates from the Upper Palaeozoic with a few exotica. Much of the material was collected in the latter stages of the last century and the early 1900's but for a number of reasons the collections were unavailable for study from 1924 until 1977. Thanks to the efforts of Parkes and Sleeman with the aid of M. Davern, R. Maher, Derek Sieveter, Steve Tunnicliff, John Nudds and a large grant from the National Heritage Council, the collection has now been curated and computer databased. This catalogue marks the culmination of this project.

The publication starts with an introduction including the history and the general organisation of the collection followed by a detailed taxonomic catalogue. The taxonomic catalogue is arranged by Kingdom, Phylum, geological System and finally by an alphabetical list of genera. Some sections have plates associated with 90 individual specimens illustrated. Amongst the macrofossils dealt with are trilobites, brachiopods, corals, bryozoans, echinoderms, bivalves, cephalopods, gastropods and graptolites. Almost half of the taxonomic catalogue covers miospores and megaspores. The final sections revise the notes and figured specimens from *Memoirs of the Geological Survey of Ireland*, provide a list of references and a very useful taxonomic index of current and old taxonomic names.

The only gripe that I have with the catalogue is with the plates which are not always of even contrast across each plate and sometimes reproduced rather flat. Considering that miospores and megaspores are a major constituent of the collections it would also have been nice to have seen a plate of these included. However, the authors should be congratulated because this is more than just a simple listing of the GSI collections, it represents a vast amount of background curatorial research work and certainly goes a very long way to making the collections of the GSI more available for study.

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## Palaeoecology: ecosystems, environments and evolution

Patrick J. Brenchley and David A. T. Harper 1998, Chapman and Hall, ISBN 0-412-43450-4, 402pp

This book provides a rounded, well-linked selection of palaeoecological concepts. Most subjects are touched on, and where not developed, there is usually a comprehensive reading and reference list. The book is concluded with a discussion of the simultaneous evolution of the marine and terrestrial biospheres drawing from links developed earlier in the book. Both are tackled comprehensively with a broad overview, and several cameo studies developed to illustrate how palaeoecology can elucidate the life habits of past organisms and their relationship to the environment in which they lived.

The chapters are well organised with a clear hierarchy of headings which makes the information readily accessible. The pages are clearly set out, not too cluttered and contain many diagrams. However with the lack of good quality photographs and the multitude of complex busy line diagrams this is certainly an 'undergraduate text book'. Each chapter is concluded with a summary section which helps to synthesise the concepts presented.

Specialist palaeoecologist course students will find this book very useful, with subjects introduced at undergraduate level, and terms and specialist fields clearly explained. The set out of the text is accessible and therefore also suitable as a reference source for students just touching on palaeoecology within their courses.

Brenchley and Harper have produced a comprehensive and enjoyable book which will be of use for all undergraduate students who require a broader, interdisciplinary understanding of the fossil record.

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## Interrelationships of fishes

Stiassny, M.L.J., Parenti, L.R. & Johnson, G.D. (1996) xiii + 496 pp. London : Academic Press. ISBN 0-12-670951-3 (pb).

In the movies, arguably, the remake, the "son of" or the "return of" is seldom as good as the original. That accusation cannot be levelled against this compendious work; whilst its scope is slightly different to that of the original, it does not disappoint, but stands as an essential reference to anyone interested in the evolutionary relationships of fishes.

In 1973, Academic Press published the first *Interrelationships of Fishes* in honour of Professors Stensiö and Jarvik; the most recent volume is dedicated to Colin Patterson, indefatigable doyen of the study of fossil fishes, whose recent sudden death robs the science of a formidable intellect. Whilst the 1973 volume rather tentatively embraced the relatively new Hennigian approach to systematics, the 1996 work is replete with cladograms derived from carefully defined and analysed morphological characters and supported with extensive data matrices.

The book contains 3 chapters dealing with chondrichthyans (Neoselachians, "Higher Level Elasmobranchs", and Batoids), 2 with basal actinopterygians (Acipenseriformes and basal Neopterygians), 10 with teleosts (Teleostean Monophyly, Osteoglossomorphs, Elopomorphs, Clupeomorphs, Ostariophysans, Lower Euteleosteans, Stomiiforms, Aulopiforms, Ctenosquamates and Acanthomorphs), and 1 with Sarcopterygians. The groups which have been omitted from this volume have been the subject of recent review in other publications.

Each chapter is written by one or more acknowledged authorities. Indeed, 5 authors (Peter Forey, Brian Gardiner, Gary Nelson, Colin Patterson and Bobb Schaeffer) have contributed to both the 1973 and the 1996 volumes, a testament both to their persistence and productivity. Many authors have proved adept at placing their group in the historical context of emerging taxonomic refinement both lucidly and concisely. The systematics of fishes abounds with names, especially for higher taxonomic units, which have been ill-defined, generalist, subject to their own evolution and based upon polyphyletic groups. The introductory remarks in many chapters will prove valuable aids to establishing clarity in the mind of the newcomer to fish classification and evolution, whilst the detail in the analytical sections will be indispensable to the seasoned and experienced !

The book is professionally produced with clear

typeface in double column format. Line diagrams and occasional halftones are of good quality. All of the chapters conform to the same general internal construction. Taxonomic articles are renowned for their turgidity, but the authors and editors are to be congratulated for maintaining clarity of style throughout.

Louis Agassiz, founder of palaeoichthyology, had a favourite dictum which ran "Study nature, not books"; his intellectual descendents have adhered to his motto as the vast number of specimens and taxa which have been examined in these pages testify. If Agassiz were alive today, his opinions of evolution notwithstanding, I'm sure he would be queueing up to purchase a copy of *Interrelationships of Fishes* hot off the press !

This volume is a worthy successor to its 1973 namesake, a timely and encyclopaedic summary of the current understanding of fish interrelationships, and an essential reference for all who are interested in the themes it contains.

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## Taxonomie des Petits Foraminifères du Carbonifère Supérieur - Permien Inférieur du Bassin de Sverdrup, Arctique Canadien

S. Pinard and B. Mamet, 1998. *Palaeontographica Canadiana* No. 15, Canadian Society of Petroleum Geologists and Geological Association of Canada, Calgary. ISSN 0821-7556, ISBN 0-919216-63-3, 253pp., 43 pls.

Bernard Mamet has been at the forefront of foraminiferal research for many years - over 30 he says in the Acknowledgements. Here he supports the work of Sylvie Pinard in this major monograph which is a high quality production with extensive and detailed systematics and 43 fine plates illustrating some 750 individual foraminifers. She has worked on the late Palaeozoic, pericratonic Sverdrup Basin in Arctic Canada.

Although the text is in French, and there is only a short English abstract, the figures, tables and numerous plates require little translation. Furthermore I know of very few Palaeozoic foraminifer workers who have not already acquired sufficient French to benefit from the seminal papers of the late Raph Conil and other Belgian authors. Unfortunately it is not possible to make the same comment about the acquisition of the Russian language!

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This study has concentrated on the "small" foraminifera rather than the standard biostratigraphy of the larger fusulinid foraminifera. Over 40 sections have been studied covering the Bashkirian to Sakmarian, resulting in fifty-eight genera with 170 taxa detailed from over 4,000 thin sections examined, whilst 17 are new species.

Pinard and Mamet connect this Arctic zonation with Mamet's previous underlying 1977 foraminiferal zonation. There he described nineteen zones for the Tournaisian - Viséan - Serpukhovian, so that here at the base of the Bashkirian the first zone begins with zone 20.

Some twelve biostratigraphic assemblages are recognised for the Bashkirian to Sakmarian, whilst another possible three are suggested for the Sakmarian to Wordian? interval. These are correlated where possible with fusulinid, miospore and conodont zones in the assemblage descriptions. However it would have been very useful to have had these displayed in correlation diagrams, even if heavy caveats were required.

The ranges of the 170 taxa are shown in three important correlation diagrams, where the three assemblage zones each of the Bashkirian and Moscovien (zones 20-25) are followed by unnumbered zones for the Kasimovien and Gzhélien, the subdivisions of the Assélien and Sakmarien, and the Sakmarien-Artinskien?, Artinskien? and Post Artinskien ('Wordien?'). The assemblage zones are by definition organised on a first appearance chronology. A minor quibble is that I would have preferred taxa within each assemblage zone, to be organised by their extinction chronology, rather than in alphabetical order.

The influence of remote isolated basins results in a lack of reliance on the stratigraphic ranges, except on a local basis. However the authors believe that it will be possible to achieve correlation with Alaskan and Yukon sections. We look forward to them then further correlating to the European and Asian successions.

Who need this volume? Anybody working with foraminifera in the Late Carboniferous - early Permian. The wealth of illustrations make it worthwhile alone. However I do dislike the "stiff card" covers so popular as a cost saving measure.

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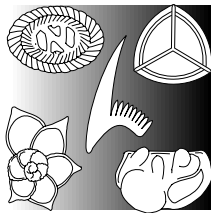
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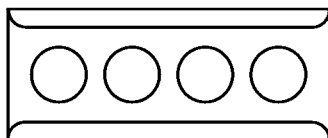
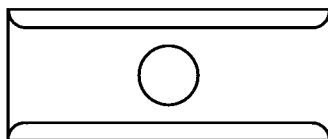
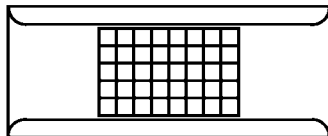
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