The Palaeontology Newsletter

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Contents

Reminder: The deadline for copy for Issue no 71 is 15th June 2009.

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

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Association Business

Annual Meeting

Notification is given of the 54th Annual General Meeting and Annual Address

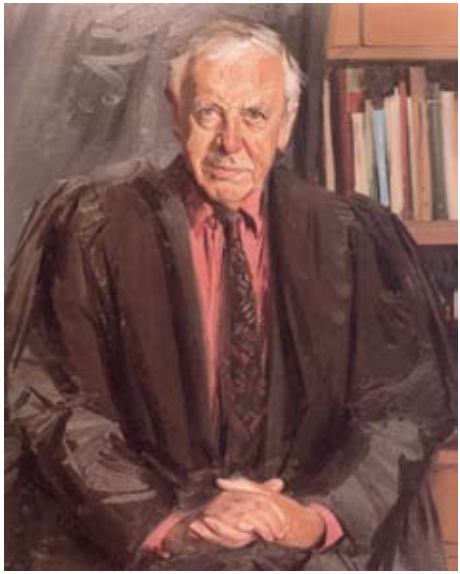
This will be held at the University of Birmingham on 14th December 2009, at the end of the first day of scientific sessions in the 53rd Annual Meeting. There are further details in the following section, 'Association Meetings'.

Lapworth Medal: Prof. Charles Holland

Charles Holland has been at the forefront of research on the palaeontology and stratigraphy of the Lower Palaeozoic in a career extending over 50 years. His research interests are wide and include the stratigraphy of the Silurian, particularly of Ireland and Britain; Silurian faunas, particularly nautiloids and graptolites; the geology of Ireland; the methodology of stratigraphy; and the concept of geological time. A sketch of his contribution may be viewed in the accompanying ten publications, chosen from a list of over 150 scientific articles and three books, a list that would have been longer had he appeared as co-author of papers arising from the postgraduate research of the many students that he supervised.

He has been influential, not just in his individual research, but also in his ability to meld the talents of others in co-operative ventures. He was the driving force behind A *global standard for the Silurian System; A revised correlation of Silurian rocks in the British Isles; The geology of Ireland* (two editions and a third forthcoming); *Telychian rocks of the British Isles and China (Silurian, Llandovery Series); An experiment to test precision in stratigraphy*; as well as several other projects not listed in the selected ten publications accompanying this proposal. In these team efforts he contributed both in his own areas of expertise and also in editorship and leadership, particularly in ensuring publication at the completion of the projects. Another influential collaborative venture is the Ludlow Research Group, set up by Charles Holland, Jim Lawson and Vic Walmsley in 1952; this informal group was a catalyst for work on the Silurian of Britain and Ireland for the following 50 years.

He has made a huge contribution in the area of correlation and standardisation of terminology of Silurian rocks throughout the globe. He was involved with the work of the Committee on the Silurian-Devonian Boundary of the IUGS from 1960 until 1974, which led to the choice of the base of the *M. uniformis* Zone as a biostratigraphical datum for the base of the Devonian (Charles had first suggested this in 1965) and to the choice of the GSSP at Klonk. Following this work, the



International Commission on Stratigraphy was established; he served on the Sub-Commission on Silurian Stratigraphy, which he chaired from 1978 to 1984. He established an eight-year programme of work, which culminated in the publication in 1989 of *A global standard for the Silurian System*. In his own view this will be the most significant legacy of his career. He was also Joint Chairman of the Ordovician–Silurian Boundary working group. He served on committees of the Geological Society of London, which published correlation charts for the Silurian and Devonian of Britain and Ireland. Likewise, he served on the Sub-Committee on the Stratigraphical Code of the same Society from 1965 (as Chairman for a period after Neville George and W. B. Harland), which produced definitive guides to stratigraphical procedure.

In the wider sphere, he has been a great advocate for palaeontology and stratigraphy. Although not actually one of those present during the celebrated taxi journey when the Palaeontological Association was conceived, he was closely associated with its early years. He served as Assistant Secretary of the Association in 1960 and 1961, as Secretary from 1962 to 1967, and was elected President in 1974 and 1975. He was President of the Geological Society of London (1984–1985).

Charles Holland is still extremely active in research. In recent years he has worked on the Silurian nautiloids of Britain and Ireland; the results of this work, which in sum form a monographic treatment, have been published as a series of individual papers, rather than as a Palaeontographical Society Monograph. In addition, he has studied the diverse nautiloid faunas of the late Ordovician and early Silurian of Anticosti Island, Canada (manuscript, in press). He also has edited and contributed to the forthcoming (2008) second edition of *The Geology of Ireland*, a lineal descendant of *A Geology of Ireland*, published in 1981. His contributions to the sciences of palaeontology and stratigraphy are such that he would be a worthy recipient of the Lapworth Medal.

Hodson Fund Award: Dr Bridget Wade

Bridget did an MSc in Micropalaeontology at UCL and a PhD in Edinburgh with Dick Kroon, followed by a NERC Fellowship at Edinburgh and Cardiff and fellowships at Rutgers, New Jersey. She now has a tenure track Assistant Professorship at TAMU. Bridget has advanced skills in micropalaeontology (especially but not exclusively foraminifera), geochemistry (with practical experience in both stable isotope and trace element work) and sedimentology (with ship-going experience). She has always taken a strong interest in the palaeobiological side of foram micropalaeontology.

Her early work, arising from her PhD in Edinburgh with Dick Kroon, was mainly on late middle Eocene and upper Eocene stable isotopes and climate. I was examiner for her PhD, which was outstanding. These climate records are still the most detailed we have for this very long interval of time, indicating an orbital influence on local oceanographic conditions and a series of regional or even global events that will need further study when suitable sections are recovered. The most high profile of these papers was published in *Geology*. During this initial phase of her work she became interested in extinction events and published an innovative and original paper in *Marine Micropaleontology* which highlights some of the problems that extinctions in the oceans pose for us. She has carried this interest into her more recent work and organized a session at GSA conference last year, specifically pre-extinction dwarfing and the lilliput effect. I gather there is a volume in the pipeline on this, co-edited with Richard Twitchett. Also significant is her paper on symbiont bleaching in planktonic foraminifera in *Evolutionary Ecology* (Wade and others, 2008). Here she shows how the calcareous plankton of the past have been vulnerable to symbiont bleaching events similar to corals, and this may have import for the future. It is also nice to see a palaeontological paper in a largely neontological journal.

Immediately after her PhD in 2001 she sailed on ODP Leg 199 and has produced a substantial amount of important work from this cruise. The papers in *Paleoceanography* (Wade and Palike, 2004) and *Science* (Palike *et al.*, 2006) are very exciting. It is not overstating the case to say that these papers revolutionize our understanding of climate in the Oligocene. Bridget has been working with me on Tanzanian samples since participating in a field season in 2004. The main results have not yet been published – one paper is just out online (Wade and Pearson, 2008) but I can say she has done a very good job of the micropalaeontology and geochemistry, including significant new discoveries, and we are aiming for some other high profile publications. We co-authored a couple of papers in *Geology* this year and last.

Bridget is very much an innovator and originator of ideas and projects. For example, she has taken the lead on an IODP proposal to drill offshore Mozambique and Tanzania, with a large international group of collaborators. She has pioneered the study of some important material from Puerto Rico, sponsored by the PalAss. Also she has been collaborating in the Paleogene Planktonic Foraminifera Working Group and was recently voted chair, showing a well-established international reputation. Re-reading some of her papers I find that they are consistently of a high quality, well presented and original, with nothing mundane or routine. I think she would be an excellent recipient of the Hodson Award.

Paul Pearson
Cardiff University

Mary Anning Award: Mr David J. Ward

David is a veterinary surgeon and exceptional amateur palaeontologist, who has made major contributions to the literature on fossil elasmobranchs, amassed what is probably the most comprehensive collection of fossil shark and ray remains in the world, and invented an internationally acclaimed machine for processing clay in order to recover small fossils. In the process of collecting fossil elasmobranchs, David made numerous important finds of other vertebrates.

He has published over 30 papers on the taxonomy of fossil elasmobranchs and chimaeroids, many of which are substantial revisions and include six papers in *Palaeontology* (*e.g.* Underwood, C. J. & Ward, D. J. 2008. Sharks of the order Carcharinifomes from the British Coniacian, Santonian and Campanian (Upper Cretaceous). *Palaeontology*, **51**, 509–536). He has also contributed over 40 papers on the stratigraphy of Mesozoic and especially Cenozoic successions.

His university years were spent in London, at the Royal Veterinary College, where he qualified as a vet in 1974. Whilst in London, and subsequently, he became fascinated by the British Tertiary and began amassing a collection of fossil vertebrates. He later applied disaggregation and sieving techniques usually used only in soft Tertiary sediments to Palaeozoic and Mesozoic vertebrate levels, yielding an abundance of new material. The clay machine (Ward, D. J. 1981. A simple machine for bulk processing of clays and silts. *Tertiary Research,* **3**,121–124. Rotterdam; Ward, D.J. 1997. A simple machine for bulk processing sediments. In A.K.G. Jones, & R. Nicholson (eds) Fish remains and humankind. *Internet Archaeology* **3,** <**http://intarch.ac.uk/journal/issue3/ward_toc.html**>) was invented in order to process the large quantities of clay needed to find small vertebrate fossils, and has been extensively used in the UK and abroad by both palaeontologists and archaeologists.

As Secretary and sometime Editor of the Tertiary Research Group, he oversaw the publication of 22 volumes of the journal *Tertiary Research*. David has led field meetings to most of the English Tertiary localities.

Currently, excluding what he has donated to the NHM, London, David has one of the most comprehensive collections of fossil shark and ray material in the world. Being accurately located stratigraphically and geographically it provides a valuable resource for systematists. Because the material is not formally registered in a national museum, it has proved valuable to workers who

use teeth for other purposes such as geochemistry, and we are currently constructing Cetaceous–Oligocene temperature and salinity curves based upon David's material.

In October 2007 David was awarded the Morris M. Skinner award for 'outstanding and sustained contributions to scientific knowledge through the making of important collections of fossil vertebrates' by the (American) Society of Vertebrate Paleontology at their Annual Meeting at Austin, Texas.

I feel that it would be appropriate to recognise David's contributions to palaeontology in the year of his 60th birthday.

Andy Gale

Palaeontological Association Research grants

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

Awards and Prizes

Lapworth Medal 2009

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

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

President's Medal

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

Nominations are invited by **1st March**, supported by a single sheet of details on the candidate's career, and further supported by a brief statement from a seconder. A list of ten principal publications should accompany the nomination. Council reserves the right not to make an award in any one year. Details and nomination forms are available on the Association Website and in the *Newsletter*.

Grants in Aid

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

Grants-in-Aid: Workshops and short courses

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

Membership and the PalAss Secure Payment Site, 2009

The Association's web-based secure online members' area, shop and membership payment site were introduced in the Spring of 2007. Thus, two membership rounds have been completed during its life, and we are able to draw some conclusions about its strengths and weaknesses. As well as the pages for renewals and online payment, the site also provides access to the electronic version of *Palaeontology* through Wiley's, and access to the members'bdiscounts on copies of *Special Papers in Palaeontology* and the Field Guides to Fossils. So it is in the interests of all members to be familiar with the route into the secure site from <**www.palass.org**>.

On the whole the site has been very successful for some 500 people, and about 45% of members use it for renewal, without problems. A separate and complete database is kept for the whole membership, past and present. It is from this Access-based data-file that the lists for address labels, mass mailings *etc* are compiled, so a certain amount of manual data exchange between the two systems has to be undertaken by us. Our original hope that everyone would pay online and keep their own entries updated was clearly unrealistic, but the advantages of online access to all 52 volumes of *Palaeontology* will increasingly come to be appreciated by members worldwide, and this is likely to push upwards the number of subscribers familiar with use of the Members Area.

There seem to be two significant reasons why many people do not want to use the electronic payment method, assuming that they have web access in the first place. One is fear of fraud – a concern that affects other online payment businesses worldwide. We can only say that there is no evidence whatsoever that this need be a concern in our case. As in other high-security sites, the submitted Card information is immediately split in half and only one person (me) gets access

to both halves. I then reassemble them and take the money manually. No record is kept of card details. The second reason relates to the problems that some people have in making the system work for them. It is difficult to know how many individual glitches there are, but some are due to a misunderstanding of the identification data that each person needs to have. These are:

1. Membership name. This is always in the form of an e-mail address with an @ in it. It may be the same as your own e-mail, or it may be a false one. If it's the same as your real e-mail, you don't have to alter your membership name if you alter your real e-mail (though you can if you like). There is a separate box on your individual profile for the e-mail address to which information is actually sent.

2. Password. This is your own password which is only known to you. It is either the randomly chosen password that was generated by the system and sent to you when you first joined, or else it is something that you yourself changed it to. We do not know your password. If you forget it you can ask for a new one to be automatically sent to you (see below). Membership name and password are the two pieces of information that you must have to get into the site.

If you have forgotten either (or both) of these, you can ask for them to be sent to you, but you will need your Membership Number (in the form of M****, where **** is a four-figure number from 0001 to 9999). We print this number on the mailing labels of *Palaeontology* and the Newsletter. Please remember that this number is *not* the same thing as your password, but merely a means of getting reminders.

So start by clicking the Subscriptions and Online Shop box on the left-hand side of the home page at <**http://www.palass.org/**>, then follow the relevant prompts. Or you can click the Members Area box and go through the same questions.

Of course, you can still renew using a paper-based system, and we send out forms attached to a reminder email at the end of the year. But you may miss out on the advantages of the Members Area if you don't also know how to get into it, as described above.

Good luck!

Tim Palmer
<palass@palass.org>

Is the Lyell Meeting a key to an integrative perspective on past life?

The Lyell Meeting has long been a cachet date in the diary of palaeontologists. It is organised under the umbrella of the Joint Committee for Palaeontology (JCP), which comprises representatives from The Geological Society, The Micropalaeontological Society, The Palaeontographical Society and The Palaeontological Association. The meetings are intended to showcase, discuss and perhaps even solve problems of common interest, and are currently held annually in the apartments of the Geological Society. These meetings have often been very successful, and have given rise to important publications in Special Publications Series of The Geological Society.

The JCP is currently considering the possibility of modifying the Lyell programme to provide a series of less frequent, but more ambitious, meetings. The purpose would be to enable the JCP to retain the original vision of generating meetings with an integrated approach to high-profile topics of broad interest; this is proving increasingly difficult with an annual, low-budget meeting.

Each member society has been requested to comment on this suggestion, and we would welcome the views of our membership before we respond. Please direct correspondence to the Secretary of The Palaeontological Association, Dr Howard Armstrong, <**h.a.armstrong@durham.ac.uk**>, by 1st June 2009.

Howard Armstrong

ASSOCIATION MEETINGS

53rd Annual Meeting of the Palaeontological Association
Birmingham, England *13 – 16 December 2009*

The 53rd Annual Meeting of the Palaeontological Association will be held at the University of Birmingham and organised by members of the School of Geography, Earth and Environmental Sciences.

The meeting will begin with a symposium on Sunday 13th December entitled "Macroecology in Deep-Time", followed by a drinks reception in the Barber Institute of Fine Arts at the University of Birmingham. The conference will commence on Monday 14th December with a full day of talks and posters, the AGM of the Association and Association Annual Address. In the evening there will be a drinks reception followed by the Annual Dinner in the Great Hall of the University. Tuesday 15th will be a full day of talks and poster sessions. The time allocated to each talk will be 15 minutes and if abstracts of sufficient number and quality are submitted, parallel sessions will be scheduled for part of the meeting. The meeting will conclude on Wednesday 16th December with a field excursion to the Cotswolds to view some of the renowned Jurassic sections.

Venue and travel

The conference will take place at the University of Birmingham (<**http://www.bham.ac.uk/**>) in the leafy suburb of Edgbaston in Birmingham. The city contains a wealth of entertainments together with cultural attractions such as the Birmingham Museums and Art Galleries, with their world famous Pre-Raphaelite collections, and the historic Jewellery Quarter (<**http://www.visitbirmingham.com**>). The University is a short distance away from the city centre and easily accessible by a direct and very frequent train service from Birmingham New Street Station as well as by numerous bus routes (<**http://www.about.bham.ac.uk/maps/edgbaston.shtml**>). The city has unrivalled access to all parts of the country through excellent rail and road links. Birmingham International Airport (BHX) is less than ten miles from the city centre and connected to the city by frequent high-speed train services. The airport is served by many major carriers and budget airlines and has direct routes to the USA and an array of destinations in Europe.

Accommodation

Rooms in a variety of hotels at a range of different prices can be reserved through <**http://www.birminghamconventionbureau.com/paam2009**>, which has been set up specifically for the Annual Meeting. The city also has a large number of cheaper backpacker hostels; information on these and alternative accommodations will be provided.

Registration and booking

Registration and booking (including abstract submission) will commence on Monday 27th April 2009. Abstract submission will close on Friday 4th September and abstracts submitted after this date will not be considered. Registration will incur an additional administration charge of approximately £15, with the final deadline of Friday 20th November 2009. The main conference lecture hall has a capacity of 380 and the number of registrants will be capped at this figure, even within the registration deadline if necessary. Registrations and bookings will be taken on a strictly first come first served basis. No refunds will be available after the final deadline.

Registration, abstract submission, booking and payment (by credit card) will be from online forms available on the Palaeontological Association website (<**http://www.palass.org/**>) from Monday 27th April. Accommodation must be booked separately and details will be placed on the website.

Programme

Sunday 13th December	Symposium on "Macroecology in deep-time"
	Reception in the Barber Institute of Fine Art, University of Birmingham
Monday 14th December	Scientific sessions (talks and posters)
	AGM and Annual Address
	Reception and Annual Dinner in the Great Hall, University of Birmingham
Tuesday 15th December	Scientific sessions (talks and posters)
-	Presentations of awards
Wednesday 16th December	Field excursion to fossiliferous Jurassic rocks in the Cotswolds

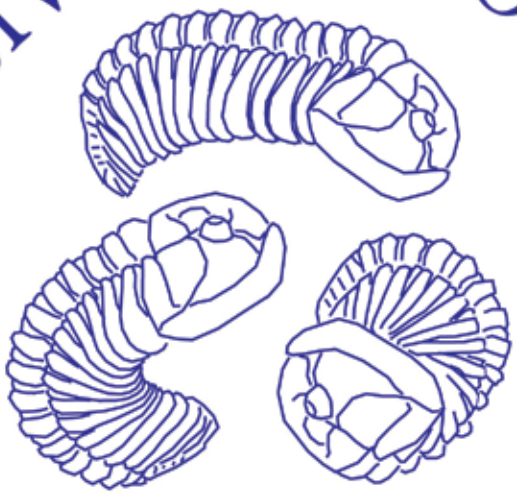
Travel grants to student members

The Palaeontological Association runs a programme of travel grants to assist student members (doctoral and earlier) to attend the Annual Meeting in order to present a talk or poster. For the Birmingham meeting, grants of up to £100 (or the € equivalent) will be available to student presenters who are travelling from outside the UK. The amount payable is dependent on the number of applicants and the distance travelled. Payment of these awards is given as a disbursement at the meeting, not as an advance payment. Students interested in applying for a PalAss travel grant should contact the Executive Officer, Dr Tim Palmer (<**palass@palass.org**>) once the organisers have confirmed that their presentation is accepted, and before 5th December 2009. Entitle the e-mail "travel Grant Request". No awards will be made to those who have not followed this procedure.

UNIVERSITY OF BIRMINGHAM

THE PALAEONTOLOGICAL ASSOCIATION

PROGRESSIVE PALAEONTOLOGY



2009

- BIRMINGHAM -

27th – 29th May 2009

School of Geography, Earth and Environmental Sciences
University of Birmingham

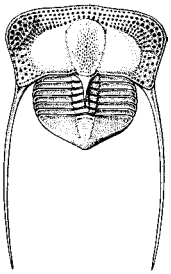
Registration deadline: 15th May
Abstract deadlines: 1st May (oral), 15th May (poster)

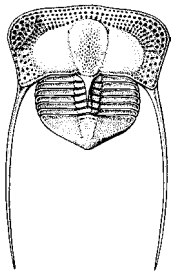
Online registration, abstract submission, and further information can be found at **<http://www.palass.org/>**.

If you have any specific questions, please email **<birmingham2009@palass.org>**.

The Birmingham organising committee are:

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



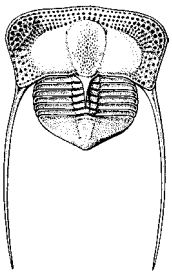


Forthcoming Major Meeting

Third International Palaeontological Congress

28 June – 3 July 2010
Imperial College and
Natural History Museum, London

Following the highly successful meetings in Sydney and Beijing, the third International Palaeontological Congress will be held in London in 2010, based in venues in and around Imperial College and the Natural History Museum. The meeting will be hosted by the Palaeontological Association and partner organizations. For further information and regular updates check the IPC3 website: <**http://www.ipc3.org/**>.



From our Correspondents

Of trousers, time and cheese

It isn't every day that one comes across Jurassic cheese. One can of course dine on Cheddar, gorge on Gorgonzola, feast on Feta: but to have placed before one a vision of such exquisite maturity is more than flesh and blood can resist. This *fromage chronostratigraphique* was as properly *authentique* as everything else on the deli counter, from herb-bestrewn olives to marinated crustacea. It demanded, nay, begged, the investment of doubloons sufficient to place a down payment on a hundred grams of this simultaneously gastronomic and geological delight.

It should be no surprise at all – *especially* to one who trades in stratigraphy for a living – that the Jura Mountains have, at one and the same time, a skeleton of rock that formed when dinosaurs walked the Earth, and an exterior mantle of soil and grass upon which cows graze and give their milk: Jurassic milk that is then skilfully metamorphosed into Jurassic cheese. Nevertheless, the unexpected recognition of this eternal duality gave a little shock of pleasure, and the frisson of something a little deeper.

The high class groceries were part of the gentle excesses that one indulges in at Christmastide, along with the indulgence of wallowing in lowbrow diversions on the silvered screen in the corner of the room, and among the kind of paperbacks whose covers are adorned with marvellously lurid sci-fi landscapes. One's indulgences, though, as a parent, cannot run entirely free; they are gently – well, occasionally gently – encouraged to run parallel with the youthful enthusiasms of one's offspring.

This Christmas season *chez nous*, the chief enthusiasm in the emerging generation, domestically, has been directed towards true fossils in the canon of British television: the original *Avengers*, where the debonair John Steed and the amazing Mrs Peel do battle with the villains of unutterable villainousness, all the while trading repartee worthy of Molière. It's among the most charming nonsense ever foisted upon a bemused begogglebox'd public, and so it has been a quite unmixed pleasure (alongside one's parental duty, you understand) to relive the days when scriptwriting was an old-fashionedly theatrical craft, and even, at times, a delicately nuanced one.

The plot itself eternally followed a comfortably familiar pattern, culminating in our heroes saving the world (or some substantial part thereof), at the very last second (the penultimate second just would not do: perish the very thought). The fascination herein, in such situations, naturally, lies in discovering what new and intricately devious means can be devised of imperilling the world, prior to its rescue by that last karate kick or by a deftly thrown bowler hat (the one with the tempered steel reinforcement, as readers of a certain age might recall). There was the nuclear-primed department store lift; the ecocidal chemical concoction; the death ray from Venus; the homicidal kitten (feline, in case you ask); the sentient thought-controlling giant man-eating extra-terrestrial plant (of the Compositae) where one sensed a certain *hommage* to John Wyndham's triffids; and mechanisms more outrageous still. Marvellous stuff, with each episode rounded off as our heroes ambled back into the sunset, final quips being lightly exchanged, the cork being lifted with a practised hand from the vintage wine that is always miraculously nearby.

World-imperilling scenarios were and remain ten a penny on both small and large screen, as alien monsters and rogue meteorites and, more recently, unhinged climates vie for our attention. One is always curious to learn more, and Wikipedia's inclusion in the genre of the giant city-threatening moussaka from outer space surely merits some serious future consideration. Mostly, of course, the world survives in the nick of time. But then, sometimes, it doesn't. A prime contender for the brief and efficient termination of domestic planetary ambitions lies, famously, in the opening of *The Hitchhiker's Guide To The Galaxy*. Here, the Earth is destroyed by the spaceships of the Vogons[1] to make way for an interstellar bypass, the entire process taking a little under two minutes. In these more realistic times, one should not always expect a happy ending.

And in these times, truth, as we now know, can rival and even surpass fiction. Well, perhaps, not truth as such and definitively, of course – but rather that qualified truth that comprises rationally devised and testable scientific hypothesis: in the form, moreover, of the variant of a possible-future-truth that is a computer model. Two such narratives have caught my eye recently. They each describe potential future paths for the Earth and all of its biota (including, notionally, us). They vary from merely representing the end of the Earth As We Know It, to well, just finally and irreversibly the end of everything on Earth, including (at a rather early stage in the proceedings) of Darwin's marvellous mechanism and the living matter it acts upon. Somewhat chillingly, both of these scenarios are in the (geologically) near future, rather than representing those existentially sensed billions-of-years-hence events destined to accompany the last outburst of the sun's nuclear fires.

One was an analysis of a curious pattern that, although only of four years vintage, has already become iconic in Ice Age stratigraphy. This pattern is of world climate for the last five million-years-and-a-bit, and was patiently stitched together by Lorraine Lisiecki and Maureen Raymo from 57 individual records of climate that were in turn derived from the isotope chemistry of fossil foraminifera, taken from cores of ocean sediment from around the world. Now known as 'the LR04 benthic stack', it provides a striking image. The first couple of million years shows the muted forty thousand year warm–cold oscillations of the relatively warm climate of the Pliocene Epoch. Then, between three and two and a half million years ago, the dip into the cold of the Ice Ages, as the great northern ice-sheets grow; the forty thousand year cycle is still there, but is now distinctly more pronounced. Then, a million years ago, comes another transition, into the yet larger climate swings as the rollercoaster of the hundred thousand year cycle takes over – and we are currently at the high end of one of the huge climate swings of this last phase.

It looks for all the world like, say, a close-up shot in a TV hospital drama of the ever-more-ominous traces on the medical monitor that is attached to the Patient with the Mystery Malady, around whom cluster the doctors and nurses, so perplexed by the ailment that they even briefly forget their own complex romantic entanglements. Or like the signal on a seismograph, growing ever more crazy just before some violent refashioning of a tectonic plate boundary. So what *is* going on with climate?

This is the pattern that climate scientists Tom Crowley and William Hyde have recently explored. They constructed a computer model of the Earth and its ice, to replicate these transitions and the ever-greater climate swings, and ran it forwards. What they found was that the current state,

[1] a highly bureaucratic and a somewhat callous species, though not exactly evil by the most demanding of human standards.

with the marked 100,000 year cycles, seems not to be a stable pattern attuned to the pattern of solar radiation and the greenhouse gas levels of the past million years. Rather, it represents an unstable (and hence wildly oscillating) transition interval that may soon (meaning in less than a hundred thousand years) flip into a stable climate state of permanent glaciation, with more or less equal amounts of ice growing around both poles. This is remarkable enough, but it is the sheer amount of ice predicted in the model that caught my eye: with a hyper-Antarctic ice sheet at each end of the globe, that is enough to lower global sea level by between *three and four hundred metres*.

This is no longer another phase of the standard Quaternary glaciation, and it also goes well beyond any previous Phanerozoic glaciations, including even the fifty-million year Permo–Carboniferous icehouse, which had nothing like that kind of effect on sea level. This seems more akin to something on the scale of the bizarre Snowball Earth glaciations of the Precambrian. And as for the effect on the world's biota, and in particular on the kind of marine organisms likely to be found as fossils by a field geologist… Well, imagine (or predict, using a bathymetric map) the effect on the world's continental shelves. They would, pretty well all of them, become dry land, which would mean that the main habitat for many – most? – kinds of shelf-dwelling benthic marine organism will also disappear; or, as nearly so as dammit, being confined to an absurdly narrow zone snaking around the upper part of the continental slope. Thus, the major extinction event that conspicuously wasn't present at the beginning of the Quaternary glaciations will almost certainly turn up with a vengeance in this new, predicted kind of icehouse world.

What's bad news for marine life might be good news for creatures on land, though, with substantial new living space around the tropics (the models show no ice below about 45 degrees North and South, so presumably the tropics would still be at least warm, if likely drier, while the temperate zones will be squeezed and narrowed even more than during the previous glacial maxima of the Quaternary.

Tom Crowley, commenting on these findings in that *Nature* issue, compared the marked 'transition state' oscillations with the crazy behaviour of share prices just before a stock market crash. Well, perhaps the less said about that the better, these days. The point was also made that the predicted new icehouse state might be staved off indefinitely by future societies carefully keeping greenhouse levels just above natural, pre-human levels. That observation seems to chime with the thesis made by Bill Ruddiman and his co-workers, that the slight rise in Carbon Dioxide levels in the ten thousand years prior to the Industrial Revolution (from about 260 parts per million at the start of the Holocene, to about 280 parts per million at about 1800 AD) was the key factor in keeping the Holocene as warm as it has been for as long as it has been, and prevented or delayed the slide into the next glacial phase.

The point was made, too, that of late the rise in atmospheric Carbon Dioxide levels since 1800 has been anything but slow and carefully controlled. The Crowley/Hyde model is thus now, *de facto*, a picture of a future that is definitively averted. It remains now just what it is, a model, hypothetical, untested and now untestable, unless some means can be found of quickly taking a few hundred billion tons of carbon out of the atmosphere and stuffing them underground somewhere. That's not impossible, but on past form it seems highly unlikely.

Which brings us on to the alternative future, one perhaps more attuned to the new reality, and one that I first heard seriously mooted as a serious possibility just before this Christmastide, though it had been lurking (I had thought, and hoped, entirely as a science fiction impossibility) somewhere at the back of conscious thought. It is the idea that the Earth might enter a Venus-like state.

Now this would represent a future so alternative that even Terry Pratchett's splendid sartorial metaphor of the trousers of time – that represent a bifurcation in the chain of causality – seems inadequate. The Earth here doesn't so much veer down an alternative trouserleg of planetary history, as find itself tangled in a thoroughly unattractive string vest in the rival haberdashers down the road.

An impossible prospect? Unfortunately, perhaps not quite. Years back, I had thought that as Venus is a lot nearer the Sun than is the Earth, the Sun's rays should shine more strongly on its surface than on that of our planet. Also, to convert the Earth into Venus one would need to start by somehow creating surface temperatures high enough – 100°C – and sustained enough, to boil away the oceans.

Likely wrong on both counts, alas, as Jonathan Lunine clearly described some time back in his fine text-book 'Earth' (yes, another one with this title, but the perspective of an astronomer makes this one distinctive). Less sunlight actually reaches the surface of Venus than hits the surface of Earth – those highly reflective clouds, you see (one forgets – I did, at any rate – the wider significance of the brightness of the Evening – and Morning, indeed – Star). So the furnace-like heat of that planet is entirely down to the Carbon Dioxide-generated greenhouse effect. But it is the precise nature of the inception of that greenhouse state, via planetary water loss, that has the sting in the tail.

One doesn't need to achieve the boiling point of water to start to siphon the Earth's oceans into outer space. And the process, once started, might be effectively irreversible, rather like opening a valve. Currently, in Earth's wonderfully equable and stably hydrous state, water vapour condenses as clouds and rain in the high, cold troposphere before it gets to the stratosphere, which is almost totally dry; any stray water molecules that do reach the stratosphere, though, are broken up by ultraviolet radiation into oxygen and hydrogen, the latter escaping into space.

But push the Earth's average surface temperature up to 340 kelvins – or about 75° Centigrade – and the top of the troposphere gets warm enough to allow water vapour passage into the destructive stratosphere, 'popping the cork' (as it is thus described) of the Earth's water resources. This is the 'moist greenhouse effect', a significant variant of the more popularly known 'runaway greenhouse'.

Ever since reading that rather sobering mechanism, I'd not heard it seriously mooted as a possibility for Earth, no matter how dire the intensified greenhouse effect of anthropogenic global warming might become. The icecaps may melt, humans may (or may not) disappear in the ensuing eco-crisis, but the biosphere will always pull through into the next evolutionary radiation, on and on until the Sun finally heats the Earth beyond its habitable limits. That was my personal ultimate existential security blanket (of a sort), until a couple of weeks ago.

But even that rather threadbare rug[2] was pulled from under my feet by none other than James Hansen, the NASA scientist who has done much (and endured much for his pains) to highlight the nature of global warming in the US – especially in the times of an administration that did not want to hear any such news. The occasion was the recent Bjerlykes lecture, given by Hansen, at the American Geophysical Union Fall Meeting in San Francisco, and the large hall was packed. In the talk, Hansen noted the extreme rapidity of the anthropogenic CO_2 rise, by comparison with any in the geological past. The speed of this rise means that positive feedbacks (*e.g.* release of permafrost methane) are encouraged much more than are negative feedbacks (such as silicate weathering to soak up the CO_2). So – and here Hansen gave what he stressed was a personal opinion – if the world's coal reserves were used up, he opined that there would be an outside chance of a runaway greenhouse effect being triggered on Earth. If the world's tar sands were used up as well, he thought that that would make it virtually certain.

Now that's about as shocking an assessment as any I've heard. Was it challenged by any of the thousand or so earth scientists present? No, and in the random sample of these around where I was sitting, there was much nodding of heads in agreement with his points. Hansen may be wrong, of course. The multiple climate feedbacks are complex enough to allow for wide error bars. So, an Earthly inferno that is triggered geologically tomorrow may – with luck – turn out to be nothing worse than a child's nightmare: a nightmare from which we may safely wake, a nightmare beyond the physico–chemical reach of even several hundred years-worth of hydrocarbon business-as-usual.

But the very fact that such a Venus syndrome can be seriously proposed, even as an outside possibility, takes the global warming debate into a different realm. It changes – it seems to me – our relationship to the Earth immeasurably. The possibility that the human race can kill itself off by one means or another, and take much with it, has been a topic of discussion since humans became self-aware enough to consider their own history. That is an integral part, almost, of the human condition. But the possibility that we can collectively put an end to the entire biological evolutionary process is something else again. That the fossil record can go on its three billion-year trek from stromatolites, to all those familiar metazoa of trilobites and brachiopods (and, yes, graptolites too), to ammonites and belemnites and (occasionally) dinosaurs, to a multiplicity of molluscs and mammals, to… A full stop?

For once the Venus syndrome took hold, even the microbes would go: even, eventually, the last survivors in the deepest of the deep subterranean biosphere, those bugs that slowly eke out their mysterious existence in mile-deep strata. And, on a dry and increasingly hot Earth (as atmospheric CO_2 levels built up without let or hindrance), plate tectonics, also, would eventually grind to a halt (with some spectacular effects along the way, no doubt). Dante's circles of Hell would multiply, to infinity.

Did the Earth ever come close to this? That the Earth has only just missed being frozen (in the self-same infamous 'Snowball Earth' episodes) has been oft-stated. But, given the mechanism of the moist greenhouse, might Earth have just escaped a Venus-like state early in its history? Establishing palaeotemperatures in the world's oldest strata is an exercise fraught with very wide error bars. But there is evidence of early warmth on Earth, from Silicon isotopes and such, for instance (Robert & Chaussidon, 2006); or from 'genetic footprints' in living bacteria of a liking for

[2] well, yes, another mixed metaphor, but I plead, m'lud, that the components are *materially* similar

high temperatures in their ancient ancestors (Boussau *et al*. 2008); controversial both, I am led to understand. But if these lines of evidence speak with unforked tongue, sea temperatures in the early Archaean might have reached 70°C or greater: a more effective greenhouse blanket – carbon dioxide and methane levels several to many times today's – overcoming the reduced heat input from the 'faint early Sun'. This condition sounds uncomfortably close to the level Lunine quoted as a threshold for the inception of planetary water loss. The Earth may have been just a shade luckier to have remained habitable than we had thought.

The wider question here seems not so much philosophical and ethical (including that of our influence on a future palaeontological record) as practical. Will wider awareness of this ultimate terminal possibility help in stimulating political and economic action to mitigate global warming? Or, is the prospect of a lifeless Earth irrelevant to a species concerned mostly with itself, where the individuals of that species are mostly concerned with themselves and their kin? Now there's a question[3]. Answers on a postcard, please.

What to do? According to the *Independent* the other day, a majority of climate scientists thought that since Plan A (Kyoto, carbon markets *etc*.) hasn't worked, with CO_2 levels now rising faster than ever, Plan B (geoengineering via giant mirrors in space, feeding plankton with iron, and so on) needs considering. Quite a piece of news, this, as Plan B isn't quite the last throw of the dice, but it's decidedly risky.

Hansen suggested another measure that is simplicity itself, is surely effective (if not sufficient in itself), has none of the potentially disastrous ecological side-effects of geo-engineering, and is cost-neutral. This is a Carbon tax, with – note this – *all* of the money raised being given back to each citizen equally as a monthly dividend in their pay packet. Such a tax would discourage hydrocarbon use, encourage alternative energy sources by default, and be socially redistributive in the old-fashioned sense of the word. However, it is still of course a *tax*, and therefore in the current body politic it is for that reason alone impossible, heretical, absurd, iniquitous and worse. Whereas, carbon trading – immensely complex, highly bureaucratic, a goldmine for lawyers and open to every possible kind of abuse – remains the favoured option for modern, right-thinking and economically savvy[4] governments everywhere. This is then yet another mirror to, and reflection of, the collective, contemporary and representative human condition. It is also, in another reading, plain bonkers.

But, hurriedly leaving the dismal science of economics for wiser heads to ponder, one can safely return to practicalities. Some types of climate engineering, now, seem gentler and less hazardous – and with, to boot, a good palaeontological pedigree. Biochar, for instance: the business of taking any organic material – wood or cornstalks or your potato peelings – and heating it in the absence of oxygen. The processes in itself generates energy, and the biochar produced – a kind of charcoal – can be added to soil where it increases fertility substantially, and also persists for several hundred years at least. The *terra preta* soil that pre-Columbian Amazonian Indians thus cultivated is still black and fertile today, unlike the barren lateritic wasteland that typically results from tropical deforestation. This path seems promising, has multiple benefits, and is also

[3] In the humans-vs-Vogons morality stakes, consider this: would the Vogons have so little sense as to eliminate their own planet?

[4] I refer you to the sentence above on the stock market crash.

relatively cheap and easy to introduce (unlike adding Carbon sequestration capability to coal-fired power stations, for instance).

The longevity of the Carbon thus sequestered can be gauged, a little obliquely, from the way in which plants are preserved – for the fossil record, that is – by forest fires. The charcoalified fragments produced may be fragmentary and brittle, but they are also indigestible to all but the most patient and determined bacteria. The kind of palaeobotanical cellular microstructures that can be gleaned from a small lump of fossil charcoal are thus truly extraordinary: witness the kind of spectacular scanning electron microscope images that have been produced by Andrew Scott & colleagues. Hence, biochar might not only store away enough Carbon to make a difference: amazingly, if adopted worldwide, it might even be able to put Carbon back into the soil at the same rate as we are currently burning it (Lehmann *et al.* 2006) – but the Carbon should stay sequestered for a long time. Even if Lehmann & colleagues are over-optimistic by an order of magnitude, the technique is surely still worth exploring.

So, all being well, as the decades and centuries pass by, the world will see thicker and deeper and blacker soils, as civilization biochars a path to avoid an unhappy conjunction with Venus. This is a path that will also grow better pastures, on which cows[5] may safely graze to produce the Anthropocene Cheese of the future. That will surely leave a signpost for yet more distant generations. Not the cheese itself, I hasten to add: a fine vintage like that needs be wholly savoured, and heavens forbid it ever be petrified.

There is, though, that portion of this gently geo-engineered soil that will go into the fossil record for future consideration. It will be a distinctive palaeosol millions of years hence, a black marker level of human occupation. Packed with finely-preserved charcoal fragments, it will present a fine puzzle, redolent of drama. Today, palaeobotanists use the charcoal content of fossil soils to estimate the amount of fossil fires in the past – to suggest, for instance, whether (or not) immense forest fires were lit by the Cretaceous–Tertiary boundary meteorite.

Here, such a record will speak, surely, to any far-future chroniclers that might arise (or visit), of black deeds indeed, of a past civilization systematically and repeatedly torching the world's forests (and, if they look closely, on heaping similar indignities upon potato peelings). Well, there's some truth in that of course. But if this conclusion is deduced from a biochar-packed palaeosol then the reforming mutt of humanity will be hung with the bad name of past infamies. There's no justice, of course – past, present or future. Better gain some consolation from making a good cheese (and the fine wine to go with it) – though remembering, first, to prepare the ground well.

Jan Zalasiewicz

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[5] Skilfully – I hesitate to say genetically – modified to be of the non-methane-emitting variety that can be allowed into polite society.

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PalaeoMath 101 Who is Procrustes, and What Has He Done With My Data?

To this point in our discussion of geometric morphometrics we've focused mostly on developing background concepts: landmarks, size, shape, shape coordinates. Over the next two essays we'll continue to develop necessary background, but now we'll be discussing concepts fundamental to the current practice of geometric morphometrics and to mathematical shape theory. In the context of this discussion we'll learn why almost everything we've discussed in this entire essay series, while valid in its own right as a set of powerful approaches to generalized data analysis, has been a bit off the mark when it comes to shape analysis. However, we'll resolve this disturbing realization by learning how, with a few relatively minor changes, we can use the same data-analysis approaches to construct a new, very powerful and theoretically consistent approach to the analysis of shape that is ideally suited to tackling the most sophisticated shape-analysis problems we can imagine.

This discussion begins, innocently enough, with a consideration of an alternative metric that can be used to express similarities and differences between the shape of sets of corresponding landmark points. Recall that, in the last essay, we discovered how to use Bookstein's shape coordinate (BSC) approach to transform landmark coordinate data from their raw form—in which size and shape information are complexly confounded—into a mathematical space that uses a landmark-defined baseline to standardize the data for position, size and rotational differences.

In terms of preserving the geometry of the forms, therein lies the rub. Baseline registration artificially fixes the positions of the baseline landmarks which, in the overwhelming majority of cases, should also be regarded as representing sites of localized shape variance, just like the other landmark positions. There may be some cases in which we have reason to expect that most of the shape variation we're interested in is located in one particular region of the form (see below). Similarly, we may wish to test a hypothesis that focuses its attention on a localized region of the form. In those cases it may seem as though Bookstein shape coordinates would be appropriate. But even in these cases the choice may be questionable. This is because the BSC approach

actively *transfers* the shape variance of the baseline landmarks to the other landmarks—variance that wasn't present at those locations to begin with. This transference results in a systematic distortion of the geometry of the BSC space, the intensity and directions of which will vary depending on which landmarks are chosen to define the baseline.

Because of this distortion due to transference of shape variance, there is an additional BSC issue to note. This has to do with the relation between BSCs and centroid size. Recall that centroid size is the size index maximally uncorrelated with shape as defined by comparable sets of landmarks. This size index is calculated by summing the squares of distances of all landmark coordinates from their common centroid (= mean). Since the positions of the landmarks in the BSC space have been altered due to the transference of shape variance from baseline to non-baseline landmarks (a transference that has nothing to do with the landmarks' centroid), the value of the size estimate is affected. Even worse, it's affected in a particularly subtle manner.

Since centroid size is calculated using the raw coordinates, the estimate of centroid size itself is not affected by transformation of the raw data into the BSC space, or into any other shape-coordinate space for that matter. However, since superposition is supposed to standardize the landmark configuration for size differences, and since the size standardization implemented by the Bookstein approach is referenced to the baseline (and not the centroid), the size standardization achieved by BSC effectively has, literally, nothing to do with the centroid, and so nothing to do with centroid size. This results from the fact that the position of the centroid of the landmark configuration is distorted by transference of shape variance away from the baseline in the same manner as the positions of the non-baseline landmarks. This transference problem also affects the other two aspects of generalized shape coordinate transformation—translation and rotation—in exactly the same way.

Table 1 shows the effect of this discrepancy between baseline size standardization and centroid size standardization for a few of the trilobite pygidium landmark configurations used in the previous essay (see the *PalaeoMath 101-2* spreadsheet for details of the calculations). Note that, after BSC transformation, the baselines of each configuration are standardized for size (= length), but the centroid size values of the same configurations in the BSC space are not.

Table 1. Lack of precise size standardization for Bookstein shape coordinate superposed data. These are baseline lengths and centroid sizes for trilobite pygidial triangles. See text for discussion and the *PalaeoMath 101-2* spreadsheet for calculations.

Genus	Baseline Length (Raw Coords)	Centroid Size (Raw Coords)	Baseline Length (BSC)	Centroid Size (BSC)
Acaste	9.244	7.224	1.000	0.781
Balizoma	5.592	4.332	1.000	0.775
Calymene	16.917	12.649	1.000	0.748
Ceraurus	9.796	7.354	1.000	0.751

Mark Webster and David Sheets have developed a partial correction for this BSC shape-variance transfer problem that involves adjusting the length of the Bookstein baseline to bring the size standardization achieved into better conformance with the expectations of a size standardization based on true centroid size. This supplement to BSC transformation has been termed 'sliding

baseline registration' (SBR, see Webster *et al.* 2001; also Kim *et al.* 2002). While SBR correction minimizes aspects of the distortions induced by baseline registration, it does not eliminate them. In addition, SBR does not compensate for the effect of arbitrary baseline choice.

So, if Bookstein shape coordinates are a pragmatic and easy-to-understand, but ultimately imperfect means of summarizing shape variation, is there a better approach? Recall that in the last column I mentioned the existence of an alternative shape space. It's now time to introduce you to this alternative shape space, which lies at the very heart of geometric morphometrics and shape theory, in the guise of a figure from Greek mythology.

Procrustes is a character from the legend of Theseus, the founder-hero of Ionia. Theseus met Procrustes on the last leg of his journey from Troezen to Athens. Procrustes was a particularly sadistic bandit who operated in the hills outside Eleusis in southern Greece. A son of Poseidon, Procrustes offered travellers a hospitable break from their journey, plied them with food and drink, and offered them a bed to rest on. But if the traveller was too long for the bed, Procrustes made them fit by amputating their head and feet. If too short, he stretched them with lethal result. Coincidental fits were avoided by Procrustes adjusting the length of the bed after sizing the traveller up from a distance. Being wise to the ways of the world, Theseus worked out Procrustes' game beforehand and gave the bandit a taste of his own hospitality, much to the relief of the local inhabitants.

As with the names of many mathematical procedures, the name of this myth's villain has been appropriated as the name of a set of mathematical techniques designed to adjust the scale of datasets while preserving aspects of their internal structure[1]. For example, a hyperbolic rotation (also known as a 'Procrustian stretch') is a mathematical transformation rule used in geometry to convert circles into ellipses of the same area. In generalized data analysis, Procrustean methods are used in a wide variety of applications and have a long history. In particular, a number have been developed to rotate the axes of principal components and factor analysis ordinations to positions such that the axes remain orthogonal, but achieve a better alignment with the extreme points in the ordination. This operation is felt by some to improve the stability and interpretability of PCA or FA results.

Morphometrically speaking the landmark alignment methods referred to as Procrustes superposition techniques were first developed in the context of 'theta-rho' (or θ,ρ) analysis (Benson 1967), which has an interesting palaeontological connection. In seeking to develop a procedure to quantify the structure of shape similarity between species of freshwater ostracodes, palaeontologist Richard Benson hit on the idea of centring a polar coordinate system on some convenient feature of the ostracode carapace (*e.g.*, a muscle scar) and using that to locate the positions of other features (*e.g.*, muscle scars, pore-conuli, carapace outline) using the standard polar coordinate method of describing positions as vectors that lie at an angle (θ) from a reference line passing through the coordinate system's origin and a radius (ρ) from that origin. These θ,ρ coordinates are completely analogous to the x,y coordinates of the Cartesian system, and can be used to represent geometric form in the same manner.

[1] In their discussion of Procrustes superposition Zelditch *et al.* (2004) offer the interesting observation that Procrustes' method of adjusting traveller size was not necessarily Procrustean in a mathematical sense, in that the amputation of heads and feet changed the spatial structure of the traveller. Of course, the analogy is with Procrustes' stretching method of traveller adjustment.

Benson originally used his theta-rho descriptions to represent form differences between ostracode carapace shapes by simply finding the sum of displacements between corresponding landmark points and using those sums to construct a form-distance matrix, the structure of which was represented by a cluster analysis. Later, Benson and colleagues added a technique for comparing forms pioneered by Peter Sneath (1967), who used a two-dimensional trend-surface analysis approach to 'fit' one set of landmarks to another. The objective of this fitting technique was to (1) maintain the relative configuration of all points in each dataset to one another and (2) minimize the squared distances between corresponding landmarks across the two datasets. Sneath approached this problem as an exercise in two-dimensional curvilinear (or multiple) regression (see MacLeod 2005). But mathematicians and biologists with a mathematical bent quickly realized that there are many possible approaches to this problem (*e.g.*, Mardia and Dryden 1989; Gower and Dijksterhuis 2004).

In geometric morphometrics, the term 'Procrustes superposition' usually refers to the variant that is technically known as generalized least-squares (GLS) superposition. As there are other types of superposition procedures (see below) it is best to treat the term 'Procrustes superposition' as a generic or class-level descriptor for the entire family of techniques that minimize differences in position, scale, and rotation for sets of landmark (and/or semilandmark) points. Unfortunately, few authors respect this distinction. I'll illustrate the basic steps in Procrustes (GLS) superposition procedure using the two sets of three pygidial landmarks for the *Calymene* and *Dalmanites* specimens from the trilobite dataset (Fig. 1).

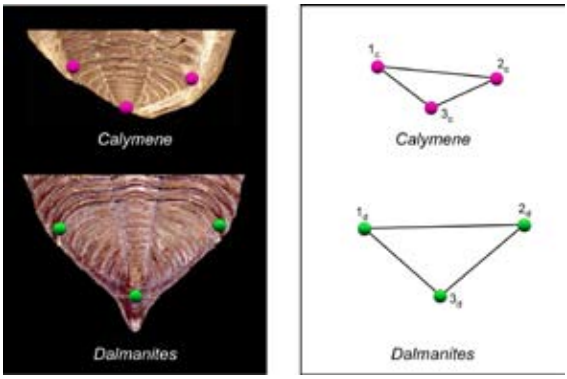

Figure 1. Landmarks used to define triangles that summarize the gross form of Calymene *and* Dalmanites *pygidia.*

There are two primary methods for calculating a Procrustes (GLS) superposition, one based on Sneath (1967) and the other developed by Gower (1971). I'm going to base my presentation of the technique on Sneath's approach because it employs simpler mathematics. Readers interested in a full treatment of algorithms and options should consult Rohlf and Slice (1990) or Gower and Dijksterhuis (2004). Remember, what we're after with this operation is a superposition of landmark datasets that aligns their position, their size, and orients them rigidly such that the sum of the squared differences between corresponding landmarks is minimized. Accordingly, it's best to think of the mathematical procedure as involving three discrete steps.

Step 1: *Alignment of position (translation)*
Obviously the two triangles in Fig. 1 occupy different positions on the page. Therefore, the first step in their superposition is to get them into the same place, one on top of the other. Since we must assume that each landmark represents a localized region of shape variability, it's not appropriate to use any of the landmarks as a basis for this superposition. That being the case, we need some other 'fixed point' we can use to achieve standardization via translation.

In the original formulation of theta-rho analysis, Benson used a landmark that represented the location of a homologous feature located in the vicinity of the ostracode carapace's centre as this fixed point. If such a feature—that could be represented by a single point—existed in the set of specimens you were analyzing this might be a reasonable choice, depending on the morphological hypothesis under consideration. However, in our set of trilobite pygidia no such feature exists. Moreover, from a purely geometric point of view, the selection of a feature unrelated to the geometry of the landmark points themselves will always result in a sub-optimal alignment, at least in a mathematical sense. In most cases the best point to use to achieve standardization via translation is the mean of all landmarks within each dataset, otherwise known as the dataset's centre or centroid. You can use the following simple equations to calculate the x,y coordinates of the centroid of any set of landmark data.

$$\bar{x} = \sum_{i=1}^{m} x_i \Big/ m \quad , \quad \bar{y} = \sum_{i=1}^{m} y_i \Big/ m \tag{16.1}$$

In these equations m is the number of landmarks in the dataset. Once the centroid has been determined the set of landmarks can be rigidly shifted such that the centroid occupies the origin of a common x,y coordinate system by subtracting the mean values of x and y from each landmark coordinate.

$$\begin{aligned} xtrans_i &= x_i - \bar{x} \\ ytrans_i &= y_i - \bar{y} \end{aligned} \tag{16.2}$$

When this operation has been completed for the example pygidia data, a plot of the translated coordinates will look as in Fig. 2 (overleaf).

Step 2: *Alignment of size (scaling)*
The next step involves bringing the two sets of landmarks into alignment by removing the effect of size differences. As we discussed last time, the standard size metric used throughout geometric morphometrics is centroid size. While there are a number of different formulations of centroid size we could use, we're going to adopt the 'industry standard', root centroid size index (*RCS*, see MacLeod 2008).

$$RCS = \sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2 + (y_i - \bar{y})^2} \tag{16.3}$$

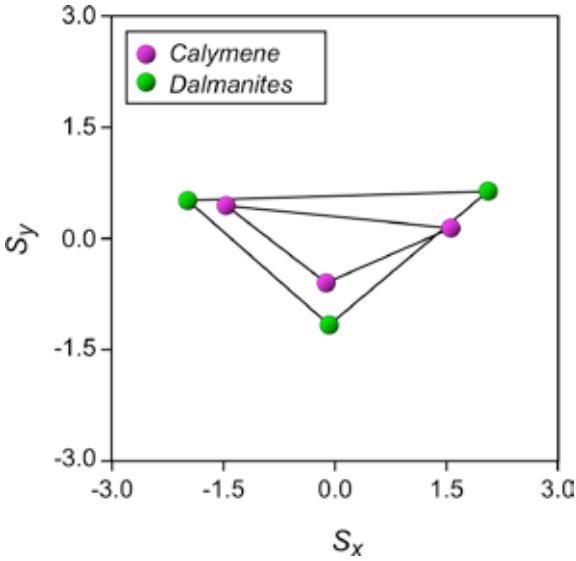

Figure 2. Trilobite pygidial landmark sets after translation via superimposition of their centroids. Note that the centroids of each dataset have been placed at the origin of the coordinate system.

Application of this formula to the *Calymene* and *Dalmanites* datasets yields RCS values of 2.28 and 3.20 respectively. These values can then be used to rigidly scale each landmark dataset to a common size, the most convenient of which is the unit value ($RCS = 1.0$). To perform this operation each x and y coordinate value is divided by the RCS value for the landmark configuration as a whole.

$$\begin{aligned} xscaled_i &= xtrans_i / RCS \\ yscaled_i &= ytrans_i / RCS \end{aligned} \qquad (16.4)$$

When this scaling operation has been completed for the example pygidia data, a plot of the translated coordinates will look as in Fig. 3.

Step 3: *Alignment of orientation (rotation)*
The final step in the Procrustes (GLS) superposition procedure involves rigidly rotating the landmark configurations about their centroids to obtain the best possible fit between corresponding landmark positions. For the initial rotational alignment it's convenient to think of one configuration as the target (*T*) and the other as the configuration that is being rotated (*R*) to an orientation of maximum shape correspondence with respect to the target. For the purposes of our example I'll designate the *Calymene* dataset as the *T* configuration and the *Dalmanites* as the *R*.

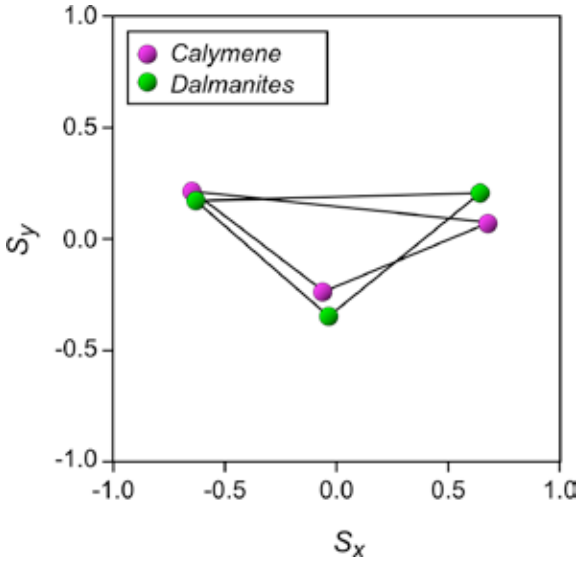

Figure 3. Trilobite pygidial landmark sets after translation via scaling to unit RCS. *Note the change in the scale of the axes. The shape space is now scaled to* RCS *units.*

Sneath (1967) provides the following equation to calculate the optimal angle through which to rotate the *R* configuration to match the *T*.

$$\theta = \arctan\left(\frac{\sum_{i=1}^{m} y_{Ti}x_{Ri} - x_{Ti}y_{Ri}}{\sum_{i=1}^{m} x_{Ti}x_{Ri} + y_{Ti}y_{Ri}}\right) \quad (16.5)$$

Once again, in this equation m is the number of landmarks in the dataset.

There are a couple of things to note about using this equation. First, most software systems will express the arctangent of this ratio in terms of radians rather than degrees. If you want to know how many degrees you are rotating the *R* configuration through, you'll need to convert the radians to degrees. It's an easy conversion (see the *PalaeoMath 101-2* spreadsheet for an example in MS-Excel).

Also, both Sneath (1967) and Rohlf & Slice (1990) recommend performing the calculation twice, once using the coordinate values determined by the scaling operation, and a second time after reflecting one configuration (usually the *R* configuration) across the x-axis. This is a convention derived from generalized Procrustes analysis in which there is no necessary correspondence between individual points in the two datasets. It makes no sense in terms of geometric morphometrics as the reflection would result in mismatching landmark coordinates. Regardless,

the fit achieved by the *Dalmanites* data after reflection is notably inferior to the fit achieved by the two datasets in their standard (= correct) configuration (see the *PalaeoMath 101-2* spreadsheet for details). The resulting Procrustes (GLS) fit between the two triangles is shown in Figure 4.

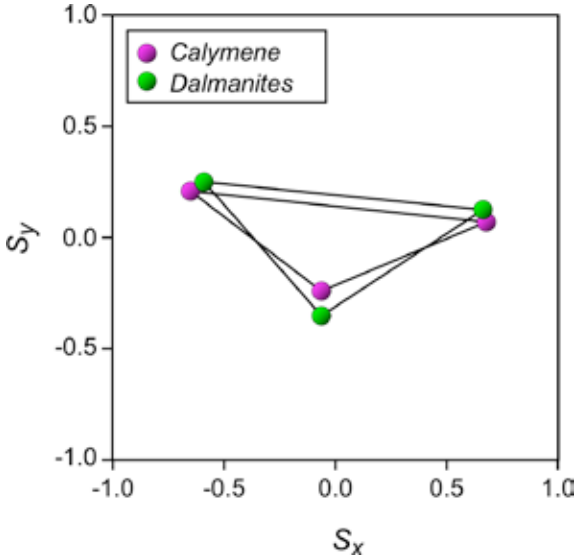

Figure 4. Trilobite pygidial landmark datasets after rigid rotation to minimize the sum of squared distances between corresponding landmarks. Note the space remains scaled to RCS *units. The rotation angle specified by the GLS calculations was -7.20° (CCW).*

Comparing Figure 4 to the results of the BSC alignment (Fig. 3 of MacLeod 2008) shows the effect of the distortion induced by baseline registration. By forcing all shape variation onto landmark 3 (posterior tip of the pygidia), shape distinctions in that region were grossly exaggerated. Specifically, the amount of pygidial elongation of the *Dalmanites* specimen relative to the *Calymene* specimen was reduced under Procrustes (GLS) alignment, revealing a potentially important pygidial narrowing of the former relative to the latter. Of course, this narrowing of the *Dalmanites* pygidium was entirely obscured by the BSC analysis because landmarks 1 and 2 were used to define the baseline.

In a routine Procrustes (GLS) analysis the rotational alignment to a target configuration (usually the first specimen in a dataset) is the first stage of an iterative search for the optimal rotational alignment over all the shapes comprising the dataset. Once this first stage has been completed, a mean configuration is calculated for all landmarks and this mean shape used as the target to which all other shapes are rotationally aligned in the second rotation cycle. Once this second cycle is complete the mean shape is re-estimated and another rotational alignment cycle conducted until the change in the fit achieved by this re-estimation procedure falls below a pre-set tolerance value. In practice, though, it is unusual for the estimation procedure to need to proceed beyond 2–3 rotational cycles.

Triangles are fun, but now let's see what Procrustes (GLS) superposition can tell us about our 18 trilobite cranidia. Recall last time we used six landmarks to assess shape variation over this structure (Fig. 5), with landmarks 1–4 representing the means of landmarks located on both sides of the mid-line after reflection of the right-side landmarks across the mid-line. This averaging operation removes left–right asymmetry from the landmark data. However, under the BSC approach we were only able to focus on the shape information provided by landmarks 1–4, as landmarks 5 and 6 were needed to define the BSC baseline.

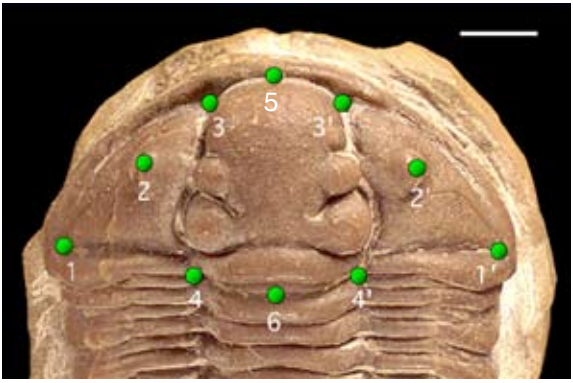

Figure 5. Landmarks used to quantify shape variation in the trilobite cranidium. Scale bar = 7.87 mm. 1: apex of the posterior lateral projection. 2: centroid of the eye location. 3: intersection of the glabellar margin with the posterior-lateral boundary of the pre-glabellar area. 4: intersection between the proximal posterior boundary of the posterior lateral projection and the posterior lateral margin of the glabella. 5: anterior mid-line terminus. 6: posterior mid-line terminus. In the superposition procedure both left and right-side landmarks were used together to achieve an overall Procrustes (GLS) alignment. The right-side aligned landmarks were then reflected across the mid-line and averaged with their left-side counterparts.

Given the taxonomic diversity of this dataset, and given the broad discrepancies in cranidial shape suggested by the comparison of Bookstein shape coordinates (see MacLeod 2008, Fig. 9), the tightness and aspects of the form of the Procrustes (GLS) superposed landmark clusters, as seen in Figure 6, may come as something of a surprise.

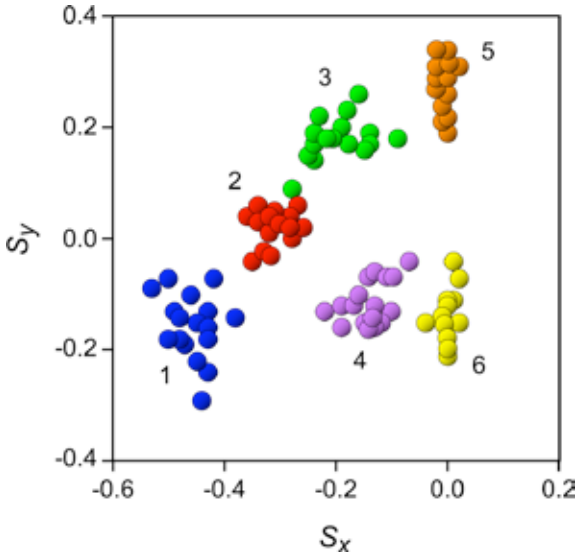

Figure 6. Results of a Procrustes (GLS) superposition of the six cranidial landmarks shown in Fig. 5. Points belonging to corresponding landmarks in each configuration set have been colour-coded for clarity. These data represent mean positions from analogous landmarks on the right and left sides of the cranidia that have been reflected across the cranidial mid-line (landmarks 5 and 6). Note the well-constrained nature of all landmark clusters along with the relatively small number shape outliers. This is a very different picture of shape variation in these data than that suggested by the calculation of Bookstein shape coordinates (see MacLeod 2008, Fig. 9).

In addition to the improved resolution gained as a result of being able to include all landmarks in the assessment of shape variation, note that each landmark location exhibits approximately the same range of variation. Some clusters are a bit larger than the others (*e.g.*, Landmark 1 *vs.* Landmark 2), but all are remarkably similar.[2] This result stands in stark contrast to that obtained from the Bookstein shape coordinates (MacLeod 2008, Fig. 9) in which there was a marked tendency for landmarks located further away from the baseline to exhibit a greater degree of variation. This bias toward the artificial inducement of large amounts of variation in landmarks located distal to the baseline is related to the Bookstein method's transference of shape variation from the baseline landmarks. Indeed, the difference between Figure 6 of this essay and Figure 9 of the previous essay constitutes a rather dramatic demonstration of the degree to which the BSC space is distorted relative to the Procrustes (GLS) shape coordinate space. But does this make a difference to the subsequent analysis of shape variation using these data? Let's use a PCA of the Procrustes (GLS) superposed coordinates to find out.

[2] Clusters of points assigned to landmarks 5 and 6 are strung out along the cranidial midline as a consequence of using the entire (left and right) landmark sets in the original GLS superposition, prior to left–right landmark reflection and averaging to achieve a consensus representation of inter-cranidial shape variation.

Table 2. Eigenvalues of PCA of GLS superposed coordinates.

Principal Component	Eigenvalue	Variance (%)	Cumulative Variance (%)
1	0.00596	35.84	35.84
2	0.00452	27.18	63.02
3	0.00310	18.64	81.66
4	0.00118	7.10	88.76
5	0.00080	4.81	93.57
6	0.00045	2.71	96.27
7	0.00036	2.16	98.44
8	0.00026	1.56	100.00
9	–	–	–
10	–	–	–
11	–	–	–
12	–	–	–

The first thing to note is that, unlike the PCA analysis of other variable types, use of PCA to analyze GLS superposed shape coordinate data results in a lower than expected number of non-zero eigenvalues. In this example we might have expected to see a 12-axis PCA solution when, in point of fact, there are only eight effectively non-zero eigenvalues.[3] This results from the various standardizations undertaken as part of the GLS superposition procedure. Two dimensions of variation are lost through standardization for the landmark configuration centroids, and another two as a result of the scaling and rotation standardizations. This loss of information will have implications for the statistical analysis of GLS superposed data that I'll discuss in future columns.

In addition to this you'll notice that the sequence of eigenvalue relative magnitudes (seen best in the Variance (%) and Cumulative Variance (%) columns of Table 2) are not as extreme as the values we've seen before. This is a consequence of removing positional, scaling and rotational sources of variation from the dataset and use of the mean shape as the final target for Procrustes (GLS) superposition.

Other than these qualitative differences, the interpretation of the eigenvector table of a PCA of Procrustes (GLS) superposed data is no different than interpretation of this table for any PCA analysis. For these data the first three components each account for more than 10% of the observed shape variation and the first six components account for 95% of the total shape variation observed. For graphical simplicity we'll look at only the first three components in detail.

[3] The eigenvalues associated with axes 9–12 are not 0.00, but very small numbers (c. $< 10^{-8}$).

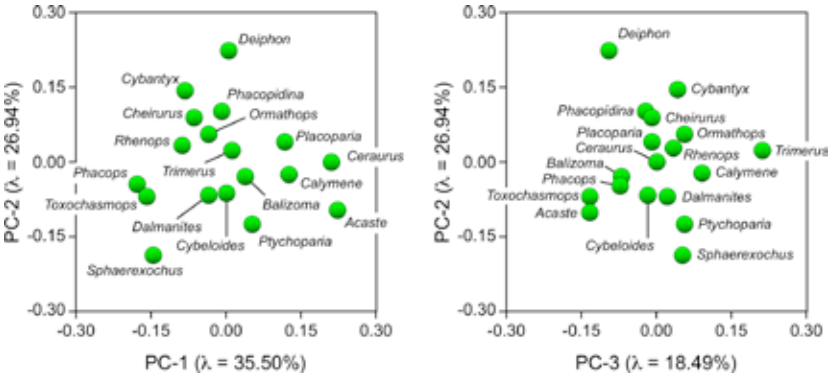

Figure 7. Scatter plots of cranidial GLS superposed landmark data in the space of the first three convariance-based principal components. See text for discussion.

Comparison of the Procrustes (GLS)-PCA scatterplots (Fig. 7) with the BSC-PCA scatterplots from the previous essay (MacLeod 2008, Fig. 8) is instructive. Whereas the overall range of shape variance has been reduced through use of Procrustes (GLS) superposition, shape relationships within the dataset are much more clearly resolved. To some extent this improved resolution results from the ability to sense shape variation at all landmarks as well as the lack of systematic bias in the assignment of shape variation to landmarks based on their proximity to the BSC baseline. For this particular group of trilobites, whereas the broad distinctions between *Acaste*, *Calymene* and *Ceraurus* with respect to *Toxochasmops* and *Phacops* (both of which were identified by the previous BSC-PCA analysis as the most prominent distinctions within the dataset) were confirmed by the Procrustes (GLS) approach, *Trimerus* has now moved to a central position within the overall shape distribution. Along PC-2 and PC-3 the re-orderings are even greater. The group of taxa (including *Cybantyx*, *Cheirurus*, *Ormathops*, *Placopidina*, *Deiphon* and *Rhenops*) that had previously shown a very strong shape similarity on both PC-1 and PC-2 axes has exploded in the Procrustes (GLS) shape space to occupy the entire region along the higher reaches of PC-2 and PC-3. This increase in shape variation makes similarity relations between this subset of forms much easier to assess and interpret.

Table 3. Procrustes (GLS) loadings for the first three covariance-based PC axes.

Shape Coords	PC-1	PC-2	PC-3
1x	0.318	-0.308	-0.148
1y	-0.593	-0.519	0.171
2x	0.166	0.096	-0.315
2y	0.087	0.036	-0.131
3x	-0.382	0.468	-0.390
3y	0.014	0.204	-0.504
4x	-0.079	0.276	0.340
4y	0.086	0.383	0.378
5x	-0.028	-0.053	-0.003
5y	0.438	-0.319	-0.185
6x	0.035	0.068	-0.003
6y	0.398	0.180	0.367

As we've seen before, a geometric interpretation of the PC space can be made via inspection of the PC axis loading coefficient table (Table 3). The PC-1 axis represents a shape change trend dominantly involving landmarks 1, 3, 5 and 6 (see Fig. 5 for landmark locations and definitions). Taking the signs of the loadings into account, landmark 1 moves laterally and anteriorly relative to the centroid along the positive portion of PC-1, effectively shortening the lateral aspect of the cranidia anterio-posteriorly and having the reverse effect along the negative portion of that axis. Landmark 5 shifts anteriorly relative to other landmarks and landmark 6 shifts posteriorly, but both move at a lower rate than the forward migration of landmark 1. Geometrically, this means the lateral portion of the cranidium migrates forward relative to the mid-line, resulting in an overall sweeping of the lateral landmarks forward as one moves in a positive direction along the PC-1 axis and backward as one moves in a negative direction. In addition to this, landmark 3 moves closer to the mid-line as the shape space location changes in a positive direction along PC-1 and further away from the mid-line as it changes in a negative direction. This interpretation is confirmed by inspecting the shape coordinate configurations for genera that scatter along the PC-1 axis (*e.g.*, compare landmark distributions for *Rhenops* with *Ceraurus* in the *PalaeoMath 101-2* spreadsheet).

The PC-2 axis represents a contrast between shape changes in the lateral margin of the cranidia (landmark 1) and in the glabella (landmarks 3 and 4). Here landmark 1 moves closer to the mid-line and forward along the positive portion of PC-2, reversing this trend along the negative portion. At the same time, the high and uniformly positive loadings on landmarks 3 and 4 indicate that the glabella expands outward from the centroid as the shape space location changes in a positive direction along PC-2 with a differentially large lateral expansion in the anterior sector (landmark 3x) and a differentially large posterior-ward migration in the posterior sector (landmark 4y). In addition to this, the entire mid-line shifts backward relative to the other landmarks slightly, but at a lower rate than forward migration of the lateral landmarks (1y) and the expansion outward of the glabellar landmarks. This interpretation can be confirmed by inspecting the shape coordinate configurations for genera that scatter along the PC-2 axis (*e.g.*, compare landmark distributions for *Balizoma* with *Deiphon* in the *PalaeoMath 101-2* spreadsheet).

Finally, the PC-3 axis primarily represents a differential anterior contraction (landmarks 3x and 3y) and posterior expansion (landmarks 4x, 4y and 6y) of the glabella along the positive portion of the PC-3 axis, with this shape change trend reversing polarity along the negative portion. Accompanying this bulging out of the posterior glabella there is a pronounced relative migration of the lateral landmarks (1x, 1y) toward the mid-line and forward as signalled by the difference in the shape changes specified for landmarks 1, 3, 4 and 6. These shape trends are reversed along the negative portion of the PC-3 axis and the overall interpretation confirmed by inspection for genera that scatter along the PC-3 axis (*e.g.*, compare landmark distributions for *Balizoma* or *Toxochasmops* with *Trimerus* in the *PalaeoMath 101-2* spreadsheet).

I'll have more to say about Procrustes (GLS) superposition in the next essay, which will deal with shape theory. That essay will explain, at long last, what the morphometric synthesis was all about and why the direct analysis of landmarks improves our ability to make interpretations of shape and shape change with confidence. But I don't want to leave you with the impression that the

Procrustes (GLS) approach to superposition can solve all the interesting problems in comparative morphology. As a last, brief, example consider the following two forms (Fig. 8).

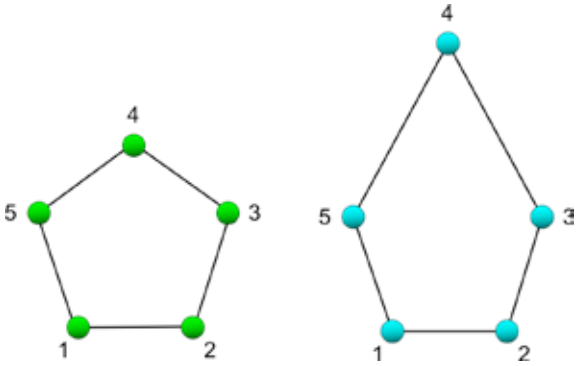

Figure 8. landmark configurations illustrating the 'Pinocchio Effect'.

Obviously the figure on the left is a pentagon with landmarks at the figure's vertices. The figure on the right is the same pentagon, but one I've deformed by increasing the height of the apical landmark (4). What will happen when we try the Procrustes (GLS) approach on these figures? Since we know there is absolutely no difference in the relative positions of landmarks 1, 2, 3 and 5, we'd like to see a superposition configuration that overlays these landmarks and identifies landmark 4 as the odd one out. However when we apply the Procrustes (GLS) algorithm …

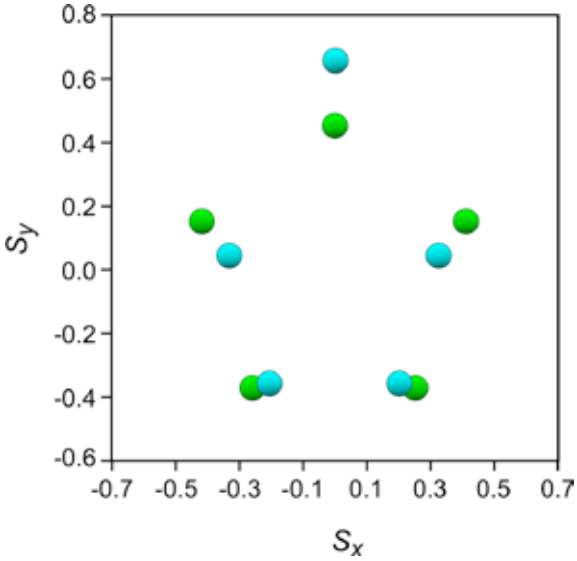

Figure 9. Procrustes (GLS) superposition of the landmark coordinates shown in Fig. 8 illustrating the 'Pinocchio Effect'.

As you can see (and as you probably already guessed), the Procrustes (GLS) algorithm will not handle this situation as we might like. In the jargon of morphometrics this is called the "Pinocchio Effect" after the wooden boy whose nose (but no other body part) grew every time he told a lie. If we have reason to believe a landmark dataset contains a Pinocchio Effect we may not want to use Procrustes (GLS) superposition, as that algorithm will try to partition the overall shape variation over all landmarks once the effects of translation and scaling have been removed. Of course, in this particular example we could resolve the problem quite easily by opting to use Bookstein shape coordinates and selecting two landmarks from among the invariant set to define the baseline. For situations in which you suspect a Pinocchio Effect might exist, but you have no idea where the invariant parts of the form are (and don't feel you have time to conduct any exploratory experiments), there is an alternative form of Procrustes superposition: Resistant Fit Theta-Rho Analysis (RFTRA; see Siegel and Benson, 1982 for the original description, or Rohlf and Slice, 1990 for a more compact algorithm). The Procrustes (RFTRA) method uses an iterative approach to find the relatively invariant landmarks and arrive at a solution that (1) minimizes positional differences between subsets of landmark locations that are similar in position and (2) maximizes differences between subsets of landmarks whose positions differ. This having been said, Procrustes (RFTRA) usually offers only a partial solution that minimizes the overall Pinocchio Effect, but rarely eliminates it entirely.

In terms of software, there are a reasonable number of programs available for implementing a Procrustes (GLS) superposition. Jim Rohlf's Stony Brook (SB) Morphometrics website (<**http://life.bio.sunysb.edu/morph/**>) lists several, including continuously updated versions of Jim's own software. I've implemented the basic steps in the Sneath version of GLS superposition in this essay's *PalaeoMath 101-2* spreadsheet and have developed *Mathematica* routines for performing either Sneath-style or Gower-style Procrustes (GLS) variants. Other, commercial software packages also include Procrustes analysis options and not just in statistical and/or numerical analysis software. Indeed, Procrustes algorithms figure prominently in many 3D data manipulation packages under the guise of registration tools. As usual, it's best to check the user's guide or the software's technical support guru for advice on exactly what algorithm has been implemented and what range of options have been designed into any software package you are considering for use on your data.

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

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

Meeting REPORTS

III Latin-American Congress on Vertebrate Paleontology
Centro Paleontológico Lago Barreales, Neuquén, Argentina
21 – 25 September 2008

The **III Latin-American Vertebrate Paleontology Congress** took place in the middle of the Patagonian desert, a place where giant dinosaurs were recovered from Cretaceous rocks. 309 participants attended from around the world. The weather was the most unusual thing that happened during the Congress. Spring is typically cold, windy with some rain; instead of that, the sun shone every day providing a warm climate more characteristic of the Summer. It seems that after 90 millions years the dinosaurs were waiting for the palaeontologists to visit the Patagonia Desert paradise!

The Congress included an extra bonus field trip, one inter-congress trip to the Villa El Chocón locality, where the largest carnivorous dinosaur lie, and one post-congress trip to Barreales Lake, where a most amazing Cretaceous palaeoecological site was recently discovered. The Congress was held at the **Neuquén Convention Center**; a 3,000 square metre building which contains six spacious rooms. All these rooms were used for this meeting and were decorated with plants, curtains, lights of different colours *etc* to make the place for a special science party. The giant Futalognko room housed the newest 7 metre long cast of *Megaraptor namunhuaiquii*; the exhibition of more than 100 paintings, sculptures and 3D reproductions made by 15 palaeoartists; and more than 135 posters displayed from the beginning of the Congress. Opening and closing ceremonies were also held in this room. The Neuquén room served as a meeting place during breaks for colleagues, who were able to enjoy a delicious variety of foods (salty and sweet), fruits, and beverages. The *Megaraptor* room was dedicated to the General Oral Sessions and the *Unenlagia* and

Macrogryphosaurus rooms were used for the symposia. The new Lago Barreales room was dedicated to a special coffee room session, proposed by **Claudia Tambussi** (La Plata Museum), where groups of researchers could work on special issues of difficult resolution. It was built as a calm environment with the sound of a waterfall, light colours, curtains, armchairs *etc.*

Since it was one of the largest vertebrate palaeontology congresses held in South America – in terms of size, fieldtrips included, number of researchers, international conferences and number of abstracts presented – the work for the organizing committee was enormous. 276 abstracts were received. Half of these were distributed in the poster session and the other half in the oral session. Present at the opening ceremony were the president of the Congress, **Dr Jorge O. Calvo**, the Major of the National University of Comahue, **Dra. Teresa Vega**, and the Vice-Governor of the Neuquén Province, **Dra. Ana María Pechen**. A final concert was given by 70 boys and girls from the Neuquén cultural orchestra.

We invited 17 specialists of different areas of study to give talks. They were included in the schedule between the oral sessions throughout the four days. **Bernardo Gonzalez Riga** (Cricyt, Arg) was the first and he talked about the evolution of titanosaurid sauropods. **Francisco Goin** (La Plata Museum, Arg) presented advances in the knowledge of the Paleogene radiations of marsupials. **Stephen Wroe** (University of New South Wales) reconstructed behaviour in fossil taxa using computational biomechanics. Finally, late in the first day, **Guillermo Rougier** (University of Louisville) talked about the evolution and biogeography of Mesozoic mammals from South America. On Tuesday, **Saswati Brandyopadhyay** (Indian Statistical Institute) showed us the non-marine Triassic vertebrates of India, followed by **James Clark** (George Washington University) who talked about the surprising abundance and diversity of shartegosuchid crocodylomorphs. During the afternoon, **Michael Woodburne** (Museum of Northern Arizona) reviewed the Great American Biotic interchange, followed after lunch by **Paulo Brito** (University of Rio de Janeiro State) with the systematic importance and palaeobiogeographic interpretations of fossils fish from the Cretaceous of South America. During the evening, **Nathalie Bardet** (National Museum of Natural History, France) talked about the marine reptile faunas from the phosphates of the late Cretaceous–Palaeogene of Morocco. Early on Wednesday, **Christopher Brochu** (University of Iowa) showed South America in the global context of Cenozoic crocodylomorph historical biogeography, followed by **Luis Alcala** (Conjunto Paleontológico Teruel-Dinópolis Foundation) who presented a model of regional development based on palaeontological resources. Before lunch, **Bienvenido Martinez Navarro** (ICREA-IPHES) talked about scavengers, hyenas and hominids, and the ecology of the first human migrations out of Africa. Finally, the fourth day included the presentation of **Oliver Rauhut** (Bayerische Staatssammlung für Paläontologie) about Cretaceous theropods of Africa: diversity, faunal compositions, stratigraphic distribution and palaeobiogeographic relationships; followed by **Michael Caldwell** (University of Alberta) who made a review about snakes, major transitions and the problems of constructing scenarios of their origins. Before lunch, **Sebastian Apesteguia** (Maimónides University) talked about fragments of lepidosaur evolutionary history in South America, followed by **Ana Maria Baez** (National University of Buenos Aires) with a temporal frame of the radiation of anuran neobatracios. The last conference was given by **Fernando Novas** (National Museum of Natural Science) on Cretaceous coelurosaurian theropods from Gondwana.

The congress included 123 oral talks. The General Session was given mainly in the *Megaraptor* room where 44 researchers presented studies of different groups of vertebrates.

Alexandre Liparini (Federal University of Rio Grande do Sul) talked about intercranial mobility in rauisuchids using 3D images. **Leonora Salvadores-Cerda** (Austral University of Chile) described new coprolite materials from Pleistocene mammals of Chile. After the break, **Alejandro Kramarz** (Argentine Museum of Natural Science) presented data on the skull of *Astraponotus* (Mammalia, Astrapotheria) with considerations on astrapothere cranial evolution. **Renato Lopes** (Zoo Botanic Foundation of Rio Grande do Sul) worked on the geological and biostratigraphical context of fossil deposits of Rio Grande do Sul, Brazil. **Fabio Machado** (Zoology Museum of Sao Pablo University) used statistical data for correcting diagenetic deformations in fossil eggs. **Amalia Villafañe** (National Science Museum PUC Minas) described a new Miocene fossiliferous locality in Chubut province, Argentina. **Francois Pujos** (CRICYT) reported deseadan sloths from Quebrada Fiera, Mendoza Province, Argentina. **Martín Chávez** (Austral University of Chile) described the taphonomic properties of the ornithofauna from the Bahía Inglesa Formation, Atacama, Chile. **Yamila Gurovich** (University of New South Wales) spoke about the higher-level relationships of the enigmatic mammalian clade Gondwanatheria. **Darin Croft** (Case Western Reserve University) described a new early/middle Miocene fauna from southern Bolivia. **Martín Ciancio** (La Plata Museum) described changes in the morphology of dasypodid osteoderms. **Enrique Bostelmann** (National Museum of Natural History and Anthropology, Uruguay) presented the discovery of a dinomyid skull (Mammalia, Rodentia) from the Miocene of Uruguay. **Mariano Bond** (La Plata Museum) spoke about a new *Carodnia*-like xenungulate (Mammalia) from the Palaeogene of Patagonia, Argentina. **Rodrigo Tomassini** (National University del Sur) described a complex system of caves in the Monte Hermoso Formation (Pliocene), Argentina. **Guillermo López** questioned the age of the divisaderan fauna. **Bianca Mastrantonio** (Federal University of Rio Grande do Sul) showed a new rauisuchid from the Triassic of Santa Maria Formation, Brazil. **Martín Ezcurra** (Argentine Museum of Natural Science) described a new early dinosaur from the Carnian Ischigulasto Formation (NW Argentina) and interpreted the origin of dinosaurs. **Luciano Leal** (Regiao da Campanha University) described the Brazilian 'prosauropod' *Unaysaurus tolentinoi* (Sauropodomorpha, Plateosauridae) and basal sauropodomorph relationships.

Following the afternoon break, a talk was presented by **Ricardo Martínez** on a new basal theropod from the Ischigualasto Formation of San Juan province, Argentina. Next, **Katrin Moser** (Bayerische Staatssammlung für Paläontologie und Geologie) spoke on locomotion and feeding behaviour of *Plateosaurus* based on a morphofunctional analysis of the presacral vertebral column. This was followed by **Alejandro Haluza** (El Chocon Museum) on new rebbachisaurid (Sauropoda, Diplodocoidea) materials from el Chocón, with a hypothesis of the homology of the spinodiapophyseal laminae in Diplodocoidea. **Leonardo Morato** (Federal University of Rio de Janeiro) spoke on the origin of dinosaurs and the conquest of the sky: learning about Mesozoic vertebrate history through strategy board games. **Octavio Mateus** (New University of Lisboa) gave a review on dinosaurs and turtles from the Turonian of Iembe, Angola. **Fernando Escaso** (Autonoma University from Madrid) described new material of *Stegosaurus* from the Lourinhã Group (Jurassic) of Portugal. **Octavio Mateus** (again) spoke on a new specimen of aff. *Dacentrurus armatus* (Dinosauria, Stegosauridae) from the Upper Jurassic of Portugal. **Leandro Gaetano** (National University of Buenos Aires) described the phylogeny and biogeography of the Middle Jurassic triconodont *Argentoconodon fariasorum*. **Alexander Kellner** (Federal University of Rio de Janeiro) reviewed pterosaurs. **Taisa Rodrigues** (Federal University of Rio de Janeiro) spoke on the taxonomy of *Anhanguera araripensis* (Pterosauria, Pterodactyloidea). **Laura Codorniú** (National University of San

Luis) presented new osteological evidences of *Pterodaustro guinazui* (Pterosauria, Pterodactyloidea) from San Luis, Argentina. **Fabiana Costa** (Federal University of Rio de Janeiro) compared two pterosaur humeri from the Tendaguru beds (Upper Jurassic, Tanzania). **Juan Cisneros** (Federal University of Rio Grande do Sul) talked about Permian vertebrates from the Rio do Rasto Formation, Rio Grande do Sur, Brazil; **Ana Figueiredo** (Federal University of Rio Grande do Sul) described a new locality with fossil fish in the Rio do Rasto Formation, Brazil. **Javier Gelfo** (La Plata Museum) showed the relationships and implications of a new didolodontid (Mammalia) from the early Palaeogene of Laguna Umayo, Peru. **Germán Montoya** Sanhueza (Concepción University) described new fossil material of Miocene mammals from the Caragua locality, Chile. **Adan Tauber** (National University of Córdoba) showed materials of *Scelidodon ameghino* (Tardigrada, Scelidotheriinae) from Córdoba, Argentina. **Pablo Toriño** (Republic University, Uruguay) reviewed the Tertiary glyptodontids from Uruguay: Glyptatelinae, Doedicurinae, Glyptodontinae and Hoplophorinae. **Monalise Cruz** (Federal University of Rio de Janeiro) talked about *Eremotherium laurillardi* (Xenarthra, Megatheriidae) with taphonomic considerations based on specimens from Pernambuco state, Brazil. Finally, **Enrique Bostelmann** (National Museum of Natural History and Anthropology, Uruguay) reviewed the Eutatini (Mammalia, Dasypodidae) from Uruguay.

Nine symposia took place during the Congress in the *Macrogryphosaurus* and *Unenlagia* rooms.

The Symposium *Snakes, turtles and frogs: clue studies for resolving problems about phylogeny and origin* took place on Monday and Thursday in the *Macrogryphosaurus* room. It was convened by **Michael Caldwell** and a complete range of topics were covered. **Randall Nydam** (Midwestern University) spoke about a Laurasian versus Gondwanan origin of the Teiioidea. **Carlos Scanferla** (Argentine Natural Science Museum) described the process that affected skeletal development in the Cretaceous snake *Dynilisia patagonica*. **Sebastian Apesteguía** (Maimonides University) described a new sphenodontid from the Cretaceous of Chubut province and the distribution of eilenodontines. **Raúl Gómez** (National University of Buenos Aires) talked about a singular anurofauna from the Lower Cretaceous Crato Formation. **Laura Nicoli** (National University of Buenos Aires) introduced the early history of frogs based on new discoveries from the Jurassic of Patagonia. **Paula Muzzopappa** (National University of Buenos Aires) spoke on new evidence for the evolution of *Calyptocephalella* (Anura, Neobatrachia). **David Marjanovic** (Paris University) recognized the monophyletic origin during the Permian of Lissamphibia, dated by three techniques. **Rueda Cadena** (Florida Museum of Natural History) used Palaeocene neotropical turtles to determine phylogeny, palaeobiogeography and palaeoclimate. **Gustavo Oliveira** (Federal University of Rio de Janeiro) reported a new pelomedusoid turtle from Barreales Lake, Neuquén, Patagonia, Argentina. **Juliana Sterli** (Natural History Museum of San Rafael) presented a series of changes in the skull anatomy in turtles that could be related with the appearance of the 'pulley system' of modern turtles. Finally, **Santiago Brizuela** (National University of Mar del Plata), made a preliminary re-description of the fossil lizard *Callopistes bicuspidatus*.

The symposium *Evolution of crocodyliforms: diversity and phylogenetic relationships* was the largest symposium according to the number of presentations (convenors: **Diego Pol** and **Lucas Fiorelli**). On Monday, the first session, after the morning break, included five talks. **Martín Ezcurra** (Argentine Museum of National History) began with a review of the archosaur *Trialestes romeri* (Suchia, Crocodylomorpha) from the Upper Triassic Ischigualasto Formation of Argentina. **Patrick O'Connor** (Ohio University) described a new notosuchian crocodyliform from the Galula Formation of southwestern Tanzania. **Rodrigo Figueiredo** (Federal University of Rio Grande do Sul) presented a new notosuchian crocodylomorph from the Upper Cretaceous deposits of the Bauru basin, Brazil. **Matías Soto** (Facultad de Ciencias, Uruguay) described a new specimen of *Uruguaysuchus aznarezi*. **Gabriel Lio** (Maimónides University) reported a new large-sized *Araripesuchus* from "La Buitrera" (Cenomanian-Turonian) of Río Negro, Argentina. The last talk of the morning session was made by **Andrea Arcucci** (National University of San Luis), who presented new information about a new Cretaceous crocodyliform from Neuquén, Argentina.

On Tuesday morning, the crocodyliform symposium continued with several talks. **Paulo Nascimento** (Sao Paulo University) made an approach to the family Baurusuchidae, while **Felipe Vasconcellos** (Federal University of Rio de Janeiro) interpreted *Baurusuchus* as a cursorial predator based on the pelvic girdle and hindlimbs. **Alexander Kellner** (National Museum of Rio de Janeiro) analyzed the phylogeny of Mesoeucrocodylia, based on the appendicular anatomy of *Stratiotosuchus maxhechti*. **Uiara Cabral** (Federal University of Rio de Janeiro) made a preliminary analysis of pathological features in *Stratiotosuchus maxhechti*, and **Diego Pol** (Trelew Museum) presented a new sebecid crocodyliform from the Río Loro Formation, Northwestern Argentina.

The final session was on Wednesday morning. **Paul Sereno** (University of Chicago) impressed the audience with a new sabre-toothed crocodyliform from the Cenomanian (Echkar Formation) of Niger. **Marco Andrade** (University of Bristol) described a new specimen of *Goniopholis* from the Intermarine Member (Berriasian, Lower Cretaceous) of Durlston Bay, England. **Alan Turner** (Stony Brook University) spoke on the evolutionary origins of Eusuchia based on the "eusuchian"-style palate. Finally, **Angela Buscalioni** (Autónoma University of Madrid) described morphometric insights into the morphological organization of Eusuchia (Crocodylomorpha).

The Symposium *Evolution of Cenozoic South American metatheres* (Convenor, **Francisco Goin**) was on Monday afternoon in the *Macrogryphosaurus* room and included several talks. **María Abello** (National University of La Plata) tested a new phylogenetic hypothesis of the Paucituberculata (Mammalia, Marsupialia). **Laura Chornogubsky** (National Museum of Buenos Aires) presented the most ancient fauna of Polydolopinae known, from the las Flores Formation (Palaeocene–Eocene) of Chubut, Argentina. **Analía Forasiepi** (Natural History Museum of San Rafael) spoke about the carnivorous Metatheres from the Tertiary of South America. **Yamila Gurovich** (New South Wales University) presented the evolution and diversity of fossil bandicoots (Peramelemorphia,

Marsupialia) from the Oligo–Miocene of Australia. **Natalia Zimicz** (La Plata Museum) described the results of palaeoecological studies of Cenozoic marsupials of South America. Finally, **Francisco Goin** (La Plata Museum) gave a review on the actual knowledge of diversity and evolution of Bonapartheriiformes and "Didelphimorphia" marsupials.

The Symposium *The Great American biotic interchange: systematic, evolutionary, palaeobiogeographic and palaeogeographic aspects* took place in the *Macrogryphosaurus* room on Tuesday afternoon (Convenor: **Alfredo Carlini**). It began with **Ulises Pardiñas** (National Patagonic Center) showing evidences of the last tardigrade (Mammalia, Xenarthra) from Patagonia. **Sauthier Udrizar** (National Patagonic Center) presented studies on the last Holocene extinctions in Patagonia. **Edwin Guarda González** (National University of Buenos Aires) recorded the first Mephitidae from Chile, from the Bajo Pilauco Site (Pleistocene). **David Silva** (National Science Museum of Curitiba) gave a summary of the Pleistocene mammals from Paraná State, Brazil. **Francisco Prevosti** (National Museum of Buenos Aires) analyzed the fossil record of South American carnivores and their relationships with the great American biotic interchange. **Leonardo Avilla** (Federal University of Rio de Janeiro State) made an integrative approach to the extinction of the mammalian megafauna from South America. **Germán Gasparini** (La Plata Museum) spoke about the Tayassuidae (Mammalia, Artiodactyla) and the great biotic interchange. **Omar Recabarren** (Austral University of Chile) described new materials of *Stegomastodon platensis* from the Pilauco Bajo site, Chile. **Enrique Bostelmann** (National Museum of Anthropology and Natural History, Uruguay) recognized the first record of Quaternary Glyptatelinae from South America. **Flávio Góis** (La Plata Museum) described a new pampatheriid (Xenarthra, Glyptodontoidea) from the Pleistocene of Rondônia, Brazil. **Alfredo Carlini** (La Plata Museum) described the palaeobiogeographic and phylogenetic implications of glyptodonts (Cingulata, Glyptodontinae) from the northern parts of South America. Finally, **Ulises Pardiñas** described the most ancient Sigmodontinae from South America.

The Symposium on *Advances in titanosaurid sauropod studies from Gondwana* was on Monday in the *Unenlagia* room (Convener: **Gonzalez Riga**). It began with the presentation of **Cecilia Pirrone** (CRICYT) on the ecological relationships between insects and dinosaurs. **Matías Soto** made a review of sauropod remains from Uruguay. **Rodrigo Santucci** (National Dept of Mineral Production, Brazil) questioned if using co-dependent characters in sauropod phylogeny we may count sauropod vertebrae. **Elena Previtera** (CRICYT) talked about bone diagenesis in sauropod dinosaurs. **Jorge Calvo** (CePaLB) established a new body size for giant sauropods and for the body length of *Futalognkosaurus dukei*. **Francisco Ortega** (UNED) showed the importance of the "Lo Hueco" palaeovertebrate site of Cuenca, España. **Lucas Fiorelli** (Crilar) described the extraordinary sauropod dinosaur nesting site of Sanagasta Park, La Rioja, Argentina. Finally, **Rubén Juárez Valieri** (CePaLB) spoke about sauropods crossing formations: biostratigraphical implications for Patagonian faunal assemblages.

The Symposium *Morphology and adaptations in birds: new tools and*

concepts took place in the *Unenlagia* room during Monday afternoon (Convenors: **Claudia Tambussi** and **Andrea Pino**). **Thomas Dececchi** (McGill University) talked about the evolution of skeletal allometries during the theropod to bird transition. **José Sanz** (Autónoma University of Madrid) made an analysis of the flight capacity of *Archaeopteryx* based on experimental essays. **Federico Degrange** (La Plata Museum) presented a model for the M. adductor mandibulae externus of *Andalgalornis steulleti* (Aves, Phorusrhacidae) and he also described the biomechanical reaction of the *Andalgalornis steulleti* skull to extrinsic forces. **Washington Jones** (Facultad de Ciencias, Uruguay) used a model of the mechanical resistance in claws using curve structures to provide a comparison between the Aves, Cariamae and theropod dinosaurs. **Carolina Acosta** (La Plata Museum) presented the cranial morphology and palaeobiology of fossil penguins from South America. Finally, **María Mosto** (La Plata Museum) tried to find a tool for taxon identification in Aves using the claws.

The Symposium *Mesozoic Marine Vertebrates from Latin America* was held in the *Unenlagia* room on Tuesday after lunch (Convenors: **Marta Fernández** and **Zulma Gasparini**). **Paulo Brito** (University of Rio de Janeiro State) gave a review about the fossil fish from the Adamantina Formation of Bauru basin. **Marta Fernández** (La Plata Museum) spoke about the antorbital fenestra of Metriorhynchidae (Thalattosuchia, Crocodylomorpha) and whether homology is a parsimony problem. **Erin Maxwell** (McGill University) reviewed the distribution and diversity of Cretaceous ichthyosaurs. **Espen Knutsen** (Oslo University) described the discovery of new Upper Jurassic pliosaurid material from Svalbard, Norway. **Patrick Druckenmiller** (University of Alaska Museum) made a preliminary comparison of diversity and palaeoenvironments between Tithonian marine reptiles of Svalbard, Norway and the Neuquén basin. **Marie-Celine Buchy** (Desert Museum, Mexico) described new materials of *Vallecillosaurus donrobertoi* (Squamata: Anguimorpha) from the upper Cretaceous of north-eastern Mexico. **Takuya Konishi** (University of Alberta) described new materials from the oldest known *Taniwhasaurus* and studied the problem of mosasaurid endemism. **Marta Fernández** (La Plata Museum) made a review of the Tithonian ichthyosaurs from the Neuquén basin, Argentina. Finally, **Zulma Gasparini** (La Plata Museum) spoke about Oxfordian marine reptiles from the Proto-Caribe.

The *First Latin American Symposium of Palaeontological Tourism* (convenors: **Magdalena Perini** and **Luisa Villar**) was on Wednesday morning. **Luisa Villar** (CePaLB) talked about the importance of alternative tourism for visitors that want to experience being a palaeontologist. **Carolina Uthurralt** (CePaLB) developed an educational programme for learning palaeontology *in situ*. **Marcieli Tatsch** (URCAMP) used palaeontology as a tool for teaching scholars. **Pablo Quilodran** (Colchagua Museum) presented the Project of Life Museum, with a reconstruction of life from a palaeontological and heritage perspective.

The last Symposium, *Non-Avian Theropod Dinosaurs from Austral continents: Anatomy, Phylogeny and Evolution*, (Convenors: **Fernando Novas** and **Oliver Rauhut**) was on Thursday. **Federico Agnolin** (Argentine Museum of Natural Science) presented a new small coelurosaurian theropod from the Upper Cretaceous of Argentina. **Peter Makovicky** (Field Museum of Natural History, USA) gave a phylogenetic insight on Gondwanan coelurosaurs. **Mathew Lamanna** (Carnegie Museum of Natural History) described an Early Cretaceous abelisauroid from Libya. **Rubén Juárez Valieri** (CePaLB) made a review of the size of the giant theropod *Ekrixinatosaurus novasi* from the "middle Cretaceous" of Patagonia. **Juan Porfiri** (CePaLB) presented a new large theropod

dinosaur from the Bajo de la Carpa Formation (Upper Cretaceous) of Neuquén, Patagonia. **Juan Canale** (El Chocón Museum) commented on cervical vertebrae referred to the African theropods *Carcharodontosaurus* and *Sigilmassasaurus*. **Nathan Smith** (Field Museum of Natural History, USA) described few materials of a *Megaraptor*-like theropod (Dinosauria, Tetanurae) from Australia, supporting faunal exchange between eastern and western Gondwana in the mid-Cretaceous. **Paul Sereno** (University of Chicago) presented a new allosauroid with intrathoracic air sacs from the Anacleto Formation of Mendoza province, Argentina. Finally, **Patrick O'Connor** (Ohio University) described new discoveries, new insights and new directions of the Late Cretaceous (Maastrichtian) theropod fauna of the Maevarano Formation, northwestern Madagascar.

It was a colossal Congress, with enough oral sessions to fill all topics and tastes in vertebrate palaeontology. The poster session doubled the number of abstracts presented, showing how vertebrate palaeontology studies have been improving in recent years. The poster session included abstracts related to Aves (3), mammals (32), dinosaurs (15), fish (9), turtles (2), crocodiles (16), marine reptiles (5), primitive reptiles (15), Anura (1), pterosaurs (1), snakes (3), educational palaeontology (3), and others related to faunas and other topics.

Upon completion of their journey, the palaeontological community was able to enjoy Neuquén City, as well as the Cretaceous outcrops in the neighbourhood. On the last night, a famous Argentine "Asado" was part of the dinner, together with the most famous red wine of the Schroeder Family named SAURUS, because sauropod material was found below its winery. Gifts were given to the 17 invited speakers and there were some surprises for lucky palaeontologists who received some free fossil casts.

San Juan city in the west side of Argentina will be the city to receive the IV Latin-American Congress on Vertebrate Paleontology in 2011; I hope to see you there!

Dr Jorge Calvo
President, IIICLPV

52nd Annual Meeting of The Palaeontological Association

Glasgow *18 – 21 December 2008*

The run-up to last Christmas saw a large number of palaeontologists flocking to Glasgow, Scotland, for the 52nd Annual Meeting of The Palaeontological Association. Hosted by the University of Glasgow, the venue for the meeting was the Sir Charles Wilson Building, which is essentially a church converted into a lecture theatre. It seated all 300 attendees comfortably for the three days of

presentations and provided an atmosphere of warmth and camaraderie to offset the wintery gloom of Glasgow. The meeting was excellently organised by **Maggie Cusack**, **Alan Owen**, and **Neil Clark** (University of Glasgow).

The meeting was preceded by a field excursion to the fossiliferous Carboniferous rocks of the Midland Valley of Scotland, starting on the morning of Thursday 18th December. Those who went on the field excursion were able to sleep in or explore Glasgow the following morning, as the special symposium on biominerals was not until the afternoon. A number of prominent speakers were selected for this symposium, entitled "Biominerals – the hard part of palaeontology", which was run in two separate sessions.

The first session, chaired by **Mike Bassett** (National Museum of Wales), was opened with a welcoming speech by Vice Principal Prof. **Steven Beaumont**. Then **Steve Weiner** (Weizmann Institute of Science) took us into the world of biomineralisation by discussing the biological strategy for mineralisation via an amorphous precursor phase, and the mechanisms involved as they are understood so far. **Steven Stanley** (University of Hawaii) followed, presenting data on oceanic biocalcification shifts between nonskeletal aragonite or calcite forming in Phanerozoic shallow seas, and the influence of Mg/Ca ratio and Ca concentration in seawater on growth and mineralogy of skeletonised organisms. The session was rounded off by **Kazuyoshi Endo** (University of Tsukuba) with his talk on skeletogenesis evolving independently multiple times in history, the genetic involvement, and it being subject to adaptive pressures. It was then time for a short break with coffee, tea and biscuits, which allowed everybody to digest the information just presented to them, until the call was given to file back into the lecture theatre for the second part of the symposium.

The second session was chaired by **Dick Aldridge** (University of Leicester), who introduced the next speaker in line: **Jan Veizer** (University of Ottawa). Jan treated stable isotope geochemistry as it is used for establishing a palaeothermometer for ancient Phanerozoic oceans, and the important contributions data from low-Mg calcite shells of oysters, belemnites and brachiopods are making to the subject right now. The pattern emerging from this collection of shells shows better correlation with celestial climate drivers than atmospheric carbon dioxide concentrations. The last – but none the less blindingly colourful (!) – presentation of the day was given by **Peter Westbroek** (University of Leiden). He brought us up to speed on the almost permanent oversaturation of calcium carbonate in the ocean water, by the suppression of spontaneous carbonate precipitation by various (biological) inhibitors, thus enhancing the habitability of the ocean. He proposed two main ways by which this biological control likely came about in Archaean times: improved inhibition of crust formation and enhanced biological calcification efficiency.

With the registration pack, everybody had been provided with a map of the relevant areas in Glasgow and a list of restaurants that were worth dining in. Well-equipped, we palaeontologists could now start hunting down whatever food took our fancy. But this was not the end of the programme for the Friday evening, as at 19:00 the Civic Reception was held to mark the official opening of the Annual Meeting. This took us on an adventurous ride on Glasgow's metro system, where the round tunnels are only just big enough to fit the equally round train through. We emerged above ground very near to George Square in Glasgow city centre, where the prestigious late 19th century Glasgow City Chambers is situated. There was a joyful atmosphere as there was a funfair on, but none of us even considered going on the merry-go-round after just having eaten dinner. Instead, we ventured up the massive Marble Staircase in the City Chambers, which led us to the reception taking place

Opening of the meeting at the Civic Reception in the Banqueting Hall of the prestigious late 19th century Glasgow City Chambers.

in the impressive Banqueting Hall, where an address was given by Bailie Nina Baker representing the Lord Provost's Office. It was an ideal occasion to catch up with friends, but also to make new acquaintances and expand your network while having drinks and nibbles. When the supply of wine ran out, we were released into town, where many more drinks were had among a large number of increasingly loud Glaswegians populating the pubs on the Friday night.

After a rather late night, the Saturday talks started very early at 8:50 in the Sir Charles Wilson Building. The introductory remarks were made by Prof. **John Chapman**, the Dean of the Faculty of Physical Sciences (University of Glasgow). The first session of the morning was entitled *Preservation and Taphonomy* (chaired by **Derek Briggs**, Yale University), and the first presentation was by **Patrick J. Orr** (University College Dublin) on soft tissue preservation in Late Triassic lacustrine deposits in Virginia. This was followed by **Maria E. McNamara** (University College Dublin), who discussed the taphonomy of keratinous tissues from vertebrates after experimental degradation, and the implications for the fossil record. **Jo Hellawell** (Trinity College Dublin) went on to discuss isotopic changes during early diagenesis and the implications for palaeontological studies, and was followed by **Martin Brasier** (Oxford University) who discussed Earliest Cretaceous 'firestorm amber' with spider webs from Bexhill. Martin was in turn succeeded by **Úna C. Farrell** (Yale University) who discussed pyritised olenid trilobite faunas. The final talk of the session was from **Joseph P. Botting** (Leeds Museum), who talked about modes and distribution of exceptional preservation in the Builth Inlier in central Wales.

The first session closed, and the thirty-minute coffee break provided the first opportunity to go downstairs and peruse the posters. The space provided was adequate but not overly roomy, so you sometimes had to squeeze past gatherings of people to make your way round.

The second session started at 11:00 and was entitled *Biominerals* (chaired by **Liz Harper**, University of Cambridge). **Antonio G. Checa** (Universidad de Granada) spoke on spikey bivalves and intro-periostracal growth in anomalodesmatans. **Jean-Pierre Cuif** (University of Paris-Sud) then

discussed the rugosan origin of the Scleractinia, and was followed by **Marcus M. Key** (Dickinson College/UEA), who talked about the use of extinct and extant bryozoan skeletons to test the calcite–aragonite seas hypothesis. **Clare Torney** (University of Glasgow) then moved on to how to determine the microstructure of the lenses from the schizochroal eyes of trilobites. **Yannicke Dauphin** (University of Paris-Sud) presented a talk on the mineralogy of coleoid cephalopod shells and whether it is caused by evolution or diagenesis. The final talk before lunch was by **Chris Smale** (University of Plymouth), who talked about the isotopic analysis of the life history of the enigmatic squid *Spirula spirula* and the implications for studying fossil cephalopods. A buffet lunch was then provided in the Glasgow University Union for those who had opted for it. Otherwise, many people went to numerous cafes and eateries that were dotted around the University, which for us meant getting soaked while ploughing our way through the pouring rain that is so typical of Scotland.

The third session of the day started at 13:30 and was entitled *Proterozoic–Early Cambrian Life* (chaired by **Lars Holmer**, Uppsala University). **Alexander G. Liu** (University of Oxford) began by talking about the Ediacara Biota in Avalonia and its taphomorphs and taxonomy, and this broad theme was continued by **Phil Wilby** (BGS), who discussed making a census of Ediacaran communities in the Charnwood Forest. **Ceri-Wyn Thomas** (University of Bristol) continued the session with a presentation on Doushantuo fossils not being giant bacteria, but bacterial pseudomorphs of animal embryos, and **Taniel Danelian** (University of Lille) discussed a lower Cambrian radiolarian that had entactinarian affinities and thus implications for the emergence of the Rhizaria. Finally, **Timothy P. Topper** (Macquarie University) reviewed the bradoriid and phosphatocopid arthropods from the Early Cambrian, and **Glenn A. Brock** (Macquarie University) finished the session on new insights into early animal diversity, evolution and ecology from the Lower Cambrian fossil archive of South Australia. Afterwards, everyone was again able to enjoy a thirty-minute coffee break and have another chance to see the posters downstairs.

The final session of the day started at 15:30 and was entitled *Functional Morphology* (chaired by **Derek Siveter**, University of Leicester). This was started by **Brigitte Schoenemann** (Universität Bonn) who spoke about trilobite eyes and their visual systems. She was followed by **Thomas A. Hegna** (Yale University) who discussed the function of forks: the asaphid-type hypostome. The final talks of the day were given by **Paul Selden** (University of Kansas), who discussed the fossil evidence for the origin of the spider spinnerets and a new arachnid order, and **Ian Corfe** (University of Helsinki), who discussed a three-dimensional analysis of dental complexity in high-fibre plant feeders.

The Annual General Meeting was held at the end of the day, for discussion of matters of common interest to the members of the Society. These involved the association of some new faces to positions on the Council (not least of the President himself!) and a vote among the members agreeing a rather significant rise in the contribution for ordinary members.

The evening started with the Annual Address, given by Prof. **Jenny Clack** (University of Cambridge). It was entitled "The emergence of tetrapods: how far have we come in the last twenty years and where can we go in the next?". She described how in the late 1980s, only three genera of Devonian tetrapod were known: *Ichthyostega*, *Acanthostega*, and *Tulerpeton*; and how the genus *Eusthenopteron* stood as model for the fish from which tetrapods evolved. She also mentioned the large number of scenarios postulated for the transition onto land. Progression of research since then has greatly enriched our knowledge of the skeletal anatomy of these early tetrapod genera, which has allowed for more detailed reconstruction of phylogenies and sequences of character

acquisition, as well as new hypotheses on when and how tetrapods evolved. New ecological information is continuously being gathered, which – linked with the increasing range of known Devonian taxa and the ever-improving techniques available to study their remains – contributes to creating a more coherent picture. This process is aided by inferences on physiological adaptations in stem tetrapods made from modern analogues, but will most significantly benefit from exploration of potential new fossil collection sites. This annual address was most interesting and well-presented, although some of us were starting to get hungry and thirsty…

Fortunately, satisfaction was close at hand. At 19:00 we were invited to a reception at the Hunterian Museum, located in the Gilbert Scott Building. The reception was jointly hosted by the Hunterian Museum and the Geological Society of Glasgow, who had opted to serve only white wine, as any spillages of red wine might have stained the floor! The reception provided us with a chance to have a look around the stunning and wide-ranging collections, as well as to speak to friends and colleagues. At 20:00, those who had booked for the Annual Dinner were ushered into the Bute Hall (across the landing from the Hunterian Museum), where the Annual Dinner was to be held. The starter comprised of layered haggis and mashed potatoes, which caused slight apprehension when first presented, but turned out to be very tasty indeed. Christmas dinner was served as the main course, and a sumptuous fruity dessert rounded off a wonderful meal.

At this occasion, Prof. **Charles Holland** (Trinity College Dublin) was awarded the Lapworth Medal by Council as recognition of his significant contribution to the field of palaeontology. The award was presented to him by **Mike Bassett** (National Museum of Wales), who also presented the President's Medal to **Paul Upchurch** (University College London) as a mid-career recognition of his prior contributions to palaeontological research, with the expectation that he will further contribute significantly in the future (we will be watching closely!). Afterwards, **Dick Aldridge** (University of Leicester) gave his inaugural presidential address. The meal, enjoyed by all, was followed by a post-dinner bar until late, with the wine being kindly funded by Wiley-Blackwell. Afterwards, most people went on to a bar near the University, called Brel, for further drinks until we were thrown back into the street at 01:00 when the pub closed. Some (mostly PhD students and some lecturers) moved on to another pub

Outside the Hunterian Museum (Gilbert Scott Building) just before the wine reception on the Saturday night.

The Annual Dinner being enjoyed by the meeting attendees in the Bute Hall.

in an old church (the following morning, this move was thought [*erroneously* – Ed.] to have been instigated by **Richard Twitchett**, University of Plymouth) to continue drinking till this place also kicked us out.

Sunday started very (*very*…) early at 09:00 with the dedicated poster session, during which the delegates (some with very sore heads) were required to stand by their posters and look smart. Some were too hungover to make it at all, probably having had only a few hours' sleep. At 10:30, the first talks session of the day started, entitled *Environment and Ecology* (chaired by **Margaret Collinson**, Royal Holloway University of London). The session began with **Liz Harper** (University of Cambridge), who discussed patterns of shell damage and repair in recent terebratulide and rhynchonellide brachiopods. She was followed by **Andrew Johnson** (University of Derby), who discussed bivalve sclerochronology and climate change as evidence of global warmth and fluctuating oceanic heat supply. **Claire M. Belcher** (University College Dublin) then discussed new limits for combustion in low oxygen and redefined palaeoatmospheric predictions for the Mesozoic, after which **Helen Hughes** (University of Birmingham) talked about taphonomic controls on trilobite associations in Silurian reefs of North Greenland. **Carys E. Bennett** (University of Leicester) was scheduled for a talk on Carboniferous ostracods and their first non-marine colonisation, but she regretfully had to withdraw due to illness. **Claire M. McDonald** (University of Leeds) discussed insect traces in Antarctic fossil forests and compared them to modern forests in Chile, after which **Jesper Milàn** (University of Copenhagen) gave a humorous account of his ongoing project to document the complete morphological variation in tracks and trackways from extant crocodiles using a very expensive bit of kit (a box made of wood, full of sand, with no lid and one open end) to help with the study of fossil tracks. He explained how progress was sometimes slow, as the

crocodiles were not always easily seduced to walk through the box and instead preferred just to sit there. Finally, **Peter L. Falkingham** (University of Manchester) talked about using computer simulations ("close the doors!") to explain variations in fossil vertebrate tracks.

A buffet lunch was provided, again in the Glasgow University Union, for a number of the delegates. All others trailed off into the cafes and eateries around the University area. After barely making it back in time because the food took so long to arrive, the second session entitled *Biodiversity Change* (chaired by **David Harper**, Natural History Museum of Denmark) started with **Ivan Sansom** (University of Birmingham). He discussed a Gondwanan view on the diversity and ecology of Ordovician fish. The session continued with **Thomas Servais** (University of Lille) talking about the Ordovician biodiversification and whether it was geologically or biologically triggered. **John E. A. Marshall** (University of Southampton) followed on with a discussion on recognising the Taghanic Event in the Devonian terrestrial environment and its implications for land sea interactions. He was followed by **Brett Metcalfe** (University of Plymouth) who spoke for only a short amount of time (basically about five minutes) on growth rates and longevity in 'Lilliput' animals in the aftermath of the Late Permian extinction event. **Bridget S. Wade** (Texas A&M University) talked about symbiont bleaching in fossil planktonic foraminifera and extinction in the latest middle Eocene, after which **Laura McMonagle** (Durham University / Natural History Museum) finished the session, talking about unravelling the history of the Indo–West Pacific marine biodiversity "hotspot". The second session closed and everyone was again able to enjoy a thirty-minute coffee break. It also offered a final chance to those who had not yet made it downstairs to have a look at the posters.

The final session was entitled *Evolution and Phylogeny* (chaired by **Euan Clarkson**, University of Edinburgh) and started with **Imran A. Rahman** (Imperial College London), who spoke about evaluating phylogenetic hypotheses of carpoids using stratigraphic congruence indices. **Cajsa Lisa Anderson** (Real Jardin Botanico) and **Alan Channing** (Cardiff University) had decided to do a sort of duet about exploration of fossil floras on the volcanic oceanic islands of Macaronesia, and were followed by **Alysha M. Heimberg** (Dartmouth College) who discussed the deep evolution of Metazoan microRNAs. **Alan Channing** (Cardiff University) stepped up again, and continued the session by talking about hot spring ecosystems through time, which was followed by **Robert S. Sansom** (University of Leicester), who spoke about unlocking character preservation before chordate skeletonisation decay of the cephalochordate *Branchiostoma*. As last speaker at the meeting, **Michael J. Benton** (University of Bristol) discussed the origins and radiations of dinosaurs using numerical approaches in macroevolution.

Before the meeting actually came to an end, the prize winners were announced. The President's Award for the best oral presentation went to **Robert S. Sansom** (University of Leicester) and the Council Poster Prize was awarded to **Heather Birch** (University of Cardiff) for her poster on planktonic foraminiferal ecology and pelagic ecosystem recovery after the K/Pg boundary mass extinction.

We would like to say "thank you" to all the delegates who attended and presented at the meeting, and also to all the volunteers and the many sponsors for their generous support. It was a really well-organised and successful meeting, and we wish Birmingham all the best for the eagerly awaited *53rd Annual Meeting of The Palaeontological Association 2009*.

Nikita Jacobsen & Martha Koot
University of Plymouth

13th International Echinoderm Conference – Echinoderms in a Changing World
University of Tasmania, Australia *5 – 9 January 2009*

Hobart welcomed us with the characteristic unsettled weather Charles Darwin experienced more than 170 years ago. But nevertheless it was much more enjoyable than the cold winter we left behind in Germany! The location for the International Echinoderm Conference rotates amongst North America, Europe and the Southern hemisphere, and this time it was held at the University of Tasmania (Stanley Burbury Theatre, Hobart). What a wonderful justification to visit the other end of the world!

Compared to previous meetings the number of delegates was very low with only 100 persons attending the conference in Tasmania. Alistair McGowan suggested that I focus on reporting the palaeontological talks, but since there were only two plenaries and four talks during the whole conference with palaeontological topics this would have resulted in a short report of one page. So here is a summary of all talks I heard during the week, biased towards recent echinoderm research…

On Monday 5th January, the delegates were welcomed by the conference convenor Craig Johnson. The following Official Opening was performed by His Excellency, The Honourable Peter Underwood, AO, Governor of Tasmania, who explained all the things he had learned about the echinoderms in the last few days, a group he had never heard of before (due to his former job as a judge). His speech included a great comparison of the functioning of lawyers, judges and scientists and the tale of the boy who kept throwing sea stars back into the ocean though knowing he could never save all of the stranded animals.

The first Plenary was held by **James H. Nebelsick** (University of Tübingen) on "The legacy of ocean climate and chemistry change in the echinoderm fossil record". The topic was introduced by an overview on the complex interactions within the earth system and the geological and biological constraints of ocean geochemistry. Two main questions were discussed: "Can echinoderms be used to determine ocean geochemistry?" and: "Has ocean geochemistry an influence on the evolution of echinoderms?" Some studies report a tight correlation between Mg/Ca ratio in well-preserved fossil echinoderms and whether the ocean chemistry was in aragonitic or calcitic sea-mode. Thus echinoderm skeletons can be used as a proxy for ocean geochemistry. There also seems to be

Official Opening by His Excellency Peter Underwood

an influence on the evolution of echinoderms, but because of the diagenetic changes the high-Mg calcite shells of echinoderms experience, it is difficult to detect. Differential survival of echinoderm lineages after mass extinctions records these changes in ocean geochemistry, and these changes may themselves reflect the influence of switches between "aragonite" and "calcite" seas on the evolution of echinoderms.

The following thematic sessions were split into parallel sessions and I joined the one with the topic "Phylogeny/Evolution" which started with the talk of **Mark P. O'Loughlin** (Marine Biology Section, Museum Victoria) who analyzed the DNA of holothuroids from the Southern Atlantic, Ross Sea, New Zealand and Australian waters to figure out that some of the morphologically indistinguishable species are genetically complex 'cryptic species'. **Alexander Ziegler** (Freie Universität Berlin) homologized the gastric caecum of irregular echinoids with structures in regular sea urchins and proposed a close link of the evolution to an infaunal lifestyle. **Igor Eeckhaut** (University of Mons) studied the molecular phylogeny of pearlfishes living in symbiosis with asteroids and holothuroids, and found paraphyletic relationships of the Carapus group to the monophyletic Encheliophis group. The talk by **Sabine Stöhr** (Swedish Museum of Natural History, Stockholm) revealed paedomorphosis in several ophiuroid species and showed its major role in the evolution of this group. Masanori Okanishi (National Museum of Nature and Science, Tokyo) reviewed the taxonomy of the poorly known ophiuroid family Asteroschematidae by close examinations of internal ossicles.

In the next Plenary **Tim O'Hara** (Museum Victoria, Melbourne) talked about "Echinoderm biogeography in the Southern Hemisphere". Tim first summarized the research history of biogeography. The focus was then put on the distinct distribution and origin of South Australian ophiuroids by studying collection material from Australia, Europe, USA, and datasets from around the coast of Australia and New Zealand. In addition, the biogeographic distribution was modelled and the resulting cluster analysis allowed insights into which occurrence patterns were statistically significant. Continental shelf region communities were significantly different from those of slope settings, and there is a latitudinal transition between coastal regions, shelf regions and the bathyal. Although seamounts and continental slope settings show almost the same distribution of species, there is no elevated species richness or endemism upon seamounts.

After the lunch break I switched to the parallel session "Recent Advances/Biology", starting with the talk of **Marc Eléaume** (Muséum National d'Histoire Naturelle, Paris) who presented features of articular facets in arms of comatulid crinoids as diagnostic characters for taxonomy. **Clement P. Dumont** (University of Hong Kong) discussed the reliability of age estimations of echinoids and compared different models by estimating the growth of *Strongylocentrotus* in contrasting habitats to conclude that the distinct models differ in accuracy of age estimations. The topic was continued by the talk of **Michael P. Russell** (Villanova University) with the analysis of growth rates of tests and jaws of the sea urchin *Lytechinus variegatus* from Bermuda; finding out that the rates do not differ in the different field samples but do differ from the laboratory experiment. **Lana M. Roediger** (Flinders University, Port Lincoln) presented her results on the linkage of reproductive traits of direct development to population size by comparing temperate and tropical asteroids.

In the evening the delegates were invited to the Government House Reception, an official meeting with the Governor and his wife. Provided with loads of delicious canapé and excellent wine we

strolled around, dressed rather glamorously for scientists (due to the dress code, ties had to be found for those who did not remember to bring one) and enjoyed the somewhat unfamiliar attention of the omnipresent waitresses.

The second day of the conference commenced with the Plenary of **Mary A. Sewell** (University of Auckland) discussing the question: "Ocean acidification and echinoderms: How bad will it be for our favourite phylum?" Increasing CO_2 and H^+ concentrations in the atmosphere and the surface ocean will continue to lower the carbonate ion levels (CO_3^{2-}), resulting in an acidification of the oceans. The analysis of sea urchin larval development in lower pH levels shows a decrease in larval size and the formation of abnormal morphology. The aragonite and calcite saturation horizon will also shift to shallower water depths, leading to a reduced bathymetric range for development of echinoderm larvae, especially larval brooding species. Thus the near future predictions (by 2100 a pH level 150% more corrosive than today) will be likely to reduce brooding success and larval development of sea urchins and probably will also influence the other echinoderm groups.

The session "Climate Change" began with an ecological topic that **Grant Leeworthy** (Deakin University, Victoria) was originally scheduled to present two days later, but was moved due to a cancelled talk. He described the geometry of the Allee effect as a result of fishing patterns on fertilisation in echinoderm populations. Back to the original session topic, **Dana Clark** (University of Otago) analyzed the effect of reduced pH on sea urchin larvae and concluded that the predicted pH levels till 2100 will not affect survival rates but may decrease the growth of skeletons in larvae. **Maria Byrne** (University of Sydney) revealed that three distinct sea urchins from South Eastern Australia showed differing degrees of sensitivity in early developmental stages to an increase in temperature and a decrease of pH. **Haruko Kurihara** (Nagasaki University) went on with similar investigations on two sea urchins, including the effect of an acidic and warm high CO_3^{2-} world on adult stage and reproduction. The effect of ocean acidification on early life history of two Australian sea urchins was also studied by **Stephanie Mifsud** (University of Sydney), confirming the former observations. **Hong Dao Nguyen** (University of Sydney) investigated the effect of heat shock on sea urchins by determining the expression of the heat-shock protein Hsp70, and revealed an overall high tolerance to acute temperature shocks.

After lunch **Mike Reich** (University of Göttingen) held his Plenary on "The fossil record, diversity and evolution of holothurians (Echinodermata)," beginning with an overview of research history on holothurians. From the palaeontological perspective the most important feature of these organisms is their skeleton, consisting of spicules in the body wall and the circum-oesophageal calcareous ring. But their fossil record is extremely sparse, leading to the description of 800 paraspecies and 30 biological species. Only 15 lagerstätten are known with preservation of body fossils of holothurians. The diversity in earth history depends mostly on the number of publications rather than deficiencies in the fossil record (due to Mike's work in Gotland showing a momentary peak in the Silurian), with the first true holothurian remains (Arthrochirotida) known from the Middle Ordovician.

The thematic session "Paleontology/Paleobiology" started with the talk by **Janina F. Dynowski** (University of Tübingen) on two ecophenotypes of the middle Triassic crinoid *Encrinus liliiformis* from Central Europe, interpreted as a reaction to differences in habitat. **Ben Thuy** (University of Tübingen) showed that under special conditions isolated lateral arm plates of fossil ophiuroids can be used for the taxonomic assessment of a fossil assemblage. The last talk concerning

Palaeontology was given by **Andreas Kroh** (Natural History Museum Vienna), about the Eocene to Miocene Clypeasteroids of India, which include numerous endemic forms and no species which are common in the Mediterranean.

The talks of day two were rounded off with the Plenary by **John Lawrence** (University of South Florida) on "Arm loss and regeneration in stellate echinoderms: An organismal view". Autotomy in echinoderms is often said to be an escape strategy, but from the perspective of the organism it is probably more advantageous to produce a clean break and wound that can be repaired without much effort. Stellate echinoderms show other defence strategies like the formation of spines or the production of chemical deterrents. To understand the mechanisms of arm loss and regeneration it is essential to understand population biology, ecology and life-history strategies.

The Poster Session was the last appointment for the day and was held in the Stanley Burbury Foyer. A total of 53 posters were displayed and the session was accompanied by Tasmanian cheese and wine: both highly recommended! The official end of the session at 7pm was extended due to the great interest and long discussions caused by the diverse poster topics.

After the first two days of talks the conference tours brought the delegates to various places and activities in and around the Tasmanian capital Hobart. I joined the Sea Life Cruise, a three hour boat trip along the coast of the Tasman Peninsula. Besides the abundant wildlife, including seals and penguins, we observed the impressive coastline build of Permian and Triassic sediments as well as great dolerite intrusions. During our lunch break we could not resist having a look at the rocks,

Poster Session, Stanley Burbury Foyer

and found a beach made out of Permian fossils (bryozoans, brachiopods, gastropods, crinoids). With our intense ground inspection, we also aroused interest among some of our biological colleagues and explained the occurrence of drop stones and the typical Gondwanan fauna. After that we went on to the Tasmanian Devil Conservation Park with the abundant terrestrial fauna of Tasmania, including the Tasmanian Devil, quolls, kangaroos (we were allowed to feed them) and the small wallabies.

Dolerite Cliff, Tasman Peninsula

Thursday, 8th January, started with the Plenary by **Phillippe Dubois** (Universitz Libre De Bruxelles) on "Metal contaminants: A threat to echinoderms in the 21st century?" Metals are a natural component of ecosystems, but the main sources for heavy metals in marine environments are river inputs and dumping sites. These metals are mainly a littoral problem and are trapped in the sediments. The studies of *Asterias rubens* originating from a closed dumping site in the Sørfjord (Norway) and along the North Sea coast revealed high levels of metals in the body wall. Results in field and laboratory experiments are contrasting, but the expression of the heat shock protein (Hsp70) increases with the metal concentration as well as the production of reactive oxygen species, and the ambulacral plates of the skeleton show the lowest stiffness in the highest metal concentrations. The impact of the global change, *e.g.* higher metabolic rates as a result of higher temperature and the resulting higher intake of metals, is still not known and should be considered in future studies.

Drop Stone, Tasman Peninsula

Catriona Macleod (University of Tasmania) picked up the plenary topic in the following thematic session "Metals/ Contaminants" (which included just this one talk) by reporting about the toxic impact of Copper

in the river Derwent on the brittle star *Amphiura elandiformis*. The following session "Ecology" was introduced by the talk of **Craig Johnson** (University of Tasmania) about the invasive sea urchin *Centrostephanus rodgersii* and the effect of deploying big lobsters as key predators. *Centrostephanus rodgersii* continued to play the key role in the following talks: **Scott D. Ling** (University of Tasmania) presented the ecological impact caused by the invader, the change from kelp beds to sea urchin barrens; **Martin Marzloff** (University of Tasmania) analyzed the interrelations of the invasive sea urchin, the native sea urchin, the formation of barrens and the fishing industry, using qualitative modelling approaches. The effect of removal of grazing sea urchins in patchy barrens off Japan (Okinoshima Island and Uchiura Bay) was presented by **Daisuke Fujita** (Tokyo University) and revealed a difference in recovery success of the natural macrophytes in the different sites. **Mark W. Langdon** (Murdoch University, Western Australia) monitored the changes of sea grass decline and recovery related to the abundance of the grazing sea urchin *Heliocidaris erythrogramma* in Luscombe Bay (Western Australia).

After lunch the next Plenary was held by **Sven Uthicke** (Australian Institute of Marine Science, Townsville) on "Outbreaks and die-offs: Causes and consequences of large amplitude population density fluctuations in Echinoderms". Three general patterns of population density fluctuations can be differentiated: density increase, density decrease and fluctuations. For each scenario several examples were presented for all echinoderm classes (aside from crinoids). The ecological consequences of the changes in population density differ depending on the feeding strategy of the organisms; *e.g.* the sharp reduction of a grazing echinoderm can lead to a phase shift to an algal dominated reef, or an increase in population size may lead to a shift from kelp beds to sea urchin barrens. Most population variations are a result of anthropogenic disturbance, *e.g.* the introduction of species or overfishing.

The thematic session "Ecology" continued with the talk by **John M. Lawrence** (University of South Florida) who observed two distinct behaviours of the sea star *Luidia* in response to wounded conspecifics, one resulting in escape, one in cannibalism. **Svea-Mara Wolkenhauer** (University of Rostock) revealed a strong linkage between diet and seasonal burying cycles of the sea cucumber *Holothuria scabra* to temperature by monitoring and modelling behaviour under controlled settings. **Craig Johnson** (University of Tasmania) discussed the suitability of the barren habitat for sea urchins and described a very complex relationship in Tasmanian sites. **Hugh Pederson** (Myriax Software P/L) used the Eonfusion software to study the behaviour of 900 translocated rock lobsters at the northeast coast of Tasmania. **Dinorah Herrero-Perezrul** (Centro Inderdisciplinario De Ciencias Marinas-IPN, La Paz) presented her observations on the variation in echinoderm assemblage structure over a three-year period at the Archipelago Espiritu Santo in Mexico. The last talk for this day was presented by **David J. W. Lane** (Universiti Brunei Darussalam) illustrating the great diversity of non-commercial aspidochirote sea cucumbers in North Sulawesi, and showing that commercial species still need to recover even though the fishery stopped about 20 years ago.

After the final session we went to Kingston to take part in the Wine & Cheese Evening hosted by the CAML (Census of Antarctic Marine Life) and the AAD (Australian Antarctic Division). Here we could have a look at the echinoderms collected during the recently completed research voyages to map the Antarctic biodiversity, and enjoy a great variety of Tasmanian wine and cheese.

The last day of the conference was introduced by the Plenary of **Gregory Wray** (Duke University, Durham) on "Evolution of an embryonic gene regulatory network in the sea urchin *Strongylocentrotus purpuratus*". The topic was introduced by a short overview of the history of gene sequencing, ending with the first echinoderm that was analyzed in 2006; the sea urchin *Strongylocentrotus purpuratus*. With 23,300 genes, its genome contains almost as many genes as a human one, and many of those devoted to immunity are homologous to vertebrates. To analyze the variation within a gene network of one population six females and six males were crossed, resulting in 36 embryos. These individuals differed substantially in the degree of gene expression and thus showed a great variation across the network. The study revealed that evolutionary constraints occur in a late embryonic developmental stage and that the robustness of development is to some degree based on the insensitivity of exact expression levels and the overall network organization.

After the plenary I switched to the parallel session in lecture theatre 2 with the topic "Ecology". The first talk was presented by **Jérôme Mallefet** (University of Louvain) on the bioluminescence of brittle stars and the indication that it arose more than twice in the evolutionary history of this group. **Regina Magierowski** (University of Tasmania) monitored the recruitment and community dynamics of echinoderms on artificial kelp holdfasts over 13 months and showed that echinoderm familial richness was well correlated with the total familial richness. **Scott D. Ling** (University of Tasmania) described and explained the mass occurrence of the sea star *Asterias amurensis* in wharves of the Derwent Estuary. The echinoderm diet of marine predators, here as example the rock lobster, was studied by **Kevin S. Redd** (University of Tasmania) by analyzing DNA from faecal samples. **Alan Dartnell** (James Cook University, Townsville) showed that the changes from cobble shore to sand habitat produced by cyclone Larry on the North Queensland coast affected the populations of the sea star *Cryptasterina pentagona*. The session ended with the presentation of **Elisabeth Strain** (University of Tasmania) talking about the interactions of commercially fished abalone and the invasive sea urchin *Centrostephanus rodgersii*.

The last Plenary of the meeting was held by **Annie Mercier** (Ocean Sciences Centre, Memorial University, St. John's) on "Challenges and breakthroughs in the study of deep-sea echinoderm biology". For a long time the deep-sea was said to be dominated by featureless mud, without any influence of seasonal changes or life-cycles reflecting periodical patterns. Echinoderms were among the first organisms to show the opposite. In the last decades many studies referring to life-cycles and feeding behaviour in the deep-sea have in fact revealed seasonal breeding and dependency on seasonal changes in food availability due to surface production. Progress in the understanding of the limiting factors for keeping the deep-sea animals alive in the laboratory now enables further studies of the exact biology of deep-sea echinoderms.

After that, the session "Recent Advances/Biology" back in lecture theatre 1 was opened by **Svea-Mara Wolkenhauer** (University of Rostock) showing that the sea cucumber *Holothuria scabra* has a key role in the daily turnover of sediment but almost no influence on the anoxic layer. **Miles Lamare** (University of Otago) studied movement and behaviour patterns of the sea star *Coscinasterias muricata* in Doubtful Sound by using archival electronic tags. **Dinorah Herrero-Perezrul** (Centro Inderdisciplinario De Ciencias Marinas-IPN, La Paz) revealed differences in the settlement of two holothurian species in two study sites in Mexico and the strong influence of currents and water quality conditions on settlement of larvae. **Mark O'Loughlin**

(Marine Biology Section, Museum Victoria) reported various different reproductive strategies of dendrochirotid holothurians, most of which include brooding of juveniles in special marsupiae. Last, but not least, the final talk of the conference was given by **Lindsay B. Jennings** (University of New Brunswick), about the influence of collector types on the settlement rate of juveniles of the sea urchin *Strongylocentrotus droebachiensis* and the sea stars *Asterias rubens* and *A. forbsii*.

After a busy but wonderful and very informative week, the conference was closed by **Craig Johnson**. We went to Hobart Harbour to get on the boat that brought us to Moorilla Vineyard, the venue of the Conference Dinner. Situated on top of a hill, above the river Derwent, 50 m behind us lay the vineyards where the excellent wine originated that accompanied a wonderful dinner. Our table was surprised by the really tasty Chardonnay, all of us usually preferring the Riesling which had been served on the previous days as an alternative white wine. After the main course the student prizes for best abstract, best poster and best talk were awarded, and all the people involved in the organisation of the conference were acclaimed for their excellent work. A wonderful benchmark for the next meeting which will be organised by Philippe Dubois and his colleagues in Bruxelles! We are full of expectations!

Janina Dynowski
Staatliches Museum für Naturkunde, Stuttgart

8th International Symposium on the Cretaceous System

University of Plymouth, 6 – 12 September 2009

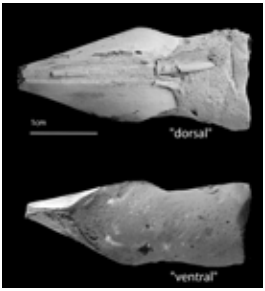
Registration and submission of abstracts online at www.cretaceoussymposium.org

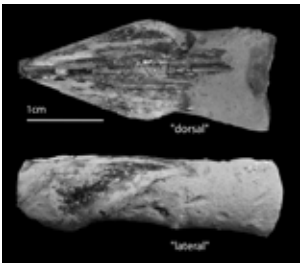
MYSTERY FOSSIL 16

The mystery fossil for this issue comes from the famous Bertie Group (late Silurian) eurypterid beds of New York and was sent in by **Samuel Ciurca** (Rochester, New York). Samuel and colleagues have named this mysterious fossil "Ezekiel's Wheel". Normally, just the 'wheels' are found, but as Samuel notes "here is, presumably, nearly the entire animal". Does anyone 'out there' know what it is? To give an idea of size, the 'wheels' are typically 20–25mm in diameter.

Mystery Fossil 14 – update

The (e)mail bag was bursting at the seams with all the correspondence suggesting possible identities for Mystery Fossil 14, sent in by Gérard Breton and appearing in *Newsletter* **69** (p. 64). Thanks to all who contributed!





As usual, our palaeontological 'ask-the-audience' threw up a number of possibilities. While most of the community were happy that Mystery Fossil 14 belonged in the phylum Mollusca, to **Neil Clark** (Glasgow) it looked a lot like a thylacocephalan, such as *Thylacocephalus cymolopos* from the Cretaceous of Lebanon. The Bivalvia received a couple of votes, from **Philip Hadland** and **Bob Peck**, who both thought it looked similar to Pinna. The vast majority of contributors, however, suggested cephalopod remains of one sort or another. **Lorna Steel** (NHM) thought that it could be "some sort of cephalopod innards. We have similar-ish looking stuff in our collection from the Lower Lias. Three-dimensionally preserved teuthid perhaps?" The fossil reminded **David Elliott** (UAU) of a rhyncholite (squid beak). **Hugh Owen** suggested that it could be the distal end of a teuthid guard, and went on to note that "the preservation of material in this bed at Bully Ste Martin is exceptionally good and a delicate thing like this could well be preserved".

Desmond Donovan got extremely excited, however, and wrote: "[Mystery Fossil 14] is a squid gladius. Fossil gladii are very rare and most of the known ones come from 'fossil lagerstätten' such as the Solnhofen limestone. It looks very similar to the modern squid *Pyroteuthis*… It is the third type of fossil gladius, to my knowledge, which shows similarity to a Recent genus. The other two are the Solnhofen squids *Plesioteuthis*, which is close to living Ommastrephidae, and *Palaeololigo* which shows some similarity to Recent *Bathyteuthis* and *Chtenopteryx*." Desmond included a figure from Toll (1998) to support his diagnosis (see left) and finished by noting that "it is sufficiently important in my view to warrant a note in *Nature* or *Science*". To my knowledge, this is the first of our Mystery Fossils to have attracted such an accolade! At the present time, further work on the find is ongoing and we await the results with interest.

R.J. Twitchett

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

Annual Address of the Palaeontographical Society:
Charles W. Peach: one of Darwin's barnacle providers
London *15 April 2009*

The 3rd Annual Address of the Palaeontographical Society will be held on Wednesday 15th April, at 4:30pm in the Flett Lecture Theatre of the Natural History Museum, London. Tea and coffee will be served in the foyer of the Flett Lecture Theatre from 4pm.

The address will be given by Dr Lyall Anderson (University of Cambridge) to mark the bicentenary of Charles Darwin's birth. Darwin published his famous work on barnacles as a Palaeontographical Society Monograph, and Dr Anderson's address is entitled "Charles W. Peach: one of Darwin's barnacle providers".

Further information about the Society can be obtained from the Co-Secretaries, Dr S. Long (e-mail <**s.long@nhm.ac.uk**>) or Dr P. Barrett (e-mail <**p.barrett@nhm.ac.uk**>), or from the Society website at <**http://www.nhm.ac.uk/hosted_sites/palsoc/**>.

"Fossil Lagerstätten: Their Formation, Paleoecology and Evolutionary Significance": a special session at the 2009 AGU Joint Assembly
Toronto, Canada *24 – 27 May 2009*

A symposium on the formation and preservation of vertebrate, invertebrate and plant Lagerstätten, and their importance for palaeoecological and evolutionary studies, will be held in Toronto in May 2009. More information is available at <**http://www.agu.org/meetings/ja09/program/**> or by e-mailing Martin Smith at <**martins@rom.on.ca**>.

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

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

Thanks to the central position of North Africa within Gondwana, and to its rich geologic history (continental drift and break-up, Tethys, Mesogea, Mediterranea), we believe that a meeting on North

African Vertebrate Palaeontology represents a good forum to discuss the evolution and radiation of vertebrates in response to palaeogeographical history. NAVEP1 will welcome all research or studies dealing with the various aspects of vertebrate palaeontology from North Africa, including: anatomy, morphology, osteology, systematic, phylogeny, evolution, taphonomy, palaeoichnology, biostratigraphy, palaeoenvironments, palaeoecology, palaeoclimatology and palaeobiogeography.

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

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

6th National Symposium on Morphometry and Shape Evolution
Montpellier, France *27 – 29 May 2009*

The 6th National Symposium on Morphometry and Shape Evolution will be held in Montpellier (amphithéâtre de la délégation régionale du CNRS, route de Mende) on 27th and 28th May 2009.

This meeting aims to promote exchanges between users of morphometrics in various fields of evolution, including evolutionary biology, development, environmental archaeology, palaeontology, palaeobotany and ecology. In addition to methodological aspects, the symposium will be of interest to all scientists involved in the quantification and study of shape in biological objects.

The meeting is open to all, but the number of participants is limited to165 (including six places reserved for people with disabilities). Submissions are invited for short oral presentations, or posters, in French or in English.

There is no registration fee, but registration is still required for organisational reasons. Lunches will be provided by the GDR MEF and the Institut des Sciences de l'Evolution de Montpellier. Participants should make their own arrangements for transport, dinner and accommodation.

Contacts:
- Paul ALIBERT, <**paul.alibert@u-bourgogne.fr**>
- Rémi LAFFONT, <**remi.laffont@u-bourgogne.fr**>
- Julien CLAUDE, <**Julien.Claude@univ-montp2.fr**>
- Jean-Frédéric TERRAL, <**terral@univ-montp2.fr**>

The First International Symposium on Biological Shape Change
Tsukuba, Japan *3 – 6 June 2009*

The deadline for abstracts has been extended to 17th April 2009.

The human visual system is especially sensitive to movement and particularly to the shape or outline of forms. The boundary constitutes one of the most important elements of the biological form in terms of image analysis, pattern recognition and classification. Nevertheless, the need to translate this visual information into the precise language of mathematics continues to present challenges. This symposium will focus on methods and applications dealing with numerical

description of the forms typically encountered in the biological sciences. The symposium on biological shape analysis will be interdisciplinary, and bring together international researchers who share common interests in shape analysis, whether from a genetic, environmental, growth or evolutionary perspective.

The organizing committee:
- Seishi Ninomiya, <**snino@affrc.go.jp**>
- Hiroyoshi Iwata, <**iwatah@affrc.go.jp**>
- Pete E. Lestrel, <**plestrel@earthlink.net**>

The meeting website and registration forms are at <**http://www.naro.affrc.go.jp/index_en.html**>.

Fossilized Development symposium, North American Paleontological Congress (NAPC)
Cincinnati, Ohio, USA *21 – 26 June 2009*

A "Fossilized Development" symposium will be held at the 2009 North American Paleontological Convention (<**http://www.napc2009.org/**>). We have an excellent line-up of speakers who have committed to the symposium, which can accommodate as many sessions as we wish. We seek to encourage palaeontologists to consider the developmental information commonly available in fossils in the broader context of evolutionary developmental biology.

If you have any questions please contact organizers Nigel Hughes (<**nigel.hughes@ucr.edu**>) or Colin Sumrall (<**csumrall@utk.edu**>).

IGCP 572: Recovery of ecosystems after the Permian–Triassic mass extinction, North American Paleontological Congress (NAPC)
Cincinnati, Ohio, USA *21 – 26 June 2009*

This symposium aims to investigate the recovery of ecosystems following the end-Permian mass extinction through analyses of the rock and fossil records via studies of biostratigraphy, palaeontology, palaeoecology, sedimentology, geochemistry and biogeochemistry. The topics will address recovery patterns of various fossil groups; reconstruct global Permian–Early Triassic oceanic and climatic conditions; outline P/Tr ecosystem types; and correlate these types of data with a global stratigraphic framework. Ultimately, this symposium will: reveal the patterns and processes of marine ecosystem restoration following the P/Tr mass extinction; elucidate the factors controlling the recovery rates of communities in various habitats and climate zones; determine the similarities and differences in the responses of different groups to the environmental crisis; and assess the effects of climate or other geological events on the restoration of the ecosystems. Funds are available to help students and presenters from developing countries.

If you have any questions, please contact organizers Margaret L. Fraiser (<**mfraiser@uwm.edu**>) or Richard Twitchett (<**rtwitchett@plymouth.ac.uk**>).

International Fossil Algae Association (IFAA) 6th Regional Symposium
Milan, Italy *1 – 5 July 2009*

The official language of the Symposium is English. Participants are invited to give oral and/or poster presentations. The maximum size for a poster is 150 cm high by 120 cm wide. The standard equipment for presentations will be PC and LCD projector. Slide-projector and overhead projector are also available.

The Abstract book and the Field-trip guide will be distributed at the Symposium upon registration. The final scientific contributions will be collected in a special volume of an ISI International Journal. Contributions are expected to start the review process by the end of 2009. Abstracts should preferably be no longer than two formatted pages, and abstracts of invited contributions no longer than three formatted pages.

Organizing Committee

- Prof. Daniela Basso – Dip.to Sc. Geologiche e Geotecnologie, Univ. Milano-Bicocca
- Prof. Grazia Vannucci – Dip.Te.Ris., Univ. Genova
- Dr Michele Piazza – Dip.Te.Ris., Univ. Genova
- Dr Giovanni Vezzoli – Dip.to Sc. Geologiche e Geotecnologie, Univ. Milano-Bicocca
- Dr Elisa Malinverno – Dip.to Sc. Geologiche e Geotecnologie, Univ. Milano-Bicocca
- Dr Annalisa Caragnano - Dip.to Sc. Geologiche e Geotecnologie, Univ. Milano-Bicocca

The fee is €180, students €100, accompanying persons €100.

There will be a one-day pre-Symposium field trip on 1st July on the topic of Triassic Evinosponges and calcareous green algae (cost, €100) and a three-day post-Symposium field trip on 3–5 July on the topic of the Tertiary Piedmont Basin (cost, €100). The latter trip will cover:

- Oligocene Characeae and Tracheophyta of S. Giustina (Savona)
- Oligocene coral and red algae reef of La Maddalena (Savona)
- Burdigalian rhodoliths of Ponzone (Alessandria)
- Serravallian rhodoliths of Stazzano (Alessandria)

For further details see the conference website at <**http://www.geo.unimib.it/ifaa/**>.

Darwin in the Field: Collecting, Observation and Experiment
Cambridge, England *11 – 12 July 2009*

In July 2009, the Sedgwick Museum of Earth Sciences, University of Cambridge will open a new Heritage Lottery funded permanent exhibition titled 'Darwin the Geologist'. This will showcase many of the rocks, minerals and fossils brought back by Charles Darwin (1809 – 1882) from his travels onboard HMS Beagle.

As part of the bicentennial celebrations of Darwin's birth, we are organizing a multi-disciplinary conference focusing on Darwin's work in the field, and have invited papers from earth scientists, zoologists, botanists, museologists and historians of science on the following themes:

- Collecting practices
- Experimental / Identification practices
- Systems of naming and classification
- Theorizing using collected specimens
- Field notebooks and drawings
- Early scientific education and mentors in scientific practice
- Use of Darwin's collections and/or specimen theorizing in historical or contemporary scientific practice

For further information, please contact Dr Lyall I. Anderson, Dept. of Earth Sciences, University of Cambridge, Downing St., Cambridge, CB2 3EQ, e-mail <**land07@esc.cam.ac.uk**>.

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

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

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

International Scientific and Organizing Committee (**as of April 2007**)
Co-Chairs:
Dr Jean Bernard Caron (Royal Ontario Museum, Toronto), <**jcaron@rom.on.ca**>
Dr Doug Erwin (Smithsonian Institution, Washington), <**ERWIND@si.edu**>
David Rudkin (Royal Ontario Museum, Toronto), <**davidru@rom.on.ca**>
Members:
Matthew Devereux (The University of Western Ontario), <**mdevereu@uwo.ca**>
Dr Stephen Dornbos (University of Wisconsin-Milwaukee), <**sdornbos@uwm.edu**>
Dr Sarah Gabbott (University of Leicester), <**sg21@le.ac.uk**>
Dr Robert Gaines (Pomona College), <**robert.gaines@pomona.edu**>
Dr Charles Henderson (University of Calgary), <**cmhender@ucalgary.ca**>
Dr Paul Johnston (Mount Royal College, Calgary), <**pajohnston@mtroyal.ca**>
Kimberley Johnston (Palaeontographica Canadiana), <**kimberley@paleos.ca**>
Dr George Pemberton (University of Alberta), <**george.pemberton@ualberta.ca**>
Dr Jean Vannier (Université Claude Bernard Lyon 1), <**jean.vannier@univ-lyon1.fr**>
Dr Xingliang Zhang (Department of Geology, Northwest University,Xian),
<**xlzhang@pub.xaonline.com**>
Dr Maoyan Zhu (Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences),
<**myzhu@nigpas.ac.cn**>

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

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

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

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

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

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

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

The International Symposium on the Cretaceous System will be held at the University of Plymouth, on 6–12 September 2009. The conference will be followed by a number of field excursions visiting Cretaceous locations in the UK. Themes for the meeting may include: 200th Anniversary of the birth of Charles Darwin, sequence stratigraphy and sea level change, Cretaceous oil and gas exploration in

the N.W. European Continental Shelf, Cretaceous stratigraphy, palaeontology, isotope stratigraphy, biotic and other events, regional geology and palaeoclimates. Papers will be solicited for peer-reviewed publication with submission of manuscripts at the meeting.

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

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

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

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

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

69th meeting of the Society of Vertebrate Paleontology and 57th meeting of the Society of Vertebrate Palaeontology and Comparative Anatomy
Bristol *23 – 26 September 2009*

The Palaeobiology and Biodiversity Research Group at the University of Bristol is proud to host the 69th Annual Meeting of the Society of Vertebrate Paleontology. This will be a momentous occasion for the Society, the first time it has held its annual meeting in Europe, and only the second time outside North America.

We will offer a number of special events to reflect the rich palaeontological heritage of the United Kingdom and mainland Europe. There will be the opportunity to participate in pre- and post-meeting field trips to the Isle of Wight, the Dorset Coast, Scottish Highlands and Islands, the Natural History Museum conservation unit and the famous fossil Lagerstätten of Germany, amongst others. Furthermore, there will be special events in honour of the centenary of the University of Bristol, the early study of Mesozoic reptiles (Anning, Buckland, Mantell, Owen), and of course Darwin. The year 2009 is Darwin year (the 200th anniversary of his birth, and 150th anniversary of the publication of *On the origin of species*) and there will be the opportunity to join a Charles Darwin Heritage tour, visiting Cambridge and Down House. Finally, as Bristol is home to the BBC Natural History Unit, we will offer an extensive programme on education and engagement in vertebrate palaeontology, including a special evening lecture by Sir David Attenborough.

We send a special invitation to all European vertebrate palaeontologists to consider attending the meeting. Membership of SVP is not required to attend. Further details, including booking details, may be found at <**http://www.vertpaleo.org/meetings/index.cfm**>.

The 5th International Conference on Fossil Insects, Arthropods and Amber
Beijing, China *20 – 25 August 2010*

The 5th International Conference on Fossil Insects, Arthropods and Amber will be held at Capital Normal University in Beijing, China from 20th to 25th August 2010. A series of scientific sessions – including plenary and special sessions, and special group meetings, in addition to mid-conference and post-conference field excursions – will be organized. Social events and programmes will also be arranged.

Preliminary schedule:

20 August: Registration and welcome reception
21 August: Opening Ceremony and group photo, Conference symposia and general sessions
22 August: Conference symposia and general sessions; Congress Banquet
23 August: Mid-conference social programme and conference excursion
24 August: Conference symposia and general sessions
25 August: Conference symposia and general sessions, workshops, Closing Ceremony
26–28 August: Post-conference field excursions

Abstracts for the meeting are due by 31st March 2010. A request for abstracts will be announced in the Second Circular, which will also have instructions for their electronic submission.

The mid-Conference social programme will be a visit to the Great Wall and Ming Tombs.

The post-Conference excursion will visit the Jurassic–Cretaceous Biota of Northern China: Insects, Feathered Dinosaurs, Basal Birds, Mammals, and Angiosperms. In recent years, the study of the Jurassic–Cretaceous Biota has been progressing rapidly in Western Liaoning of China. A lot of very significant fossils have been found in this area. Up to now, about 23 kinds of fossils in the Jehol and Yanliao Biota have been reported from Western Liaoning, including insects, dinosaurs, lizards, choristoderes, pterosaurs, birds, mammals, turtles, amphibians (anurans and salamanders), fishes, conchostracans, ostracods, bivalves, gastropods, shrimps, limuloids, spiders, ferns, gymnosperm, angiosperm, algae, pores and pollens. Western Liaoning of China is really a rare treasury of Mesozoic fossils and a magnificent place to study the origin and evolution of insects, birds, eutherian mammals and angiosperms. This trip begins and ends in Beijing, including two localities in Beipiao City, one locality in Chaoyang City and one locality in Lingyuan City of Western Liaoning.

The registration fee is US$350 (students US$200, accompanying person US$200), which will cover the expenses of the meeting resources and support, congress publication (congress special issues, abstract volume and programme, not provided for accompanying members), conference bag, T-shirt, tea and coffee breaks, all meals from 20th to 26th August, Mid-Conference social programme to Great Wall and Ming Tombs on 23rd August, icebreaker reception, and conference lunch and dinner. The Congress Banquet on the evening of 22nd August will be available for regular registrants without additional charge.

Note:

1. Registration fees are subject to modification depending on the exchange rate between the Chinese Yuan RMB and US$. The rate of exchange on 23rd January was US$100 = 680.37RMB Yuan.)

2. Payment: A down-payment for the meeting and field trips will be requested in the Second Circular. The balance will be due at the time of the meeting, payable in US$.

3. Outstanding students and distinguished retired palaeoentomologists may apply for limited financial support (free of charge for Registration Fees and Accommodation from 20th to 26th August). All applicants should give an oral presentation and contribute an original manuscript to the Proceedings for evaluation by the Organizing Committee.

If you would like to receive the Second Circular with the programme outline, registration and abstract forms and the application for accommodation, please contact the Conference Organizing Committee before 31st December 2009 at the address below:

Prof. and Dr Dong REN
College of Life Science
Capital Normal University
105 Xisanhuanbeilu, Haidian District
Beijing, 100048
P.R. China

E-mail: <**rendong@mail.cnu.edu.cn**>
<rendongprof@yahoo.com.cn>
Fax: 0086-10-68980851
Tel: 0086-10-68901757 (office)
Cell: 0086-13661048193

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

The ammonoid hunter in the snow: A wintry fieldtrip around the Trias of Jena

As my current research project on the ammonoids of the Muschelkak required a trip to the Staatliches Museum für Naturkunde Stuttgart, I decided to go via Jena – a classic area for Muschelkalk research during much of the 19th century – for a one-day fieldtrip. I must insist on describing this as a fieldtrip, after a rather depressing conversation with Alan Owen (Glasgow) during preparation of a grant application, during which he explained that we are not supposed to use the term 'fieldtrip', as it does not sound serious enough. Apparently 'field class' or 'fieldwork' are how we must now refer to the part of geology (and other field-based sciences) which offer the attraction of getting outdoors. Going in early December was chancing it with the weather, but years of working outdoors in Scotland have vernalized me sufficiently to handle most weather – except, of course, the heat.

Jena retains the feel of a medieval city, which is fine during the day once you have worked out the layout of the town, but not so good when you arrive at night and try to find your way to your accommodation with the inadequate map you downloaded. The backpackers hostel I had booked into turned out to be cunningly located on the top floor of a corner block that housed a number of medical practices, which left me wandering up and down Semmelweg unable to find it, despite the help of several passers-by. I headed into the centre to use the Internet, but stumbled across an Irish pub and applied the logic that other backpackers are often to be found in Irish bars across the world, even in Ireland. So I entered to make enquires. No-one had heard of the place I was booked into, but Andreas, a historian, kindly made a few phone calls and got the correct address for me.

After this inauspicious start to my visit, things improved when I got into the hostel. My instinct that Jena was not on the main backpacker trails and would be quiet in December was correct. I got a six-person room all to myself for two nights for €30. Hostels have changed a lot in the past twenty years and I regularly use them in preference to hotels. Hostels often have better Internet facilities than hotels, access to a kitchen and a chance to meet people, compared to the 'boxed life' of staying in a hotel. As they are usually half the price of a hotel room, this can keep down costs for research trips. Sylvester-Bradley applicants take note! On top of my good fortune with the room, when I asked at reception about hiring a bike the man working at the desk kindly offered to lend me his bike, although this was a mixed blessing, as I will explain as I recount the next day's field activities.

Saturday dawned, or rather became less dark, with steel grey sky and sleet on the wind. After fortifying myself with the substantial breakfast buffet that is one of the glories of German cuisine, I headed off to explore the Muschelkalk. Around Jena the older beds of the Rot (top of the Bund) and the Lower or Unter Muschelkalk outcrop on the Jenzig to the NE of the city, while the more ammonoid-rich succession of the Upper or Oberer Muschelkalk lies in the forested hills to the west. Some good fortune in the German Geological Survey (BGR) collections housed at Spandau

Fig 1: The Jenzig

meant I had a number of sites more clearly defined. My plan was to spend a couple of hours on the Jenzig, then go ammonoid hunting in the western hills in the afternoon.

I started off on the bike and quickly realized it was going to be a less than trusty steed. Rather than the mountain bikes I am used to, with such cunning devices as 18-24 gears and powerful front and back brakes, the bike I had borrowed had a coaster rear brake, which you back pedal to use, and the German equivalent of Sturmey-Archer 3-speed gears. Jena is a rather hilly city, and combined with wet cobbled roads the first ten minutes were a bit perilous.

However, I made it to the Jenzig (Figure 1) and having ascertained that the bike was not up to the ascent of the cycle path, I headed up the hill on foot. The first fossils I encountered were in blocks that had been used to build the small shelter in Figure 2. German and Austrian hills always seem to be dotted with shelters and painted route markings, which I find very different from the austere Scottish mountains where cairns mark the paths and provide some shelter from the wind, if you're lucky. The blocks had come from higher up the succession, as the bedrock at this level was the Röt.

Fig 2: shelter

Once I crossed the boundary bed into the Lower Muschelkalk I started to use the steeper paths rather than the switchback cycletrack. The steeper paths offered good, if small, sections of the beds. Finally I reached a weathered slope on the nose of the hill and spent half an hour picking over the area (Figure 3). My hopes of finding some specimens *Beneckia buchi* were not realized, but the slope had many bivalves and brachiopods from higher in the succession.


Fig 3: path up the Jenzig

German and Austrian hills and mountains seem to have a plethora of buildings on top of them and the Jenzig was no exception. When I got to the top, streetlamps and a bistro graced the top of the beds. However, it was a little early in the day for the inn to be open, so I descended by the cyclepath, which offered some extensive sections of the Lower Muschelkalk beds. The whole of the southern slope has exposure, as Hagdorn, Simon and Szulc (1991) describe in their field guide written for a 1991 field trip that took advantage of the fall of the Iron Curtain, although the scrubby vegetation is thicker than it was when the field guide was written.

Cutting across the north side of Jena took me towards the forested slopes where I hoped to find some ammonoids. The names of a number of small towns and villages were familiar to me from the BGR collections, so I decided to head for Münchenroda. The roads were steep, with some exposures of rock on the sides, as well as small streams downcutting onto the bedrock. However no ammonoids were forthcoming. The beds were rather unproductive, although dripping water and a covering of dead leaves were not providing the ideal conditions for fossil hunting. Münchenrodastrasee became steeper and steeper, providing many small exposures in driveways, but by now I was pushing the bike and looking forward to reaching the plateau. I emerged onto the plateau to be greeted by a biting north wind and sleet. And, of course, the next town – Großschwabhausen – lay more or less due north.

When I reached Großschwabhausen I decided to make for Remderoda via the cycleway through the forest, rather than head back onto the windswept plateau. As it turned out, this was not the best plan. The sheltered conditions on the forested north-facing slope were also providing ideal conditions for snow to lie, and the cycletrack was mostly covered in sheet ice. The journey to rejoin the main road was rather fraught, including a steep descent and the chain coming off the drive. As this was a town bike, a chainguard was fitted, making remounting the chain tricky, so I reverted to using it like a draisienne, the first bike which lacked pedals or brakes and which was invented by a German forest ranger Baron Karl von Drais to get around more quickly in the forest. The draisienne survives in Germany in the form of the


Fig 4: walls

Laufrad (running bike) for children. I regained the main road and fixed the chain and was able to examine some more outcrops, but alas not a ceratite in sight.

By now it was mid-afternoon, so I decided to return to Jena and have a look at the buildings, many of which were built from blocks quarried from the Muschelkalk (Figure 4). Sure enough, in the failing light I came across a set of stone fence posts stuffed with fossils (Figure 5). Then it was time to head to the Irish pub and its wall of whisky.

Fig 5: pillar with fossils

Although I didn't find any ceratites, the fieldtrip was not entirely wasted, as it raises the question of exactly where these fossils came from and whether they were collected by the listed collectors, or whether as I suspect they were found by quarry workers, foresters and farmers and passed on to geologists and palaeontologists. Sometimes it is what you don't find that can be revealing too.

Acknowledgements

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Al McGowan
Newsletter Reporter

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Sylvester-Bradley REPORT

Skull function and evolution in Choristodera (Reptilia: Diapsida)

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Choristoderes are an enigmatic group of extinct aquatic reptiles that show considerable morphological diversity in terms of size, neck-length and skull shape. Our knowledge of Choristodera has grown disproportionately in the last few decades. Until the mid-1970s, only two genera (*Champsosaurus* and *Simoedosaurus*) were recognised, limited to the Late Cretaceous/Early Tertiary of Euramerica (*e.g.* Cope 1876; Brown 1905; Erickson 1972; Sigogneau-Russell and Russell 1978). In the intervening period, nine further genera have been added by new discoveries and by reassessment of existing specimens, extending the temporal range to more than 150 Ma and revealing an unexpected diversity in Asia (*e.g.* Evans and Manabe 1999; Gao *et al.* 1999; Gao *et al.* 2000). However, many questions remain with respect to their origin, sister group, evolution, internal relationships, distribution and functional anatomy.

Derived neochoristoderes are characterized by snout elongation and skull flattening – modifications that occur in other fish-eating animals including dolphins and gavials. They also have wide temporal openings, supposedly to house jaw muscles. However, in more basal members of the group, these openings are smaller and may even be closed (*e.g.* Evans 1990; Gao *et al*. 2000). In order to explain these differences, we need to understand the functional morphology and lifestyle of the animals concerned. However, any discussion of the evolution of functional traits must be made against the background of a robust phylogeny, and this is a problem. Although recent phylogenetic trees are similar in many respects, there are two controversial areas:

1: The basal taxon: Most recent cladistic analyses have placed the youngest (Oligocene–early Miocene) choristodere, *Lazarussuchus*, at the base of the clade, one step below the oldest known genus, *Cteniogenys* (Middle–Late Jurassic) (*e.g.* Evans 1990; Evans and Manabe 1999; Ksepka *et al*. 2005). In fact, Gao and Fox (1998) removed *Lazarussuchus* from Choristodera, placing it as the sister taxon of the clade. However, my preliminary analysis placed *Cteniogenys* as the basal taxon (Matsumoto *et al.* 2007), and *Lazarussuchus* in a more crownward position (a better stratigraphic fit).

2: The relationships of non-neochoristoderes: The positions of Chinese and Japanese genera (*Monjurosuchus*, *Philydrosaurus*, *Shokawa*, and *Hyphalosaurus*) vary in relation to one another and to the crown clade Neochoristodera (*Champsosaurus*, *Simoedosaurus*, *Tchoiria*, *Ikechosaurus*).

These problems reflect the instability of the phylogeny; the topology is easily changed by small differences in character coding. To address some of these problems, some of my project goals were to:

1) revise the existing character list and re-define ambiguous characters (*e.g.* the designation 'large' or 'small' without a point of reference);

2) fill in missing data on Lower Cretaceous Chinese taxa *Philydrosaurus*, *Hyphalosaurus* and *Monjurosuchus* by direct examination of specimens;

3) identify additional characters (*e.g.* in the palate, braincase, postcranium).

The Chinese genera are of particular importance because they include new morphotypes (*e.g.* long-necks; closed lower temporal fenestrae) and a range of sizes and taxa, but much of this material has not been adequately described. The most recent cladogram is shown in Figure 1.

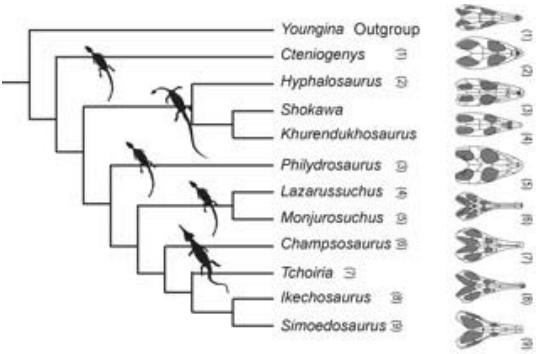

Figure 1. Hypotheses of relationship of Choristodera using one outgroup, Youngina *(Modified from Matsumoto* et al. *2008).*

The Sylvester-Bradley Award allowed me to travel to the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) in Beijing (Figure 2), which holds the largest collection of choristoderes in China, including type specimens. This trip gave me an opportunity to examine *Hyphalosaurus*, *Monjurosuchus* (Figure 3) and *Ikechosaurus* at first hand.

Figure 2. IVPP Paleozoological Museum Director, Dr Yuan Wang (right) and the author (left) at the IVPP museum entrance.

Figure 3. One of the remarkable specimens of Monjurosuchus splendens *(IVPP V13761) with seven juvenile skulls in the abdominal cavity (Wang* et al. *2005).*

In addition to the phylogenetic data, examination of the original material allowed me to collect anatomical data that could not be obtained from photographs, notably: muscle attachment areas (occiput, jaw); suture morphology and bone thicknesses; details of the marginal and palatal dentition. These data will make a major contribution to my thesis work.

Some IVPP *Hyphalosaurus* specimens show clear cranial sutures in dorsal view, which were not obvious in previous descriptions (Gao *et al.* 1999; Gao and Ksepka 2008). In addition, a juvenile *Monjurosuchus* specimen has a well-preserved palate that fills missing data points in the data matrix for phylogenetic analysis and provides new information on the

palatal dentition. I was also able to study some isolated cranial elements of *Ikechosaurus* which had been only briefly described, but not figured, by Brinkman and Dong (1993). These specimens provide information on suture morphology. In addition, re-examination of *Ikechosaurus* cranial and cervical morphology permitted re-coding of some characters in the data matrix and gave new information on muscle attachment and palatal tooth morphology. All data were recorded by digital photographs and detailed drawings under a stereomicroscope.

A new phylogenetic analysis using these data is a part of my PhD project, but the main goal of the thesis is an exploration of the functional morphology of the skull in choristoderes using data from tooth shape, skull sutures, neck length, muscle attachments *etc*, as well as morphometrics. That part of the new data will be presented in future conferences and papers.

Acknowledgements

I would like to thank the Palaeontological Association for the Sylvester-Bradley Award that made this visit possible; Dr Yuan Wang (IVPP) for hospitality and access to its collections; Dr Fang Zheng (IVPP), Mr Binghe Geng (IVPP) and Ms Shuqin Duan (IVPP) for access to collections; Mr Jack Tseng (University of Southern California) for helping take photographs; Mr Zhiheng Li (IVPP) for his guidance at Beijing airport; Professor Susan E. Evans (UCL) for continuous advice and support; Dr Marc E. H. Jones (UCL) for checking this manuscript; and my family, Machiko Matsumoto and Shinichi Fujiwara, for support.

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Graduate Opportunities in Palaeontology!

Students: Do you want to study for a postgraduate qualification (MSc, MRes, PhD etc.) in palaeontology or a related discipline in the UK or abroad?

If the answer is YES then please check out the home page of the Palaeontological Association (<**http://www.palass.org/**>) and follow the link to "Careers & Postgrad Research".

These pages will be updated regularly over the coming months, so don't forget to check back at regular intervals!

Researchers: Do you want to advertise your palaeo-related MSc course or PhD to as many students as possible?

If the answer is YES then please send details of your courses/projects to the Newsletter Editor. These details will then be posted on the Association website and will be published in a forthcoming edition of the *Newsletter*.

For available PhD titles please include the title, the names of all academic advisors and a contact email address. For MSc and other graduate courses please include a brief descriptive paragraph, a link giving details of admission procedures and a contact email address or telephone number.

Current MSc opportunities in palaeo-related subjects

MSc in Palaeobiology: University of Bristol, Department of Earth Sciences

The MSc in Palaeobiology offers a broad-based overview of modern approaches in palaeobiology. Students study nine out of 14 possible options, and topics range from taphonomy and palaeoecology to dinosaur and mammalian palaeobiology, to trace fossils and arthropod palaeobiology, and systematic methods. Then there is a six-month independent project, and students are offered a wide range of topics. The programme is designed for students with a BSc in either a biological or an earth sciences subject, and conversion courses in evolutionary biology and sedimentology are offered. Students also receive training in writing scientific papers, creating websites, applying for Ph.D.s and jobs (both in Britain and overseas). So far, 160 students have graduated, and many have gone on to rewarding careers in palaeontology and related scientific areas.

The project is a major component of the degree, and we encourage students to carry out cutting-edge work and to present it in publishable form. So far, some thirty MSc projects have been published, and we aim to help and encourage students to publish as many as possible.

Full details of the programme, of former students, and of how to apply are available on the course website at <**http://palaeo.gly.bris.ac.uk/MSc/index.htm**>.

Application forms may be downloaded from the website, or can be provided by contacting <**earth-msc@bris.ac.uk**>.

MSc in Geobiology at Cardiff University

Cardiff University School of Earth and Ocean Sciences introduced a new taught one-year MSc degree course in Geobiology in September 2007.

Geobiology is a rapidly developing interdisciplinary and holistic approach to Earth and Life sciences. It explores the inter-relationships of life and environment on Earth and their consequences for both.

The course reflects Cardiff's research strengths in areas such as climate change, geomicrobiology, and palaeobiology. The Geobiology MSc consists of Taught Courses (late September to April) followed by a Research Project (May to mid-September). The taught courses include: Biogeochemical Cycles, Climate Change, Geobiology Frontiers, Geobiology Residential Field Course, Geomicrobiology, Marine and Terrestrial Biospheres Past and Present, and Transferable Skills.

Cardiff is a friendly and vibrant capital city, and the School of Earth and Ocean Sciences is a leading centre for research and teaching. We welcome applications from students with backgrounds in Earth Science, Environmental Science, or BioScience.

For further information see our website at <**http://www.earth.cardiff.ac.uk/**>, or contact Emma Paris by sending email to <**parisec1@cardiff.ac.uk**>.

MSc in Advanced methods in taxonomy and biodiversity: Imperial College London

Imperial College London College of Science, Technology and Medicine and The Natural History Museum are jointly offering a Masters degree course in Advanced Methods in Taxonomy and Biodiversity.

The one-year full-time MSc course provides essential skills for all concerned with taxonomy and biodiversity. The course is composed of ten taught modules followed by a four-month research project. The series of modules seeks to provide as wide as possible an overview of the theory and practice of modern taxonomy and systematics, with associated biodiversity studies. During their four-month research project, students can specialise in their chosen area.

The course is based at The Natural History Museum, London, one of the world's premier institutions for research on the diversity of the natural world. The collections include over 68 million specimens, 800,000 of which are type specimens, and the Museum houses a world class library covering all areas of taxonomy and systematics. The Museum is situated next to the main South Kensington campus of Imperial College, and there are close research and teaching links between the two establishments. Students will therefore be situated in the heart of London, and able to make full use of the facilities at both institutions.

Students are trained to a high level of competence in systematics and a detailed understanding of the various uses and problems involved. The course provides methodological background, including quantitative skills, computer applications and practical skills in morphological and molecular techniques of taxonomy and systematics. The most up-to-date ideas and research in taxonomy and biodiversity are taught, to a large extent from primary literature. Hands-on training in conducting research in this area will be provided by project supervisors, with specialisation in the student's field of choice.

After completing the course, students will be able to:

- apply a wide range of techniques to the study of systematics, including collections management, identification, key construction, taxonomic revision, phylogeny reconstruction and comparative methodologies;
- understand the diversity of living organisms in space and time, and be familiar with methods for measuring this diversity and monitoring changes due to both anthropogenic and natural factors, and in Earth history;
- select appropriate methods to solve taxonomic and biodiversity problems, and be able to acquire and analyze taxonomic data, including both traditional and molecular data;
- understand fully the conceptual basis of taxonomy and phylogenetics, and in particular, cladistics, and to understand "biodiversity" within this framework;
- apply these concepts to issues of biodiversity and conservation management and research, to set priorities for sustainable development, environmental assessment and inventories;
- apply these concepts to other areas of biology such as parasitology and epidemiology.

Who is this course aimed at?
The course is aimed at anyone concerned with taxonomy and biodiversity. It is relevant to those involved with biodiversity assessments, conservation and sustainable development, from biomedical sciences to agriculture and fisheries, as well as to those intending to pursue academic careers in systematics and related fields.

Entry requirements:
Applicants should normally either have or expect to gain at least a lower second class honours degree (or equivalent) in a biological or environmental subject (*e.g.* zoology, botany, microbiology, agriculture, veterinary science). Exceptionally, students with different backgrounds or with related work experience will be considered.

Further details:

Please contact Ms Amoret Brandt, Department of Entomology, Natural History Museum, London SW7 5BD, UK (tel +44 (0)20 7942 5036, fax+44 (0)20 7942 5229, e-mail <**a.brandt@nhm.ac.uk**>).

MSc/MRes in Global Environmental Change: University of Plymouth, School of Earth, Ocean and Environmental Sciences

The MSc/MRes in Global Environmental Change is a one-year, full-time course which aims to provide opportunities within a multi-disciplinary environment to gain both theoretical knowledge and practical experience in understanding the scientific basis of past, present and projected future environmental change. Quantitative, multi-disciplinary training is provided for Earth, Marine and Environmental scientists together with graduates from biological or other scientific disciplines.

The course emphasises applying scientific knowledge largely through practical application to real environmental problems. The key objectives of the course are to provide:

- an understanding of the operation of the climate system, and its interactions with other elements of the Earth System (oceans, biosphere, *etc*);
- an understanding of variability in the global environment, now and in the past, and the methods by which long-term temporal variations can be reconstructed and explained;
- experience of the fundamentals of key data-gathering processes and methods (*e.g.* electron microscopy, remote sensing, marine and non-marine palaeoenvironments, isotopic and geochemical techniques);
- insights into aspects of biological diversity;
- an assessment of the basis of future climate prediction, primarily through numerical modelling experiments.

The Global Environmental Change course provides an interdisciplinary approach designed to evaluate the potential impacts of global change; a critical assessment of the political responses to scientific advice on 'global warming'; and aims to develop and promote a sense of independent enquiry and the development of investigative and research skills, addressing particular aspects of environmental change.

Further details and application forms:
Please contact the Postgraduate Admissions Team, Faculty of Science, University of Plymouth, Drake Circus, Plymouth PL4 8AA, United Kingdom (tel +44 (0)1752 233093, e-mail <**science@plymouth.ac.uk**>). University bursaries may be available.

MSc/MRes in Micropalaeontology: University of Plymouth, School of Earth, Ocean & Environmental Sciences

This programme in Micropalaeontology operates within a scheme involving a range of M-level subjects in the Earth, Marine, Environmental and Biological Sciences. In the first term a range of taught courses are offered, including both subject-based topics and skills training. After this is completed satisfactorily, students pursue a major research project from January to mid-September (for the award of MRes). This may be based on field samples collected by the student, samples provided by an industrial sponsor, samples requested from the Ocean Drilling Programme, or other samples in the collections of staff. Projects undertaken by students in the last few years include foraminifera from Plymouth Sound, sea level change in S. E. Italy, foraminifera from the Cretaceous/Palaeogene boundary in Texas, foraminifera from the Callovian "Squid Bed" in Wiltshire, and the use of foraminifera and stable isotope stratigraphy in dating volcanic activity on Montserrat, Caribbean Sea. During this period of research, students have to generate assessed reports and give a full seminar presentation on their research. The MSc students are involved in three further modules during the Spring Term, after which they embark on a research project (May to September).

Further details and application forms:
Please contact the Postgraduate Admissions Team, Faculty of Science, University of Plymouth, Drake Circus, Plymouth PL4 8AA, United Kingdom (tel +44 (0)1752 233093, e-mail <**science@plymouth.ac.uk**>). University bursaries may be available.

MSc in Geology by Research: Royal Holloway University of London, Department of Geology

This programme is offered to prospective students who wish to pursue research in a selected field of the Geological Sciences for a period of one calendar year full-time or two calendar years part-time and be awarded a Masters degree. Students will receive training in research skills, including data collection, data handling and analytical techniques as well as transferable and presentation skills. Students will take a course in a subject area closely related to the chosen field of research, selected from a menu of masters level courses offered by the department. The main outcome of the programme is a piece of independent research presented in the form of a dissertation. Upon completion of the programme students will have gained experience of research and presentation of material in the geological sciences which equips them to publish work in international scientific journals.

Prospective students should contact individual members of staff in the department to discuss potential research projects. The research interests of staff are available on the department website at <**http://www.gl.rhul.ac.uk/staff/acad.html**>.

The life cycle of *Alumnus orientalis* – an account of graduate study in Japan

It is over 30 degrees and there are copper-coloured snakes winding in and out of the bushes. Just out of the corner of your eye it's a worrying 500 metre drop down to the paddy fields below, where dragonflies the length of a child's forearm lance in and out of the Japanese *sampa* hats worn by the farmers. In central Kyushu, the Permian/Triassic boundary is recorded as an evil-looking black line slung at a shallow angle across the cliff face. Below the boundary the limestones are a pasty yellow colour and devoid of any recognisable fauna – a dead and sterile time in the history of the great ocean Panthalassa. Immediately above, the rocks become black and mottled-looking, dark peloids are strung across the rock like pearls on a string and stacked into narrow layers that can be traced for several metres across the rock face. You can see that thin threads of micrite are woven in and around the laminae, producing an unsettling, and overwhelmingly organic texture reminiscent of the wispy mycelium you find growing on old leftover lasagne. This is a particularly lovely corner of Japan in Summer time, and just one of a thousand sites with rich invertebrate fossil assemblages. There's certainly plenty to work on in Japan, enough at least for an MSc and PhD, and the great news is that the Japanese Government could be paying you to study there.

For those of you who read Al McGowan's account of doing a PhD in the United States (<**http://www.palass.org/modules.php?name=palaeo&sec=careers**>), this article is very much in the same vein and I hope that it will provide the stimulus for other students to conduct graduate study outside of the UK. I've just finished studying for my MSc at the University of Tokyo, piggybacking into the graduate programme via a Japanese Government Monbukagakusho (MEXT) scholarship. Being awarded the MEXT scholarship and entering into the graduate programme of your choice at a Japanese university are two separate processes, and as far as possible I shall try to separate the two. In addition, although my experiences with the University of Tokyo were limited to a brief period as a research student and then MSc, there's no reason why this article should not be of help to aspiring PhD candidates too (indeed, a French student, David Casenove, is in the process of writing his PhD on the palaeobiology of protoconodonts in Tokyo at this very moment). The MEXT scholarships (as well as their larger cousins, the JSPS fellowships – see <**http://www.jsps.go.jp/english/**>) are a tremendous resource for scientists and students pursuing any aspect of graduate or postgraduate study, and I hope this article will encourage some of you to consider research in Japan.

The Monbukagakusho (MEXT) scholarships

The best place to find out about the history of these scholarships and the process of application is on the Japanese Embassy website (in the UK: <**http://www.uk.emb-japan.go.jp/en/study/mext_postgrad.html**>). There is an extensive series of scholarships, available to all nationalities, which fund students at any stage of their careers to undertake a two-year period as a 'Research Student' at the Japanese University of their choice. Once enrolled at a particular university, it's possible to enter into graduate degree programmes, and although sometimes tricky, this process is often facilitated by your 'host' supervisor. Whilst you are under the auspices of the MEXT scholarship, the Japanese Government will pay all tuition fees required by your university. During my time at the University of Tokyo I met a Bulgarian student studying the content of Tokyo train announcements, a French

post-doctoral student who is the world's greatest authority on translating ancient Japanese texts, and innumerable postdoctoral physicists who all lived in an entirely separate world of their own devising. The message here is that the MEXT scholarships are open to people of all nationalities, in all conceivable disciplines, and to students at all stages of their career. The scholarship provides a generous monthly stipend (currently 160,000 yen, which is about £1,150 at present exchange rates[1]) which is comfortably enough to live on (especially if you arrange student accommodation), visa sponsorship, and will also pay for your flights to and from Japan at the beginning and end of your tenure. In short, it's an incredibly good deal for an aspiring palaeontologist. Applications for the 2010–2012 scholarships will begin in April 2009.

The most important part of the application process will be establishing contact with a host supervisor: a member of academic staff at your chosen university who will be responsible for you during your time there, and will fill in the other half of the application. This is also the hardest part as Japanese academics can be a bit on the reclusive side or can merely be confused at receiving an exquisitely worded email in a language they don't necessarily understand. For this reason it is *crucial* to research the members of academic staff with whom you'd like to work, before trying to drum up their interest in taking on an international student. It helps to have a convincing reason for coming to study in Japan, be it a specific field locality, a specific project, or merely because you'd like to be supervised by someone who sets the global standard in his/her field. In addition, I discovered that it is often enormously helpful to maintain contact with a member of academic staff back in the UK, with whom you can discuss aspects of the project, and/or eventually publish the results (I've listed a few good reasons for this in later sections). I was extremely fortunate to have Dr Richard Twitchett as a co-supervisor for my MSc work, and he was kind enough to correct errors in my science and proofread the final thesis – things which for various reasons were not always possible in Tokyo. I also received informal supervision from international post doctoral fellows, notably Drs Aaron Hunter and Andrzej Khaim, for which I am eternally grateful.

Graduate degrees at Japanese universities

Unlike the UK, MSc degrees in Japan typically last two years, and if you add on several months at the beginning to allow for your entry through MEXT and application to graduate programmes, you can be looking at two-and-a-half years to complete your Masters – a lot longer than in the UK. A PhD can take between three and five years, similar to the Unites States, although the last two years may not be funded. As a scientist, the first year of your studies (MSc or PhD) will include attending a number of courses, on the way to accumulating the necessary number of credits for graduation. At

[1] The present exchange rate is around 140 yen to the pound, but over the past five years or so has typically stood at around 200 to the pound – *Ed*

the end of your first year you will probably have to submit a literature review on your chosen topic of research, and at the end of the second year a written thesis that you will have to defend orally in front of the department faculty. Again similar to the United States, you can be flexible in your areas of research and will be able to design your own project, rather than having to audition for an assigned topic. As an MSc student, this gives you a huge boost in developing the skills necessary for independent research, and supervisors will commonly grant you the freedom to pursue whichever weird and wonderful approaches you fancy (although this can be problematic if you want them to take part). You will commonly have to fund any fieldwork yourself, however in many cases the MEXT monthly stipend will cover some of this, and some labs will have their own sources of funding which can be co-opted to research projects. Departments are not a single entity and cost centres are related to labs or seminar groups connected to one or two facility members, so that equipment, lab space and general costs are directly related to your supervisor and can be a bit of a lottery.

I spent a total of two weeks fieldwork collecting microbial carbonates from an obscure backwater in the southernmost of Japan's four large islands, and funded this extravagant research schedule through variously pouring drinks in 'alternative' bars around the rough end of Shinjuku, appearing in bizarre TV commercials and appallingly revisionist period dramas, scientific proofreading, and teaching pidgin English to aspiring young air-hostesses. It says a lot for Japan that most of these are considered perfectly normal pastimes for visiting foreign scholars, and I have friends who explored plenty of more unconventional ways to secure funding for their research. Part-time work in Japan is perfectly legal for foreigners and you may well end up being paid in cash. While on a MEXT scholarship, however, you will need to apply for the cumbersomely named 'Permit To Engage In Activity Other Than That Permitted By The Status Of Residence Previously Granted'. These are valid for a year and will be provided by the University.

Accommodation

The University of Tokyo possesses a variety of dormitory blocks and apartments for foreign students, at a reasonable price. After talking to other MEXT students, this appears to be true for most other universities around Japan. The cheapest of these in Tokyo, by far, is the International Lodge Komaba, situated conveniently in the most attractive of the University's three campuses and priced at 15,000–20,000 yen a month (currently £110–145, and a fraction of your monthly MEXT stipend). For this paltry sum you get a small but serviceable room, full en-suite (micro-) kitchen and (nano-) bathroom facilities, and a balcony that overlooks the most happening and interesting parts of town. If you want to guarantee a place in student accommodation, it is best either to contact your supervisor in advance, or to speak directly to whoever is directly responsible for international students at the university. Some

of these lodges put a limit on the amount of time that you can stay there (in the case of the international lodge, six to 12 months), after which you'll have to find accommodation elsewhere. This can be a tortuous process if attempted alone and without fluent Japanese, so it's best to enlist the help of your supervisor or a fellow student, apply to one of the gaikokujin guesthouses around the city, use the university realtor, or gain entry into one of the other international lodges (which will require application in advance).

Cost of living

I overspent at times in Tokyo and had to be bailed-out by family and friends at least once, however this was pretty inexcusable as, surprisingly, the cost of living in Japan can be scandalously cheap, especially if you consider that a bowl of noodles and dumplings in pork broth is a decent meal (it really is). For 1000 yen (currently around £7), even in Tokyo, you could buy between eight and ten plates of sushi at one of the cheaper revolving *kai-ten* restaurants; the aforementioned bowl of noodles and Chinese dumplings; or a sizzling pancake of pork and vegetables cooked on a hotplate at your table. If you want to eat western food life can get considerably more expensive, particularly for things like cheese, sausages and fresh fruit. Cooking for yourself becomes an incredibly cheap option as soon as you invest in a rice cooker, since seasonal fresh fish and vegetables cost very little and are a staple on top of rice if you know how to cook them. Imported beer can be expensive, but Japanese *sake* and *shochu* for example are delicious and can cost very little. Food is also easy to get hold of, as there are 'combinis' located virtually everywhere, and the vast majority are open 24 hours. Vegetarians may struggle initially (especially those who eschew fish), but vegetables are cheap and the Japanese have an amazing array of soya-based alternatives – there's even an entire style of cooking devoted to it. Moreover, most Japanese food is extremely low in cholesterol, although can be high in salt.

Health insurance is a must and relatively easy to sort out; MEXT will talk you through all the documents and afterwards all you have to do is pay a monthly premium of 800 yen (currently £5–6), payable in cash at any of the ubiquitous convenience stores. For things like field trips, Winter sports, and other strenuous activities the university will have all the relevant documentation and a year's coverage will rarely cost 4000 yen (currently £30). I've never driven a car in Japan (and never needed to, the public transport system is both cheap and superb) and so can't comment, however you'll need an international licence to start with. Practical things like field kits start out relatively cheap, although don't appear to have an upper limit in price. Laptops and computer hardware can be cheap: while wandering round Tokyo's electrical district in Akihabara I've seen new and used laptops for under £150 stacked in boxes outside in the street like a jumble sale. Added to which, the average Japanese university student has a keen sense for everything electrical/electronic, so with a little help it's extremely easy to install the equivalent of a Ferrari engine, spoiler, and under-dash UV lights.

Language

This is difficult, because although it obviously helps to arrive in the country with a working knowledge of Japanese, proficiency in the language is not required either for application for a MEXT scholarship, or to enter many of the university graduate programs. I arrived in Japan with absolutely none. Part of the MEXT scholarship involves an optional free four-month intensive (typically four to eight hours, five days a week) language course upon arrival. I probably don't have to stress how valuable this is but I will briefly outline the benefits.

At the University of Tokyo these courses are superbly taught, and are extendable for as long as you wish on a part-time (around four hours a week) basis for as long as you want, and at whatever level (it's quite possible in fact to start from scratch upon arrival, and end up after five years with a PhD and fluency in Japanese – and I'm sure many have). Over the course of nearly three years I received well over one million yen's worth of free language tuition, which elevates you to conversational level, allows you to interact with your colleagues in the lab, and crucially allows you to understand what the lectures and seminars are about. Much of the material covered in the lectures will be required when you write exams at the end of the first year and, although you will generally be allowed to write in English, the University may well not translate the questions. If any of you are daunted by the prospect of learning Japanese then you shouldn't be; it's not a tonal language like Chinese, it's logically constructed in terms of grammar, and 80% of the time the circumstances (academic or otherwise) will only demand a basic knowledge. Increasingly, Japanese students are being encouraged to write – and more importantly, publish – in English, meaning that Japanese universities will often be thrilled to have you.

Funding

Funding will vary between universities, as well as within departments. If you are designing a research project that requires field trips to the Bahamas or run time on expensive equipment (especially in different departments) then it's obviously wise to consult your host supervisor first. As mentioned already, at MSc level you'll be funding things like fieldwork yourself, which can usually be covered by the MEXT stipend and/or proceeds from part-time employment. At PhD level, departments may well have more funding to contribute towards certain projects, and will encourage you to apply to external sources of funding (typically JSPS). Doing part-time teaching assistant work is also typical for PhD students, and can be a useful source of income.

Academic Culture and Research Environment

This is the really tricky section; the ease with which you can communicate and cooperate with your lab and supervisor will vary enormously depending on where you are, whom you're working with, and your knowledge of Japanese language and/or lab protocol. I can offer some general guidelines but they will certainly not be applicable everywhere.

My experience of research at the University of Tokyo was that it encouraged a large degree of independent, autonomous research at all levels of graduate and postgraduate study. Faculty and members of staff typically supervise a large number of students working on a wide range of subjects, so sometimes won't be able to offer a vast amount of expert advice on the specifics of your topic (or being busy, may not be able to see you all that often). Cooperation between labs is

also scarce, and gives rise to a multitude of bureaucratic issues when, for example, you wish to use an SEM or preparation room belonging to another lab. Students belonging to the palaeobiology seminar group in Tokyo would rarely collaborate if supervised by different members of staff, even when working on the same problem or field area. There are obvious downsides to working in this sort of environment, and it may occasionally be frustrating; however there are a number of positive aspects:

1. Students as early as MSc level quickly pick up the sorts of skills that are necessary for being successful in independent research. Masters students design their own projects and approaches, and often organise and undertake solo all their own fieldwork.

2. The main forum of supervision is within the seminar group, with members of staff taking on large numbers of students in a variety of disciplines. The students are required to present their research often and in front of the entire group. This ensures a broad spread of supervision and expertise.

3. Facilities are usually superb, and, using a little initiative, you have the freedom to develop your own experience with a huge range of extremely high-tech and powerful equipment.

4. The relative isolation actually encourages you to seek out and collaborate with other foreign researchers, regardless of the field they work in. My own research was based on ecological recovery from mass extinction events. However, two years is a generous allowance for an MSc and I used the time to collaborate with British, Polish and Japanese scientists (outside of my own group) on material ranging from crinoid palaeoecology to Holocene diatom records and glacial retreat. This sort of interdisciplinary upbringing is invaluable to a well-rounded education in the Earth Sciences and becomes tremendously useful when approaching a PhD.

In terms of more general cultural advice, there are any number of books published on the peculiarities of Japanese culture, manners and social order. One of the genuine thrills about

studying in Japan is experiencing this first hand, and I wouldn't dream of spoiling it for you. In the vast majority of cases you won't be expected to observe the finer points of Japanese etiquette, and in fact you will spend a lot of time being complemented on everything from your Japanese language ability, to your mastery of chopsticks (regardless of whether or not you can manipulate them at all). As foreign researchers you will to a certain extent be exempt from the incredibly formal rules that govern exchanges between faculty and students, and they will be delighted as you slowly develop both Japanese language and social skills.

In Summary

Being allowed to complete my MSc degree at the University of Tokyo was a unique privilege, and one that is having a huge influence on my wanting to stay in scientific research. The MEXT scholarships are an incredibly generous source of funding at whatever level, and during my time in Japan I met plenty of postdoctoral students who were happy to spend two years at the University of Tokyo on this basis alone. Entry into graduate programmes at Japanese Universities can be extremely hard and expensive (especially for the Japanese); however, the MEXT scholarships are a great way of getting onto these degrees. Students from all over the world are now starting to filter into Japanese MSc and PhD programmes, and still more are there on the basic Research Assistant programmes, publishing their work and taking advantage of the fantastic facilities.

Graduate study abroad fosters international scholarship, breadth of scientific and cultural experience, and encourages students as early as MSc to have the confidence to undertake independent research. The two most crucial pieces of advice are: (1) to research the member(s) of staff you'd like to work with and contact them well in advance; and (2) don't be intimidated by the prospect of learning a new language, you'll never have to be 100% fluent and it's a terrific opportunity to make friends along the way. I would be happy to offer any further advice or information on MEXT scholarships, Japanese universities in general, or merely where's good to go in Tokyo. Other good people to contact are David Casenove (for advice on PhDs at Japanese universities), Drs Richard Twitchett and Aaron Hunter (about JSPS), and Professor Tatsuo Oji who was excellent at supervising me during my time in Japan. Their contact details are:

- Professor Tatsuo Oji: <**oji@eps.s.u-tokyo.ac.jp**>
- Dr Richard Twitchett: <**richard.twitchett@plymouth.ac.uk**>
- Dr Aaron Hunter: <**afossilhunter@gmail.com**>
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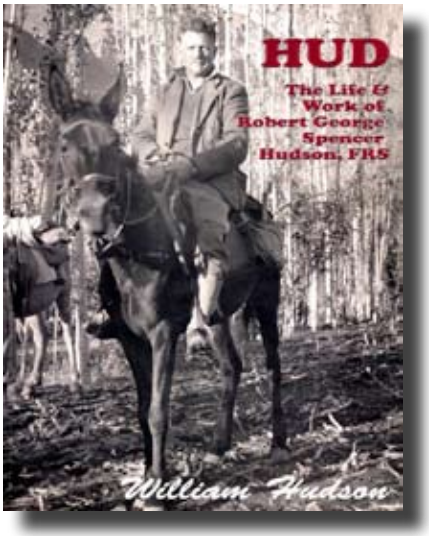
Book Reviews

"Hud" The life and work of Robert George Spencer Hudson, F.R.S.

William Hudson (2008). Published in San Antonio, Texas. 117 pp.
ISBN 978-0-9815556-2-1 (paperback; available via Amazon at $15).



This book, by one of the subject's sons – himself a geologist – is of some interest to members of the Association as Hudson was a major force in founding it and was its first president.

Hudson was a distinguished academic geologist and palaeontologist who later in life also became a notable oil company geologist in the early days of the industry. After service in World War I he graduated from University College London in 1921. He joined the lecturing staff in geology at Leeds in 1922 and continued in this post until 1939, when the chair at Leeds became vacant on the retirement of Arthur Gilligan. Hudson was one of the candidates considered for the post – it is unclear whether he applied for it. The short list was distinguished, including Arkell, Bulman, Hawkes and Richey. Hudson was appointed as from October 1939, to the distress of H. C. Versey, a fellow lecturer who was (slightly) senior to Hudson. There is little doubt that Hudson was the better qualified candidate.

There were personal complications, however. Hudson was having an affair with Versey's niece, who changed her surname to Hudson in December 1939 when she was pregnant with their first child; perhaps a tactless thing to do under the circumstances. Hudson at the time was living with his mistress (a different one) in Ingleton under the assumed name of Scott (if you think this is complicated, you need to read the book). Hudson submitted his resignation from the chair in March 1940. The author suspects interference by Versey's wife's family, but a short chapter of the book devoted to the matter does not really resolve the question.

As soon as the war ended Hudson joined the Iraq Petroleum Company and made important contributions to the geology of Iraq, as he had done earlier to the geology of Yorkshire. In 1958, Iraq Petroleum cut back its operations in Iraq because of a revolution and Hudson became redundant. He embarked on a second academic career at Trinity College Dublin where he became professor in 1961 following Dan Gill's move to Imperial College, London.

A great deal of the present book is concerned with family history and genealogy, as the author has been at pains to sort out his subject's wives, mistresses and children. It mentions Hudson's geological research, and includes some account of his pioneering work in the Middle East. For an

appreciation of his geology and palaeontology one would turn to the biographical memoir for the Royal Society by Sir James Stubblefield (1966). Hudson was elected F.R.S. in 1961. The goniatite *Hudsonoceras* was named after him by E. W. J. Moore in 1946. Sadly, the *Treatise on Invertebrate Paleontology*, Part L, 1957, chapter on Paleozoic Ammonoidea by A. K. Miller, W. M. Furnish and O. H. Schindewolf regards the genus as a synonym of *Girtyoceras* Wedekind, 1918.

The page on the origin of the Pal Ass is the most interesting for our members, though it does not really add anything new. It recalls the attempts from 1954 onwards by a group of young palaeontologists – Ball, Hodson, Hughes, McKerrow, Ramsbottom, Gwyn Thomas – to improve the prospects for publication of palaeontological papers. The Geological Society was approached. Bill Ball (Ball 2007) tells us how he and Gwyn Thomas appeared before the Society's Council to make the case for a larger format and better quality illustrations for the Quarterly Journal, but without success. Davies in his recent history of the Society (2007, 262) makes only brief mention of this and I do not know whether it is even recorded in the minutes of Council. Ball and Thomas then lobbied the Palaeontographical Society's Council, suggesting that it could publish a journal in addition to the annual volumes, but were again rebuffed. I was on Pal Soc Council at the time and the reasons were twofold: first, the Society had been set up to describe British fossils, and this limiting factor was embodied in its constitution; second, and perhaps more important, the Secretary of the Pal Soc, the late Richard Melville, flatly refused to take on any more work. At that time the secretary was also the editor of the Pal Soc monographs, a substantial responsibility, and Richard's stance was understandable.

Both these approaches having failed, a couple of years had gone by and the young hopefuls had got nowhere. A senior palaeontologist was needed to head the group and Hudson was an inspired choice. He chaired an interim committee and a public meeting, raised money, and when the Association was formally constituted in 1957 he was our first president. He was a charismatic (and photogenic) man, and it is clear that he threw himself wholeheartedly into getting the Association going. Without him we might not exist.

Desmond Donovan

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Palaeontological Atlas of Phanerozoic faunas and floras of Uzbekistan

Kim, A. I., Salimova, F. A., Kim, I. A. and Meshchankina, N. A., 2007. Republic of Uzbekistan State Committee on Geology and Mineral Resources, Tashkent, v. 1, Palaeozoic, 707 p., 142 pls.; v. 2, Mesozoic and Cenozoic, 261 p., 62 pls. Available in English, Uzbek or Russian.
To order contact **<zangiatapalsocuz@list.ru>.**

The *Palaeontological Atlas of Phanerozoic Faunas and Floras of Uzbekistan* is dedicated to the 80th anniversary of the Geological Survey of Uzbekistan. These two attractive volumes are a summary of the numerous completed and continuing biostratigraphic investigations in the country during the past 50 or so years.

Volume one covers the Palaeozoic, and Volume two the Mesozoic (Jurassic and Cretaceous) and Cenozoic (Palaeogene). The brief introduction, including a map of Uzbekistan showing the various mountain ranges, is repeated in both volumes. Most mountain ranges are labelled on the map, enabling readers not familiar with the geography of Uzbekistan to orient themselves. This map shows that considerable detailed investigation remains to be completed before the detailed geology of the country is known.

In both volumes, each geological period is a separate chapter divided into an introductory section followed by sections on each of the major fossil groups that have been studied within that period. The table in the introductory section shows the international global (most chapters) or Russian (Cambrian and Lower Cretaceous) chronological terms and recognized local units. This is followed by one to four columns showing fossil zonations recognized in Uzbekistan that are significant for that period. The table also has columns giving the lithostratigraphic terms for various mountain ranges or regions in the country. In most chapters, regional stages are given under subheadings, provide brief lithologies of the major stratigraphic units, and list the various fossils found at significant localities or in certain mountain ranges for those units. Sections on each of the fossil groups provide brief descriptions and illustrations of nearly all taxa mentioned; the few exceptions refer to the original description and re-illustrate the specific taxon. Information provided for most taxa includes a brief synonymy (often including reference to a complete synonymy where appropriate), location of the holotype, a brief description, remarks, and occurrence. New taxa are described in slightly greater detail and give the derivation of the name. If a new genus is proposed the type species is designated.

References are given at the end of the volume and are subdivided into sections on stratigraphy followed by each of the various fossil groups. A taxon index precedes the plates, which have figure

explanations on facing pages. A table of contents concludes each volume. Authors of each of the stratigraphic and fossil sections are listed in the table of contents, but are not given in the text or systematic sections.

The Palaeozoic volume is dominated by investigations in the southern Tien Shan, and the references therein show the vast amount of work that Russian and Uzbekistan geologists and palaeontologists have contributed to the region. Many of the type specimens are housed in Russian museums (St. Petersberg and Moscow), although types of many of the new taxa described are housed in one of several Uzbekistan museums, such as the Museum of the Kitab State Geological Reserve and Museum of the State Committee on Geology and Mineral Resources, Tashkent.

The numerous authors of each of the sections on the fossil groups in individual chapters are to be commended for their diligence in compiling the significant taxa. A total of 1,241 taxa are treated in the two volumes: 979 Palaeozoic, 221 Mesozoic and 41 Palaeogene. Fossils described include invertebrates, vertebrates (conodonts) and plants. New taxa described are: stromatoporoids, six new species; tabulate corals, seven new species; rugose corals, three new genera, ten new species; trilobites, two new species; tentaculitids, two new genera and species, one new subspecies; brachiopods, two new species; bivalves, five new species; echinoderm columnals, four new genera, 12 new species; foraminifera, three new species, one new subspecies; chitinozoans, two new species. The English edition is to be used for priority purposes of systematics.

Many of the 456 references cited are in Russian, published in limited numbers, and copies are difficult to obtain. The compilation of these references is a convenience that will be appreciated by future investigators interested in the region and the taxa described.

The volumes are attractively bound and the text and plates are printed on good quality paper, but the quality of the figures is variable. Most are clear and of high quality, but some are reproductions from originals that were printed on poor quality paper and a few are slightly blurry. Typos are rare and the text and palaeontological descriptions are easily read. Diagnoses are not given for new taxa as recommended by the IZCN. The editors maintained consistency of format and style throughout, with minor exceptions that include the lack of suture patterns for Jurassic and Cretaceous ammonites and location information for the holotypes of some Jurassic and Palaeogene fossils.

These volumes belong in any reference library, and many palaeontologists and stratigraphers should have copies for their quick reference.

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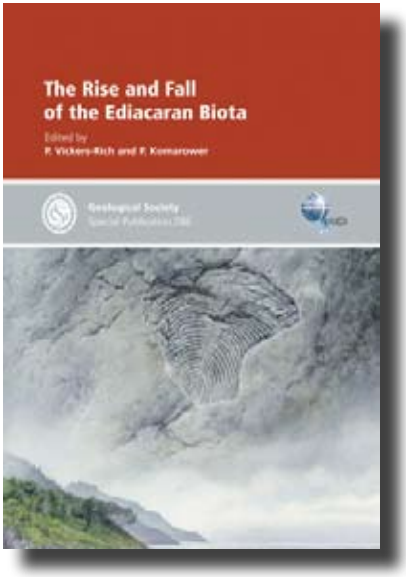
The Rise and Fall of the Ediacaran Biota

Patricia Vickers-Rich and Patricia Komarower (eds) (2007). Geological Society, London, Special Publications, 286. 456 pp. ISBN: 978-1-86239-233-5 (Hardback), £95.00.



Released in the middle of the debate about whether or not the Ediacaran period can be subdivided into epochs, the timing of this book could hardly be better. *The Rise and Fall of the Ediacaran Biota* presents a diverse collection of papers covering a full spectrum of events that define the recently introduced Ediacaran period, from the first planetary-scale weakening of the Neoproterozoic Era glaciation to the Cambrian radiation of the Metazoa. Whilst the "Ediacaran biota" should intuitively encompass all organisms from the Ediacaran period (including microorganisms, macroalgae and skeletal faunas), this book focuses on the highly distinctive assemblage of Late Ediacaran macroscopic organisms preserved as casts and moulds in aluminosiliciclastic, volcaniclastic or carbonate sediments to which the term is most commonly applied. The overall taxonomic diversity of this soft-bodied fauna remains modest: a little over 250 species have been described (including three new species in this volume). Half of these nominal species represent valid taxa, with the remainder being either pseudofossils, or synonyms reflecting life stage or preservational variations. The disparity between the valid taxa, however, is enormous.

Marc Laflamme *et al.* report the results of descriptive, quantitative, landmark and traditional morphometric analyses of numerous rangeomorph specimens which suggest that the different species currently referred to *Charnia* had fundamentally different constructions: *Ch. masoni* had branches fixed around an internal organic skeleton, whereas *Ch. antecedens* had branches of variable and irregular morphology, and *Ch. wardi* had a cylindrical body with an internal central stalk and even more loosely organized branches. Rangeomorphs, however, are being confused with a totally different group, the frondomorphs, which are composed of three distinct parts: a large, relatively flattened unbranched foliate section, a central stem, and a holdfast or rooting anchor. In their contribution, Richard Jenkins and Christopher Nedin describe a new frondomorph from South Australia. Although the authors couldn't resist straying into phylogenetic fancies (or fantasies), the remarkable mouldic, if not three-dimensional, preservation of a foliate section and stem is worth seeing. Such preservation is exceptional, because – as demonstrated in the paper by Ekaterina Serezhnikova – the fossil record of these organisms is always biased towards holdfast structures that were rooted in the sediment at the time of burial and consequently had a much higher preservation potential than the foliate sections. Two contributions by Breandán MacGabhann are a reminder that the discoidal holdfasts of frondomorphs are often confused with microbial colonies and sedimentary structures.

For the first time since its original description by Mary Wade in 1972, *Kimberella* is the subject of a monographic-style description. The contribution by Mikhail Fedonkin *et al.* represents a very comprehensive analysis, with 55 figured specimens, of one of the most interesting Ediacaran fossils, and perhaps the most reliable candidate for a benthic bilaterian organism. In particular it is described as having a relatively rigid external skeleton (organic shell), overprinted by the collapsed soft parts. However, a sobering commentary by Peter Trusler *et al.* follows the paper on *Kimberella* and is a timely reminder that having a bilaterally symmetrical body doesn't necessarily mean being a bilaterian. Some would argue that the true record of the bilaterians starts with Ediacaran trace fossils, but the contribution by Sören Jensen *et al.* raises a worrying possibility that some of the trace fossils found in these strata could be unusually preserved filamentous organisms.

The Petalonamae – an imperfectly defined group dominated by serially quilted body plans, most exotic to mainstream biology – is once again the subject of methodological and interpretative controversies in a paper by Mikhail Fedonkin and Andrey Ivantsov. The unique palaeobiology of the Petalonamae has been the central argument in Adolf Seilacher's concept of giant Ediacaran protists, the Vendobionta, which is reiterated in this book by the author himself. This debate is not yet over. In their contribution, Jonathan Antcliffe and Martin Brasier demonstrate that morphospace analysis for the study of growth, form and function, originally used by Adolf Seilacher to define the Vendobionta, could now become a powerful tool in testing this hypothesis, whereas Bunji Toji *et al.* apply theoretical considerations to predict that there were a finite number of quilt arrangements in the Vendobionta and suggest a possible regulatory genetic mechanism that controlled the morphogenesis.

I am most impressed by the thorough analyses of the psammocoral *Protolyellia* provided by Enrico Savazzi. The Psammocorallia represent a distinctive group of latest Ediacaran but mostly Early Palaeozoic soft-bodied organisms that embedded well-sorted, coarse-grained sand into their epithelium and used it as ballast. Whilst *Protolyellia* itself is an Early Cambrian fossil, all Savazzi's conclusions could equally apply to the related latest Ediacaran taxon, *Nemiana*, discussed in a contribution by Maxim Leonov. Enrico Savazzi's careful examination of *Protolyellia* has revealed many anatomical insights, including sand inside both epithelium and gastric cavity, a subepithelial muscle layer, an internal sphincter, and no mesenteries. These structures clearly establish psammocorals as members of the Ediacaran biota that survived into the Palaeozoic by evolving novel adaptations to the conditions of the Early Cambrian substrate revolution.

The Rise and Fall of the Ediacaran Biota brings together a wealth of new and previously-published material to illustrate the rich and diverse descriptive research that defines the study of the Ediacaran period. What is missing is the *rise and fall* of the Ediacaran biota, the evolutionary patterns and processes related to what is arguably the Earth's most profound shift in ecosystem structure over the past four billion years. The Ediacaran period marks the introduction of two fundamental novelties, the expansion of eukaryotic phytoplankton and the escalatory coevolution of eumetazoans, leading to a revolution in the structure and evolution of marine communities, including the establishment of multi-level trophic structures, predator–prey interactions and infaunal activity. In this context, I have to applaud a couple of papers from this book. In the first, Jerzy Dzik further elaborates the idea that the increase in infaunal activity and the coeval appearance of skeletons at the Precambrian–Cambrian transition could be two sides of the same coin – an infaunal escape from evolved predation. In the second, Erik Sperling *et al.* suggest that the mid-Ediacaran disturbance

in the global carbon cycle could have been triggered by a massive drawdown of dissolved organic carbon by a newly evolved type of heterotroph – the Ediacaran biota. These papers, however, stand out as exceptions in this volume. A broader ecological perspective that would bring together the escalation of the earliest macroscopic communities, the evolution of planktic ecosystems, the revolution in organism–sediment interactions, and the advent of biologically controlled mineralization cannot be found in this book. In that sense, the final chapter is yet to be written.

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