The Palaeontology Newsletter 48

Contents

Reminder: The deadline for copy for Issue no 49 is 12th February 2002

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

Association Business

Grant aid to attend the Annual Meeting

Grant aid is available to assist postgraduate palaeontologists attending the Association's Annual Meeting. This is available for those travelling from outside the country hosting the meeting. (England, Scotland, Wales and Northern Ireland are regarded as constituent members of the UK for this purpose.) Awards are limited to those making an oral or poster presentation. Applications for grant aid to attend this year's meeting (no form necessary) should be made to the Executive Officer: Dr Tim Palmer, Institute of Geography & Earth Sciences, University of Wales Aberystwyth, Aberystwyth, Ceredigion SY23 3BD, <**palass@palass.org**>.

Sylvester-Bradley Award

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

Applications consist of a CV, one A4 page account of research aims and objectives, and a breakdown of the proposed expenditure. Successful candidates must produce a report for *Palaeontology Newsletter* and are asked to consider the Association's meetings and publications as media for conveying the research results. Application forms can be down-loaded from the Association Web site <**www.palass.org**> or from the Secretary:
Dr H.A. Armstrong, Department of Geological Sciences, University of Durham, South Road, Durham DH1 3LE. <**h.a.armstrong@durham.ac.uk**> **Deadline: 30th November, 2001.**

Mary Anning Award

The Award is open to all those who are not professionally employed within palaeontology but who have made an outstanding contribution to the subject. Such contributions may range from the compilation of fossil collections, and their care and conservation, to published studies in recognised journals. Nominations should be supported by a short statement (up to one page of A4) outlining the candidate's principal achievements, and should be sent to the Secretary: Dr H.A. Armstrong, Department of Geological Sciences, University of Durham, South Road, Durham DH1 3LE. <**h.a.armstrong@durham.ac.uk**>. Members putting forward candidates should also be prepared, if requested, to write an illustrated profile in support of their nominee. The award comprises a cash prize plus a framed scroll, and is usually presented at the AGM. **Deadline: 30th November, 2001.**

Hodson Fund

The Award is conferred on a palaeontologist who has made a notable early contribution to the science and who is aged 35 or under on the closing date for nominations. Candidates must be nominated by at least two members of the Association, and the application must be supported by an appropriate academic case. Closing date for nominations is 30th November 2001 and should be sent to the Secretary; Dr H.A. Armstrong, Department of Geological Sciences, University of Durham, South Road, Durham DH1 3LE. <**h.a.armstrong@durham.ac.uk**>. Nominations will be considered and a decision made at the January meeting of Council. The award will comprise a fund of £1,000, presented at the AGM.

Sale of Field Guides

Third International Conference on Trilobites and their relatives, Oxford, 3-6 April 2001

Two field-guides were produced for the trilobite-rich localities visited on the field trips associated with this conference. They can now be purchased from the Executive Officer <**palass@palass.org**> at £10 each, or £15 the pair (cheques payable to the Palaeontological Association).

They are:

1. Scotland and Northern England, by A.W. Owen, E.N.K. Clarkson, J.K. Ingham, and R.M. Owens. 47 pp, 7 pls.
2. South Wales and the Welsh Borderland, by R.M. Owens, P.D. Lane, A.T. Thomas, R.A. Fortey, D.J. Siveter, A.W. Owen, W.T. Dean, and P.R. Sheldon. 47 pp, 6 pls.

N.B. Most of the localities described in these field guides are on private land; some of them are SSSIs. The necessary permissions to visit the sites and to collect material must always be sought.

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2001 International Prize for Biology awarded to Harry Blackmore Whittington

On September 19, 2001, the Committee on the International Prize for Biology (chaired by Dr. Setsuro Ebashi, Member of the Japan Academy) decided, based on the recommendation of the Prize's Selection Committee, to present the 2001 International Prize for Biology to Dr. Harry Blackmore Whittington, Emeritus Professor, Cambridge University, UK. The field of specialization for the 2001 Prize is 'Palaeontology.'

The International Prize for Biology was instituted in April 1985 by the Committee on the International Prize for Biology in commemoration of the sixty-year reign of Emperor Showa and his longtime devotion to biological research. The Prize is awarded annually and consists of a medal and ten million yen. Coincident with the award, an international symposium on topics relevant to the Prize is held under the support of the Ministry of Education, Science, Sports and Culture. Previous recipients include Motoo Kimura, Edward O. Wilson and Ernst Mayr.

Achievements Recognized by the Award

Dr. Harry Blackmore Whittington has contributed immensely to the biological knowledge of trilobites in a long and distinguished career devoted to research on the morphology, ecology, and evolution of these fossil creatures. The award further recognizes that, in leading the research team that studied the fauna of the Burgess Shale and documenting the remarkable burst of differentiation of multicellular animals that took place in the Cambrian period, Dr. Whittington has made major contributions toward a new interpretation of the history of life on Earth.

Dr. Whittington is the foremost authority on trilobites, to which he has devoted a long and distinguished scholarly career at Harvard and Cambridge Universities. Among his great scientific attainments is his role in leading the Burgess fauna research team and bringing to light the 'Cambrian explosion'.

In the 1950s, Dr. Whittington first published detailed descriptions of trilobite fossils that were unusually well preserved due to silicification. These monographs clarified features which could not be determined using ordinary specimens, such as the fine structure of organs and the mode of development from the larval stage. He has since continued, with meticulous dissection work and precise observations, to elucidate the structure and function of the trilobites' exoskeleton, appendages, gills, mouthparts, and other organs, and has even reconstructed their palaeoecology by developing theories about their locomotion and feeding behaviour. In short, we owe to Dr. Whittington a significant part of recent knowledge concerning the nature of trilobites. In 1998, these findings were brought together in the *Treatise on Invertebrate Paleontology: Trilobita*, a revised edition in whose publication Dr. Whittington played a central role.

The Burgess fauna is a richly diverse fossil fauna located in the Canadian Rocky Mountains, near Banff, in geological strata that date from the mid-Cambrian period (some 530 million years ago). Although compressed to a thin film, soft tissues and entire soft-bodied animals are beautifully preserved.

The Burgess Shale is thus a very precious resource that yields a complete picture of the marine fauna of the time. The Burgess fauna was discovered by the American Charles D. Walcott in 1909, and in early studies many trilobites and other animals such as *Marrella*, *Opabinia*, *Anomalocaris*, and *Pikaia* were named. However, the taxonomic research remained suspended for years because many species were simply too strange to be classifiable.

Dr. Whittington led the way in recognizing the importance of the Burgess fauna, and since the mid-1960s he has closely observed and described a vast number of specimens from both existing and new collections from the site, using his own original techniques. This work has revealed that many of the specimens do not belong to any previously known taxonomic group. While pursuing his own research, Dr. Whittington has also mentored such outstanding younger palaeontologists as Derek Briggs and Simon Conway-Morris, and collaborated with them on the project.

The findings of the 'Cambridge Group' as this expert team is called, have very wide ramifications. Most importantly, their work has changed our understanding of how the animal kingdom evolved. Animal life was long thought to have undergone a gradual increase in diversity over eras of geological time. However, study of the Burgess fauna has led to general acceptance of several new ideas: that an explosive diversification of the animal kingdom occurred during the Cambrian period; that many phyla, including the Chordata, had already appeared at that time; and that only of a few of those numerous lines survived to become the ancestors of more recent taxa. In other words, the findings have revolutionized the way we view the history of life on Earth.

Dr. Whittington has chosen a rich source of primary materials, worked with them to uncover and firmly establish many facts, and founded and led the research group that has provided concrete evidence of the Cambrian explosion. In every aspect of his scientific career—the high calibre of his research, its international scope, his inspiring leadership, and the impact of his findings—this distinguished palaeontologist is a worthy recipient of the International Prize for Biology.

Ceremony and Commemorative Symposium

The presentation ceremony for the 2001 International Prize will be convened on Monday, 3 December, 2001 at the Japan Academy, Tokyo; a commemorative international symposium will be held on 5-6 December at Kyoto Research Park.

Committee on the International Prize for Biology, Japan Society for the Promotion of Science, 6 Ichiban-cho, Chiyoda-ku, Tokyo 102-8471. Telephone: +81-3-3263-1722, Facsimile: +81-3-3221-2470. Full details of the award are at <**http://www.jsps.go.jp/e-biol/main.html**>

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Association Meetings Programme

Annual Meeting of the Palaeontological Association

Geological Museum, University of Copenhagen 15th-19th December 2001

The Annual Meeting of the Palaeontological Association, 15th-19th December 2001, will be held in the Geological Museum with field trips to Bornholm (pre-conference), Stevns Klint and Faxe Quarry (one-day post-conference excursion, 18th December). (Delegates intending to visit Bornholm should contact Richard Bromley directly to make arrangements: <**rullard@geo.geol.ku.dk**>). The technical sessions will consist of two days of talks and posters (16th–17th December) on all aspects of palaeontology, supplemented by a series of social events in the capital city of jazz and design, of smørrebrød and Danish beers, and intimate bars and restaurants. Lectures will be held in the museum's lecture theatre (16th and 17th December) and space will be provided on the adjacent galleries for poster displays. Talks are scheduled for 15 minutes with a further five minutes for discussion. The museum has also substantial collections of Palaeozoic, Cretaceous and Paleogene fossils; type material will be available for study by prior arrangement.

Copenhagen is a relatively small and compact European capital but with many attractions. Cultural aspects of the city are described on the Wonderful Copenhagen Web pages <**www.woco.dk**>. The Geological Museum <**www.geological-museum.dk**> is Denmark's National Museum for geology; but it also forms a network within the Science Faculty of the University of Copenhagen together with the Botanical Gardens, Botanical Museum and Zoological Museum. The museum is also part of the Copenhagen Geocentre that combines the museum, the Geological Institute and Geological Surveys of Denmark and Greenland (GEUS) together on Øster Voldgade, adjacent to the King's Gardens, the Botanical Gardens, the Art Gallery and the Rosenborg Palace.

The museum is a 15 minute train journey from Copenhagen's international airport, Kastrup, but is also accessible by rail and road from other parts of mainland Europe. There is now a fixed link to Sweden across the Øresund Bridge. There are flights from many European cities. Cheap flights from the UK are available with GO from Stansted (<**www.go-fly.com**>).

Accommodation, near the museum, is being reserved in the 'Cabin Inn Scandinavia' group of hotels. Prices include breakfast. Further information about alternative accommodation at a wide range of prices is available on the Wonderful Copenhagen Web pages.

Booking forms can be downloaded from the Association's <**www.palass.org**> and Museum's <**www.geological-museum.dk**> Web pages.

Dave Harper (chair), Walter Kegel Christensen, Finn Surlyk, Svend Stouge and Nina Topp.
<palass2001@savik.geomus.ku.dk>

From our Correspondents

Those troublesome species

A certain moment always comes around in evolution courses. There is everyone talking politely and interestingly about, say, fossil horses and "Darwins" when someone says "but how do you know they are real species?" The Species Problem has reared its ugly head. Naturally, that is a great deal more than can be said for the average attender of such a course—their heads will typically be thudding into their copies of *Evolution—a biological and palaeontological approach* with boredom at this point. So, to continue the horse theme, I shall gallop through the history of species, and offer an unfortunately rather abstract view on modern and surprising approaches to the subject.

As this is the Swedish autumn, and the time available for viewing them is quickly lengthening, I shall start with the stars as an analogy. When we look up into the sky, we see, not just stars, but constellations, familiar groupings of stars. And the question I want to ask is: do constellations really exist? Anti-astrology scoffers will of course say that they certainly do not: a constellation is merely a chance perspective from a human point of view, and in any case the stars are moving, so that in a few thousand years time the sky will look rather different. Of course, all that is true. But on the other hand; i) one simply cannot look at the sky through non-human eyes; and ii) the stars would still be in the same position even if one could. This simple example points to one of the live topics in philosophy of science today: which things really exist, and which are mere inventions by us? Or even, are there some things that we cannot help but see as falling into patterns (as Kant thought)? And which of these possibilites are species?

We owe the terminology of species (and genera), or rather, their Greek equivalents, to Plato and (especially) Aristotle who were really the first people to try and systematically chop up the world into its constituent bits and pieces. I use the word chop advisedly, because theirs was a method of definition by division: humans, (species—particular type of thing) for Aristotle, were animals (genus—general category of things) that were *distinguished* from other animals by their hairless bipedalism and (to avoid confusion with a chicken, say) broad nails. We see this tendency even today in the use of such differentia when defining a new species. Linnaeus thought that all species could be established by naming the single distinguishing feature that distinguished it from the next closest species.

In his species-chopping role (one of many) Aristotle takes on the role of the ontologist—someone whose (somewhat tedious) job it is to make lists of things that really exist. We might all agree that a dog exists: but what about the bark of a dog? Or a group of dogs? Or a thought about dogs? Obscure though it may seem, this esoteric activity is what lies behind the continual agonising about species, and in certain aspects the entire argument has swung round back to its Greek roots some 2,300 years ago. Aristotle, briefly, thought in his *Categories* that there was a nice round number of sorts of things that really exist (10)—and at the top of the list he put something called "substance"—a thing that can bear properties. For example, some thing might be shiny, hot or heavy, but these secondary characteristics were merely features of a more primary thing.

The question is, what sorts of things are substances? Plato and Aristotle dithered over this. Plato, at some point in his career (but perhaps he never really believed it), held the doctrine of the Theory of Forms: that the perceived world is a sort of projection of an Ideal World, peopled by shadowy but perfect Forms. Thus, when we see animals on earth, we are seeing nothing but imperfect projections of an Ideal Animal. Aristotle in his *Categories*, conversely, thought that particular things (especially particular animals) were the things that really had substantial existence. So, the difference between the two is as follows. Plato thought that substance was "up there" somewhere, and in an ancient version of the trickle-down effect, pervaded the natural world from the top down. And I suppose such a view somehow underlies the popular "body plan" notion today. For Plato then, the things that were closest to substances—the things that "really" existed—were the most general categories—for example, the genus animal. But for Aristotle, the things that really existed were particular individuals such as *a* dog, or *a* human. If this sounds confusing, it gets worse, because Aristotle half changed his mind in the monumentally obscure *Metaphysics* wherein he suddenly announces that substances are really after all not individuals but species. So, the things that really exist are dogs, not individual dogs as such. This was perhaps the high-water mark of the species concept: the idea that species were the *fundamental* thing that existed.

It is genuinely difficult to make sense out of all this. But the one thing that Aristotle and Plato had in common was their strong anti-materialist mind-set. Materialists—and there are plenty around today of course—argued that the only thing that really existed was some sort of fundamental matter, out of which everything was constructed. Aristotle was a realist though, and found this unacceptable, because he wanted to be able to understand the world: and saying that the only thing really in existence was some sort of formless (and thus inexplicable) soup, or indeed some general (and thus undefinable) ideal Forms, would be to admit ultimate defeat. What Aristotle was trying to do was to come up with a sub-set of real things that could be fairly said to have true existence. One way in which he approached this tricky task was a definitional one—substantial things had existence because they could be defined, and thus their essence could be captured and understood. Perhaps one reason that Aristotle plumped for species being substances is that he didn't think they changed, so their definition and thus essence didn't change either—whereas individuals palpably did. And perhaps Linnaeus in the 18th century started off with such a notion too when he formalised genera and species in his *Systema Natura* (although John Ray (d. 1705) seems first to have used the division in roughly its modern sense).

Although all this Greek philosophy might seem terribly out of date and irrelevant, the dreadful truth is that we are still faced with the same questions. Indeed, even in Linnaeus' time, there was a recognition of what we would call hybrids and mutants, so the fixity of species was already under assault. And ever since Darwin, the problem has become more anxious. Mayr famously attacked Aristotelian essentialism in biology in the 1960s on the grounds that species evolved, and their composition could not be defined (and so they could not qualify as Aristotelian substances). Hence the famous *biological species* concept came into being: species are groups of individuals bound in time and morphospace by barriers to interbreeding. In other words, the content (its "essence") of a species is not defined, only its boundaries. If only it had stopped there. At the last count there were some 25 competing species concepts, from the "agamospecies" to the "diagnosable version of the phylogenetic species". To make matters even worse, there is another completely different way of approaching this problem ("nominalism") that denies the existence of general groups at all: we simply group things in the world together, not on the basis of some "essence" they share with the group we put them into, but because of conditions of membership we construct ourselves. Groups do not really exist: and nor do species (unless they are, as some argued, themselves individuals!).

Since the 1960s there has been a something of a reflorescence of a vaguely Aristotelian way of looking at the world, the idea of Natural Kinds. A natural kind is a group of things—stars, for example—that is in some way (if unclearly) naturally united. For a Natural Kind philosopher, dividing up the world into constituent components is akin to hacking up a chicken "at the joints"—the divisions you make correspond to real divisions in the material at hand. A species, in this line of thought, is a Natural Kind. It is not one that Aristotle would be happy with, because the essential unity of such a thing is not guaranteed by some set of abstract and eternal definitions (which, if species change, is impossible), but by some cluster of features (that can be empirically determined) which in some way keep the whole thing together. A species, then, has a natural unity that is forced on it by certain of its features—for example, the fact that all of its members need to interbreed. And because it has this unity, then after all it can be *defined* and therefore its essence picked out. Finally, and very importantly, species also show a sort of consonance between really existing and being scientifically useful: the species concept fits well into our theorizing about the world.

I should apologise for this rather abstract discussion. But one point about it is that sciences like biology and palaeontology do not exist in a vacuum, but at some points along their borders touch on other more grand topics such as "ontology". One reason why the species concept has proved so awkward is precisely this: that just under its surface is a complex and completely unresolved issue about (and I admit it sounds pompous to say) the nature of reality. We cannot help abstracting from statements about particular things to statements about groups of things: but does this abstraction lead us closer to or further from reality?

Studying the evolution of the horse is, fortunately, most unlikely to lead as far astray as, say, the Kant-Friesian theory of universals. And if it does, my advice is not to get worked up about it. We have, after all, the example of Aristotle himself as a warning for not getting too engrossed in insoluble problems. Legend informs us that he threw himself from the cliffs of Euboea, frustrated at not being able to understand the tides ceaselessly churning away beneath him.

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Further reading: ***overleaf***

Further reading

Aristotle (1998). *The Metaphysics*. Penguin Classics, Clays Ltd, St Ives.

Avoid it if you can, but if you can't I recommend reading the excellent introduction first. Book Zeta is where the gruesome details lurk.

Hull, D.L. (1976). Are species really individuals? *Systematic Zoology* **25**, 174-191.

Notorious attempt to claim that species have real existence because they are individuals, not groups.

Keller, R.A. and Wheeler, Q.D. (2001). Typology revisited: the nature of definitions in biological classification. An amusing and informative poster available online at **http://www.cals.cornell.edu/dept/entomology/wheeler/Keller/Keller.html** defending essentialism, but not Aristotle.

Wilson, R.A. (ed) (1999). *Species: new interdisciplinary essays*. MIT Press, Cambridge, Mass.

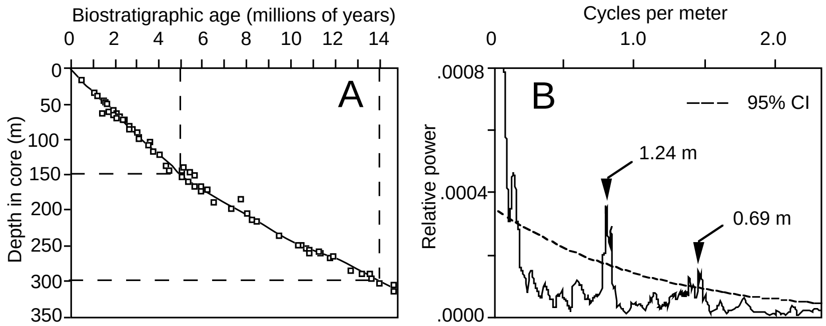
If you have any comments or opinions on this article, however concise, please send them in to <**newsletter@palass.org**>.

The quest for stratigraphic completeness

The geologist Derek Ager memorably claimed that the phrase "stratigraphic completeness" did the same reaction for him as the word "culture" did for Joseph Goebbels. This is because one of the first things that any stratigrapher learns is how disappointingly incomplete the record is. Even an innocuous looking bedding plane might represent half a million years of lost time, or more, and the most monotonous mudrock could be full of undetectable gaps of various durations. Given this, it is often an elementary mistake to try to read narrative history from the fossil record.

Back in Victorian times there was a hope that deep-sea sediments might contain a more complete record of the evolution of life than is typical on land and on the continental shelves, if only it could be recovered. But initial coring in the twentieth century dashed the idea. The deep-sea floor turned out to be a surprisingly dynamic place, with active erosional processes and surprisingly abundant burrowing animals, even to the greatest water depths. Every now and again a great turbidity current would rip through the sediment, and of course subduction eventually destroys everything.

Despite these early findings, a quiet revolution has occurred recently in the world of deep sea drilling that allows us to revisit the question of stratigraphic completeness. Motivated by the need for long records of climate change, the drillers have gradually learned by trial and error where to look. It turns out that the places are aseismic ridges, plateaus and



A: Biostratigraphic age:depth plot for the top 300m of ODP Site 926, Ceara Rise. B: Power spectrum of cyclic sedimentation in the top 100m of Site 926. The significant cyclicities at 0.69m and 1.24m represent changes in the precession and obliquity of the Earth's axis.

submarine highs, which not only escape the turbidites but are also above the zone of carbonate dissolution, which means they have well-preserved microfossils.

In the early 1980s, David Schindel introduced a simple equation to assess stratigraphic completeness. Take the measured thickness of your section and divide that by the time interval it covers multiplied by the short-term rate of deposition. Applying this commonsense approach, Schindel estimated that even the most "complete" deep-sea deposits have only about a quarter of the sediment they would have, if the short-term deposition rate had been sustained.

Schindel's approach is basically sound, if one takes into account the effects of compaction, but the main problem comes in assessing the short-term rate of deposition. How reliably can it be measured? And what does short-term mean? The answer is, it depends on what you want to study. If you are interested in evolutionary processes over millions or tens of millions of years, then a suitable definition of short-term would be thousands or tens of thousands of years. Fortunately many deep-sea cores come with a ready-made measure of time at the appropriate scale, in the form of Croll-Milankovich cycles. These are regular changes in sediment properties that reflect changes in the earth's orbital parameters.

A few years ago I sailed as biostratigrapher on Leg 154 of the Ocean Drilling Program to the Ceara Rise, an aseismic ridge in the equatorial Atlantic, a few hundred km off Brazil. Figure A shows the biostratigraphic record for the top 300m of a typical site (ODP 926). This was obtained by four biostratigraphers working round the clock as the coring progressed. (This is, by the way, tremendous fun and infinitely better than the sedimentologists' job of describing mile upon mile of ooze!). The ages for each datum (squares on the figure) were taken from standard tabulations that have been built up from years of drilling elsewhere. We did not find any obvious gaps in sedimentation, but the data are admittedly scattered because of imperfect correlations and in some places the points are quite widely spaced.

Fortunately, however, the sites we drilled are strongly influenced by Croll-Milankovitch cycles. The area receives a supply of Amazon mud, which probably waxed and waned as sea level went up and down, resulting in more or less muddy or chalky sedimentation at the site. Spectral analysis of the sedimentary records of the top 100m (Figure B) shows that there are two significant cyclicities, which correspond to the obliquity and precession of the Earth's spin axis. Since we know the frequency of these cycles (approximately 41 and 21 thousand years), we can use their thicknesses to estimate the short-term rate of sedimentation, as follows.

Each precessional cycle takes 21 thousand years to complete and is, on average, 69cm thick in the core. That means the short-term rate of deposition would equate to about 30m per million years. A second independent estimate can be obtained from the obliquity cycles, which are 1.24m thick on average and each takes 41 thousand years to complete. That also equates to about 30m per million years. So using Schindler's equation we can estimate that the completeness for the top 300m of core is 300 divided by 14 times 30, or about 70% — better than any of Schindler's original estimates.

But wait a minute! It is clear from the biostratigraphy plot on the left that the rate of sedimentation almost doubled about 5-6 million years ago, causing an inflection in the line. The cycle thicknesses we have used only come from the top part of the core. If we repeat the exercise for the last five million years of nearly constant-rate sedimentation, at 150m thick, we get 150 divided by 5 times 30 which is 100% complete!

It is no longer controversial among palaeoclimatologists that sections like this are practically complete over many millions of years. A big effort is currently underway to develop a continuous "astrochronological" timescale back as far as the Cretaceous, based on counting Croll-Milankovitch cycles in various deep sea cores. At the Ceara Rise, the coring penetrated far below the levels shown in the diagram, to about 60 million years, and we found many long apparently complete intervals punctuated by the occasional recognizable hiatus. For example, we estimated the length of the Oligocene simply by counting how many obliquity cycles were within it.

Schindler proposed a kind of palaeontological uncertainty principle which states that "a study can provide fine sampling resolution, encompass long spans of geological time, or contain a complete record of the time span, but not all three." Now we know that this barrier is regularly being broken, and it is important for palaeontologists to seize the moment. For example, at the time of publication of this article, the ODP drill ship will be working 24 hours a day at recovering long and hopefully complete records from the Eocene of the tropical east Pacific.

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If you have any comments or opinions on this article, however concise, please send them in to <**newsletter@palass.org**>.

More about ancestors

I read with interest the correspondence between Henry Gee and Paul Pearson (Newsletter 47, pp. 33-42). I don't wish to add to that particular controversy, but I do wish to comment because the controversy involves classic examples of two double standards that are routinely applied to palaeontology, and especially biostratigraphy. The first involves the burden of proof. Gee's two contributions contain frequent references to proving hypotheses, or establishing the facts, of ancestor-descendant relationships. I have met this challenge from other cladists, so I am not getting at Gee personally, but I do ask why biostratigraphers should be required to prove anything at all when other scientists are only required to test, or at most, falsify hypotheses? Ancestors undoubtedly existed so I cannot understand Gee's equally frequent assertion that hypotheses of ancestor-descendant relationships are "no hypotheses at all." (p. 41).

Let's take a simple example. I imagine everyone reading this article believes (note the verb) that trilobites became extinct by the end of the Palaeozoic. We can never prove this, but the concomitant hypothesis is tested every time anyone collects and identifies a post-Palaeozoic fossil or a living animal. Either the specimen is a trilobite or it is not. Thus the hypothesis that trilobites became extinct in the Palaeozoic has been tested literally millions of times and we are probably justified in our belief that trilobites are extinct. Nevertheless, this hypothesis could still be falsified tomorrow by the discovery of just one post-Palaeozoic trilobite. Undeniably we can establish the limits of stratigraphic ranges of fossils (both first and last occurrences) and hence the stratigraphic occurrence of fossils can be used to falsify hypotheses of ancestor-descendant relationships. On purely stratigraphic grounds no trilobite can be ancestral to any arthropod that evolved, for example, in the Tertiary.

The existence of "living fossils", such as the monoplacophoran *Neopilina*, emphasizes that we cannot dismiss the possibility of discovering living trilobites out of hand. Prior to the discovery of *Neopilina* the Monoplacophora were thought to have become extinct in the Devonian. However, beware of the trap of thinking that a handful of known "living fossils" implies that all fossil ranges are equally unreliable. The ultimate logic of that argument is to deny the existence of extinction. We need to distinguish between possibilities and probabilities. It is extremely improbable (but not impossible) that trilobites survived the Palaeozoic.

The second double standard involves completeness of data. Fortey & Jefferies (1982) first raised the idea that at some level of completeness the fossil record might be used to contribute to phylogenetic analysis. Pearson argues that the incredibly abundant microfossil record undoubtedly can. However, completeness of data is a red herring. No other science is based on complete data, so again, why should palaeontology be required to meet this exacting (indeed impossible) standard? What would Henry Gee say if I argued that even the simplest, three taxon cladogram could only be valid if every character and every character-state had been documented in every specimen of every species involved? Yet so long as a single example remains unexamined it *might* alter our perceptions. This is just as true of cladograms as it is of stratigraphic ranges. Returning to biostratigraphy, the order in which fossils are preserved in the record cannot possibly be wrong with respect to the order in which they evolved, unless the original organisms coexisted. Estimates suggest that between 3% and 5% of all organisms that lived during the Phanerozoic coexisted at any given time (Paul, 1982, 1985). If this were not true we could not correlate using fossils. This conclusion does not depend on the completeness of the fossil record. If the record consisted of just two different fossils, the probabilities are overwhelming that they would still be preserved in the correct stratigraphic order. Even when the organisms did coexist, the probabilities are still that their fossils will be preserved in the correct evolutionary sequence and we have several methods of estimating confidence intervals on known stratigraphic ranges.

There will, of course, still be some organisms that never became fossilized or which we have yet to discover. However, I recall way back in the early 1960s when I was a student one of my zoology lecturers commenting that "Evolution is a phenomenon that always seems to occur elsewhere." When will people realise that it is special pleading always to invoke incompleteness every time the fossil record throws up some unpalatable fact? Why are the links always missing? The stratigraphic sequence of fossils is the truth, it may not be the whole truth, but it is certainly nothing but the truth. I would turn Gee's argument around and say that it is cladists who must realise that cladograms are no more than hypotheses about relationships and as such must be tested. I would further assert that for any group with a fossil record, there is no more powerful test of a cladogram than congruence with the fossil record. I will go further and predict that whenever there is a discrepancy between stratigraphy and cladograms, in at least 19 cases out of 20 the cladogram will be wrong. This is not an unwarranted assertion by an ageing palaeontologist who is rapidly losing his marbles. It is a testable hypothesis. If discrepancies between cladistics and the fossil record are due to the latter's imperfections, then as we collect more fossils the record will come closer into congruence with the cladograms. We'll find the links and put flesh on the ghost ranges. So in time we can test this hypothesis, and it will be falsified when only 5% of discrepancies are resolved in favour of cladograms based on character analysis alone. Needless to say, I don't expect it to be falsified in my lifetime (and I have every intention of living a few more years yet), but the test will continue to be available long after I am gone. Indeed this 'test of time' is probably the most powerful of all tests.

Some time ago I outlined a simple step by step approach to the problem of recognizing ancestors (Paul, 1992). The approach involves both cladistic tests (the ancestors must belong to the nodal group of Craske & Jefferies 1989) and stratigraphic tests (ancestors must be older than any and all of their descendants). The method does not infallibly identify an ancestor, it merely identifies the most likely candidate for ancestor based on current knowledge. However, once one accepts the possibility of identifying potential ancestors, the simplest way to falsify any specific ancestor-descendant hypothesis is to discover a better candidate for the ancestor. It's amazing how frequently the 'test of time' can be applied to scientific hypotheses.

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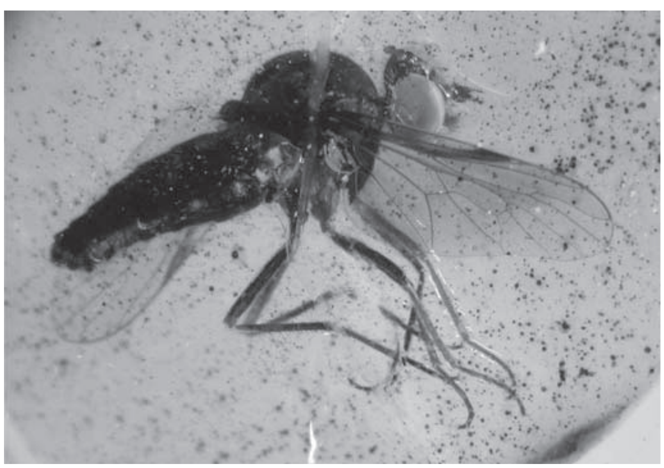
If you have any comments or opinions on this article, however concise, please send them in to <**newsletter@palass.org**>.

"Live from Dinosaur Island"— BBC 2, 10th-16th June 2001

Five dinosaurs. Six days. *"Live from Dinosaur Island"*, a series of five programmes, was broadcast from the Isle of Wight in June 2001. The series worked on the premise successfully pioneered by productions such as the BBC's *"Meet the Ancestors"* and Channel 4's *"Time Team"*, wherein a team of experts had a fixed schedule in which to excavate and document an interesting and significant archaeological site. *"Live from Dinosaur Island"* took this format several steps further, with live coverage of work at the dig sites (interspersed with pre-recorded segments filmed during the week), by covering several sites simultaneously and by extending the time range of such efforts back to the Mesozoic (rather than to the Neolithic, or "overburden" as we prefer to call it). This ambitious project followed the progress of excavations at no less than six dig sites. Teams of committed (in both senses) palaeontologists and students hoped to uncover further material of the dinosaurs *Neovenator*, *Hypsilophodon*, the Barnes High brachiosaurid, *Iguanodon* and *Eotyrannus* from the Early Cretaceous Wessex Formation exposures along the island's southwestern coastline. Presented by Bill Oddie, Edwina Silver, Simon King and Adam Hart-Davis, the series involved far more than just digging for dinosaurs. The sedimentology and taphonomy of the sites were investigated, as were the plant, invertebrate and microvertebrate fossils. Artists and model makers participated and the whole thing was a tremendous social event. However, it was ultimately destined to be a little disappointing as precious little dinosaur material was actually recovered. Still, the expectation that substantial parts of skeletons would emerge from the cliffs during filming was, perhaps, more than slightly unrealistic.

On arriving with fellow diggers at HQ, the now famous Dinosaur Farm at Brighstone, the magnitude of the operation became apparent. The BBC had basically hired most of the Isle of Wight, and the number of vehicles and people involved was tremendous. The use of heavy



1) One of the beautifully preserved insects entombed in amber that was discovered during the course of the week's activities. A preliminary assessment of the material by Ed Jarzembowski suggested that at least eighteen new species may have been discovered during the various digs (photo: David Ward).

2) Steve Hutt, Jon Radley, Jane Francis, Susan Evans and many others busy on-site at the Neovenator excavation (photo: David Ward).

machinery, helicopters and all-terrain transports certainly meant that our dig sites could be uncovered and investigated in a far grander, more intensive way than ever attempted before. Amazingly, the weather held for the duration of the event and, even more amazingly, most of the student volunteers worked hard in the field.

Two or three days into the project, several themes became established that would run through the rest of the project. No really good dinosaur bones were found. A couple of bits and pieces, including some possible parts of a theropod skull and a manual claw, were unearthed at the *Neovenator* dig site, but other than that none of the major sites produced any material of note—just a few isolated teeth and bone scrap. However, good quality amber was turning up all over the place: Ed Jarzembowski had a whale of a time identifying new midges, parasitic wasps and assorted other insects. Among these were a considerable number of new species, possibly as many as 18! This is probably the largest single contribution to palaeontology (beyond publicity) that the series brought about. Rumours of spectacular discoveries would periodically sweep through the diggers and crew, due largely to problems in communication between the sites and the high expectations among many that something would be found. For example, it was rumoured that a complete cycad frond had been discovered and that a complete *Neovenator* skull had been found. Both were embellishments to say the least. One rumour that did prove to have a solid basis in fact was the discovery of another bone-producing site during the week by local amateur Mick Green and postgraduate student Denver Fowler. Although the original plan had us digging at five sites, this discovery eventually persuaded the powers that be to increase this number to six. Opening up this new site provided partial salvation for one of the broadcasts as it was found to contain a veritable treasure trove of vertebrate fossils, including some of those elusive dinosaur bones. As Mike Barker noted wryly—"its difficult to keep them interested with just pond mussels".

Just about everyone ended up with their three minutes of TV time and most people seemed to be reasonably pleased. In the meantime, many of us were happy peering down microscopes or just hacking at lumps of clay. One highlight was provided by a juvenile crocodile that had the good sense to bite Dave Martill when the latter tried to clean the former's teeth for the cameras. Dave now sports some interesting scars on one finger: fortunately, the crocodile avoided food poisoning and is in rude health.

Despite the best intentions and efforts of everyone involved, a number of notable *faux pas* made it into the commentary. These included: mentions of 12 m goniopholidid crocodiles; the suggestion that allosauroid theropods killed with their hands, not their jaws; a brief discussion of the idea that *Hypsilophodon* was ecologically and morphologically similar to flamingos (!); and various mistakes regarding the history of discovery of *Iguanodon*. No names need to be mentioned—you know who you are. Still, at least the programme allowed and even encouraged discussion on the evidence used to reconstruct dinosaur biology and palaeoenvironments—a luxury not afforded by some previous series that we could mention.

Although Dave Martill's suggestion that the *Hypsilophodon* Bed might contain 5,000 individuals proved somewhat over-optimistic, this unit proved to be productive in general terms, with several pterosaur teeth, baryonychid teeth and gastroliths discovered. Hybodont shark spines and teeth proved very abundant at the site and novel sedimentary structures were revealed, all of which were useful in deducing the context of the site and in assessing its palaeoenvironment. The brachiosaur site, which yielded only a few small fragments of indeterminate bone, greatly benefited from having a taphonomist (Stig Walsh) on site. Stig's interpretation, backed up by David Ward's analysis of bone shards from the site, is at odds with the other palaeoenvironmental scenarios presented for this locality. Sadly, this taphonomic analysis got only a brief mention.

The artwork aspect of the project was fun. Starting from an off-the-shelf wireframe of a *Deinonychus*, Darren Naish worked with Keith Fallon to produce a digital 3-D walking *Eotyrannus*. This took an age as the original *Deinonychus* was simply awful. However, at least the *Eotyrannus* made it onto the screen: Richard Tibbetts prepared stacks of excellent diagrams and reconstructions, only one or two of which were ever used. Several palaeontologists worked closely with Bob Nicholls, the mural artist, as he reconstructed the Wealden landscape. Bob's original vision was vibrant and positively alive with creatures: a mired diplodocoid had attracted the attention of an *Eotyrannus* group as well as a *Neovenator* while iguanodonts and hypsilophodonts walked by in the background. Plans changed according to what was covered in the series, however, and the final mural (a real 'catch' for any museum display) depicts a single *Iguanodon*, a *Neovenator*, a herd of *Hypsilophodon* and some very distant brachiosaurs. An interesting, albeit minor, *contretemps* developed over Nigel George's clay model of *Neovenator*. Because Nigel was insistent that large predators simply must have well-developed stereoscopic vision he modified *Neovenator*'s head so that its eyes were forced into a forward-pointing position. This is contrary to what the bones indicate and the result was quite unrealistic (in our opinion): a good example of what can happen so easily even when scientists are on hand to advise in the creative process.

A final frustration was that some particularly exciting bits and pieces from several sites were not mentioned, largely because they did not fit into the predetermined story that the production team had concocted for a particular site. For example, during the last day of the brachiosaur dig, nice material of an atoposaurid crocodile was discovered, yet this was not mentioned in any televised broadcast. Neither was the recovery of an interesting small theropod humerus from one of the *Iguanodon* sites. In the latter case, the decision was made to concentrate on the flooding of the site rather than on the nice material that it was producing. Much to Paul Barrett's pique, one "new" microvertebrate record for the IoW, a small lizard jaw fragment, was also dropped from the programme. Still, this was nothing compared to the annoyance that Susan Evans felt—she had spent four days picking through residues looking for lizards and left for London about 30 minutes before Paul found what she had spent so much time (and eyestrain) looking for!

Much else happened besides, with a multitude of palaeontologists contributing. David Ward and Susan Evans did a great deal of microvertebrate sampling, vastly improving the known record of these tiny critters from the island; Jim Marshall was able to bring some stable isotope work to the party for palaeoenvironmental discussions; Ian Harding and Jane Francis worked hard with the plant fossils; Jon Radley and Ed Jarzembowski provided the invertebrate know-how. The dig leaders, Mike Barker, Dave Martill, Phil Manning, Steve Hutt and Denver Fowler did excellent jobs in keeping up levels of enthusiasm and in getting the job done: the diggers were tireless and good-humoured. Nigel Larkin and his team of preparators at HQ did a superb job in cataloguing, conserving and preparing the specimens as they were received. The BBC staff were unwaveringly enthusiastic and carried the project through with aplomb—through their efforts we got a good boost for palaeontology (over three million people watched our efforts) and even managed to talk about some sensible science too. Makes a change, doesn't it?

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3) Jane Francis and Adam Hart-Davis do their best to cement a strong media-science dialogue, with help from Dave Martill (photo: Paul Barrett).

Meeting REPORTS

The Lyell Meeting 2001: Palaeobiogeography and Biodiversity Change.
Geological Society, Burlington House, London *21 February 2001*

This year's Lyell meeting, held in the splendid surroundings of the Geological Society's headquarters in Burlington House, Piccadilly was on the subject of palaeobiogeography and biodiversity change. The great thing about such a themed meeting is that every single talk has immense interest and relevance for researchers in the subject field… and what a grand theme it was! Behind that buzzword 'biodiversity' is a topic of greater than ever importance, with palaeontologists using the latest taxonomic databases, and computer modelling techniques, to investigate the huge questions of how and where life has achieved the dazzling diversity levels we see around us today.

The day was split into two halves, with the focus in each dedicated to two of the major episodes of biodiversity change during Earth's history—hence the morning's talks concentrated on the Ordovician period of diversity increase, and the afternoon's offerings emphasised the events at that most celebrated of times—the Cretaceous-Tertiary boundary. Alan Owen outlined these two focal points in his opening remarks to the meeting. He also had the task of displaying the first graph of the day—Sepkoski's famous Phanerozoic marine diversity curve—and observed it would doubtless not be the last time we would see it (he was right, though I didn't bother counting!).

The morning's talks started with an event all too predictable—the first speaker was stuck on a train midway between Cardiff and London. Some hasty re-shuffling later, and David Harper stepped up to tell us about Early Ordovician brachiopod diversity, unfortunately no longer following on from Michael Bassett's account of Mid-Cambrian–Tremadoc brachiopods, which was delivered once the latter had escaped the clutches of Great Western trains.

Brachiopods didn't hog all the limelight during our Ordovician morning however; those other Palaeozoic protagonists the trilobites and bivalves also got a look-in courtesy of Sam Turvey and John Cope respectively. Conodonts and those with a bit of backbone were covered by Howard Armstrong and Paul Smith, while Joe Botting in his wonderfully soft-spoken way hypothesised volcanism as a catalyst for the whole Ordovician shebang.

Lunch and a quick trip to Fortnum and Masons later (well, those of us from the provinces have to take advantage of these meetings), and we were gearing up for our K-T session. The four speakers in the pre-tea slot dealt with the build up to the crash, from Martin Aberahn's Early Jurassic bivalve diversity, through to David Cantrill's account of floristic change in the Cretaceous, particularly concentrating on the angiosperm record of the Antarctic Peninsula—a region thought to have provided the main connection between east and west Gondwana.

After the biscuit break we were on to the K-T aftermath. Alistair Crame brought us up to the present describing Cenozoic diversity; he suggested that old favourite climate-change as the driving force behind rapid Neogene tropical speciation. Paul Markwick rounded the day off with some practical suggestions for using Geographic Information Systems (GIS) to link taxonomic occurrence databases with palaeomaps, thus creating a powerful new tool in analysing biodiversity and palaeobiogeography data simultaneously. The obvious question to Paul of 'how much does it cost?' received an impressively high number as an answer, probably putting GIS out of the reach of most researchers for the time being. An exciting new possibility none-the-less.

Before we all rushed for the wine reception, Alistair delivered a summary of the talks and a comment on the continuing excitement in this field of research created by ever-expanding computing possibilities. This combined with the quality of work displayed by the speakers surely means we are closer than ever to pinning down the reality of past biotic change.

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WOGOGOB-2001

Oeresund Region, Denmark *16 – 20 May 2001*

"Wobblygob" to some of us, or more correctly—the Working Group on the Ordovician Geology of Baltoscandia—was originally a forum primarily for Ordovician workers from Norway, Sweden and Denmark, but has since been enlarged to accommodate colleagues from the Baltic States (Estonia, Latvia, Lithuania), Poland and Russia. In May 2001, the meeting was hosted by the Geological Museum, University of Copenhagen, and well organised by David Harper and Svend Stouge from the Geological Survey of Denmark and Greenland (GEUS) together with their colleagues. If my memory serves me correctly, this was the sixth official meeting although I remember the initial meeting in 1988 (making the number seven) which somehow does not count.

I understand that the organizers had more than their share of anguish when arranging this meeting with a series of no-shows. None the less, things sorted themselves out and I believe David Harper is now preparing to organise the Palaeontological Association meeting at Christmas 2001, so do come. There is nothing like "Wonderful Copenhagen" and the Danes have a great knack of producing delicious food and wonderful beer (with aid from the Carlsberg Foundation) at all times of the day. The auditorium at the Geological Museum has been recently decorated, the pine floors varnished and there is an air of the grand old days in the walls and around the bar top covering the rotunda. The museum staff and research students did all they could to make us feel at home and the dinner upstairs with live music from the Irish-Western group of Svend Stouge, Jan Audun Rasmussen and Claus Sten made for a lively evening.

There were two days of lectures (17-18 May) followed by an excursion to Scania, led by Kent Larsen from Lund University. Unfortunately I could not take part in this but I understand it was a huge success and participants had the experience of crossing the new Øresund road-rail bridge which now joins Denmark and Sweden.

The formal lectures, 27 in all, covered the themes of Biodiversity, Palaeontology and Stratigraphy, Geochemistry, Palaeoenvironments and Faunal Dynamics, and Geodynamics and Sequence Stratigraphy, and there was an impressive poster session. Lectures were generally of high standard but often represented a reinterpretation of older palaeontological and stratigraphical data presented in a new quantitative way. This is a welcome trend but I hope we shall not see this become a substitute for the still much needed field work and collecting followed by careful preparation of material, identification and description. This time the meeting also included contributors to IGCP project 410 (The Great Ordovician Biodiversification Event) and from this we were treated to an instructive lecture on Ordovician biodiversity changes across Baltoscandia by Øyvind Hammer. He has put together an impressive database, so far standing at 8,500 records of first and last appearances of a single species at a given locality, and freely available on the Internet (**asaphus.uio.no**).

David Harper's knowledge of Ordovician brachiopods is becoming most impressive and he and Linda Hints from Tallinn share years of experience. It was unfortunate that Leonid Popov and co-workers did not turn up as their abstract promised some new ideas on the evolution of the Baltica palaeocontinent. Discussions on trilobites were well taken care of by Jan Bergström, Arne Nielsen and Kristina Månsson; graptolites by Sven Olaf Egenhoff and Jörg Maletz; conodonts by Anita Löfgren and Jan Rasmussen (who has recently published an excellent account "Conodont biostratigraphy and taxonomy of the Ordovician shelf margin deposits in the Scandinavian Caledonides," in the long awaited *Fossils & Strata* No. 48 which appeared at the meeting), to mention the most important. Andrei Dronov and his team provided excellent documentation of "fine tuned" stratigraphy, whilst the highlight for me was Bjørn Buchardt's presentation on carbon and oxygen isotope signals from limestones. His photographs of polished surfaces were made directly from placing the hand specimens on a computer scanner to reveal colour contrasts, crystallisation history and diagenesis. Baltoscandian Ordovician limestones are probably the best preserved in the world and the least altered, yet they provide elevated seawater temperatures of from 35-45°C. This cannot be correct, so where is the trap? I am sure Bjørn would be happy to receive suggestions.

The crowd of approximately 45 people contained many new and young faces, both male and female. This is encouraging, and I left the meeting convinced that research in the Ordovician of Baltoscandia has an exciting future.

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NAPC7 (North American Paleontological Convention) 2001
Berkeley, CA *26th June – 1st July*

The idea for a North American Paleontological Convention came from Ellis Yochelson in the 1960s. He was concerned that palaeontologists were becoming isolated within separate interest groups, and that these groups were going their own ways, holding their own meetings, and generally missing out on the benefits of interaction. The first convention was held in Chicago in 1969. The Berkeley meeting was the seventh. It will be half a decade, or so, before the next one (location still to be decided). Should you be thinking about pencilling it into your diary?

The convention was held on the Clark Kerr campus of the University of California, about ten minutes walk from Telegraph Avenue and the main Berkeley campus, and about fifteen minutes from the city centre. All talks, posters and meals were at Clark Kerr, as was the designated accommodation. I cannot comment on the accommodation as I live only a short walk away, but the meals were excellent, and the campus itself was a great setting for the meeting. There were plenty of flower- and grass-filled courtyards with scattered benches for quiet conversations to the background of fountains and flowing water. Fortunately the weather behaved itself, after some unseasonable rain the day before participants arrived (which must have caused the organisers some concern as the posters were displayed in the courtyard outside the dining hall).

It is difficult to give an accurate figure for total numbers at the convention, as some people only came for a day, or registered late, but some idea of scale can be got from the 450 or so at the Saturday evening banquet, though this did include a few partners. Apparently this was a rather low figure compared to previous conventions, at one stage giving rise to concerns that the convention might not be viable. As it was, the planned post-convention field trips were cancelled.

The technical sessions were many and varied. For the first three days there were five parallel sessions, dropping to three on the Saturday, and two on the Sunday. It was obviously impossible to sample more than a small fraction of what was on offer, and by the Sunday fatigue was obviously setting in, which was a great pity as there were some really interesting contributions.

The talks were organised into a number of symposia, theme sessions and sessions of contributed papers. The number of talks that were listed to be presented in a session (omitting preliminary remarks by the chair) are shown in square brackets. Very few speakers failed to turn up.

Symposia:

1. Evolution of high latitude biota during the last 100 million years (Middle Cretaceous–Recent) [12]
2. When clocks collide: calibrating lineage divergences from fossils and molecules [14]
3. New uses for the dead: paleobiological contributions to conservation biology [14]
4. Changing perspectives of Tertiary paleobotany in North America [12]
5. Spatial and temporal resolution of the fossil record [15]
6. Evolution in the computer: artificial life and evolution models [10]
7. New interpretations of complex trace fossils [9]
8. The beginning of the Mesozoic [16]
9. New perspectives in non-mammalian synapsid paleobiology [11]
10. Drilling predation and demineralization through time [11]

11. Species-level and community-level stability: case studies from the Dominican Republic Neogene [12]
12. Cenozoic paleontology and stratigraphy of the John Day Basin, Oregan, USA [13]
13. Future of micropaleontology: application to environmental problems? [11]
14. Bioinformatics: databases in paleobiology [12]

Theme sessions: (There were no 1 and 4)

2. New approaches in Paleoecology [12]
3. The Precambrian-Cambrian biotic transition: interplay of biological and environmental changes [16]
5. The evolution of grass-dominated ecosystems during the late Tertiary [13]

Sessions of contributed papers:

Taphonomy [4], Micropalaeontology [3], Paleoecology [9], Extinctions [2], Invertebrate paleontology [10], Trace fossils [3], Molecular clocks [2], Vertebrate paleontology [17], Paleogeography and paleobiogeography [4], Invertebrate paleontology and evolution [21], Paleobiogeography [5]

I shall not comment in detail on any of the talks, though most were good, and the conference as a whole was well worth attending. Most of the time the session chairs kept to the printed schedule, so it was usually possible to cut from session to session and find the expected talk; though the odd exception should make us all ready to point out the problem to the chair (as happened here a couple of times). How could it have been better?

One problem was that four out of the five meeting rooms were only medium sized, and could not always provide space for all who wanted to attend a talk (I missed two talks by well-known speakers as I came from other sessions and found myself several rows back in the corridor). Overfull rooms meant that they could get quite stuffy, leading to several nodding heads (nothing to do with the copious food and liquid refreshment available, of course). The blackout facilities in the medium-sized rooms were not perfect, so many bad slides were made worse. And there were quite a few bad slides, not made any better by authors' apologies on the lines of: "As you can see, I haven't quite got to grips with PowerPoint yet", or "My grad students thought this one was pretty bad, but I'm afraid that some of the others are worse". I thought back to the founding of the Pal Ass President's Prize, which my perhaps-faulty memory recalls as originally awarded primarily for the quality of presentation and illustrations, with quality of science being less important, and realised how much it did to improve the overall standard of talks. Perhaps an American equivalent is needed. I also thought that several of the talks would have been better as posters, which might have forced the authors into thinking more carefully about quality and quantity of illustrations.

I also wondered if the symposia could have been improved (and this is not directed solely at the NAPC). I felt that though I learnt a lot that was new and interesting, I didn't really get a feel for how much of this new material fitted in with what we already think we know, except in some of the very specific detail of the individual talk. Difficult, of course, with talks and questions confined to a twenty minute slot, and partly helped by discussion sessions at the end (though these seemed to me to concentrate on what had been presented that day), but it did seem to illustrate the kind of compartmentalisation of knowledge that worried Ellis Yochelson when he originally proposed the idea of a convention. But there were talks by people from other fields, applying their techniques to palaeontological problems. I heard one by a physicist and another by a fluvial geomorphologist, both applying statistical techniques to model palaeontological data.

These are only minor quibbles. Most talks were well presented and illustrated, and there was a huge volume of new data and ideas presented. The organisers and most of the speakers did a good job.

Apart from the talks, there was plenty of opportunity to meet colleagues, mostly from America but with a scattering from round the world (much helped by two morning refreshment breaks, and long lunchtimes). A large number of the participants were graduate students, many helped by funds from the National Science Foundation. I was told that, in comparison to previous conventions, there was a noticeable absence of people from industry (I only counted a handful). This must reflect the serious ‘downsizing’ that has been seen, particularly in the oil industry. I did hear a tale of a meeting in BP, where a senior geophysicist broke into a discussion on palaeontology saying something like “The sooner that you stop trying to tell us things like the age of rocks, which we know from seismic stratigraphy, and concentrate on palaeoenvironmental interpretations, which we can’t yet get from seismic, the better.” With attitudes like that, and new fast drilling techniques that wreck most microfossils, it is no wonder that the numbers of palaeontologists in oil companies have been dropping fast. I could not help reflecting on a talk at the BMS (British Micropalaeontological Society) AGM a couple of years ago, where on-site palynological work was resolving a complex structural setting that had been totally misinterpreted by the geophysicists. The company? BP.

Apart from the posters, there were also a number of exhibits including book publishers (Blackwells, Columbia University Press, Elsevier Science, University of California Press, University of Chicago Press), scientific societies (BMS, Pal Ass, Pal Soc), a bookseller (Hahn’s Natural History Books), a scientific illustrator, and a computer imaging firm. The Pal Ass table seemed busy whenever I chanced by. Most exhibitors provided a prize for a draw for students attending the convention. The Pal Ass provided a year’s free membership, helping to spread the message about the benefits of joining.

The program and abstracts were printed in PaleoBios volume 21, supplement to number 2. Most of this material, and general information about the conference, is still available (at the time of writing) on the Web at **http://www.ucmp.berkeley.edu/napc/general.html**

So, should you be thinking of saving up for the next convention? The way academia is going in Britain at the moment, five years is beyond most planning frames. But it is an opportunity to meet and hear a wide range of people and topics, and a great opportunity for networking. For those at the start of their careers it may open many doors (three jobs in the Museum of Paleontology at Berkeley were announced during the current convention), though many who will be in that position are probably still undergraduates at the moment and unlikely to be avid readers of the newsletter!

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The 6th International Congress of Vertebrate Morphology (ICVM-6)
Friedrich-Schiller University, Jena, Germany *21 – 26 July 2001*

ICVM-6 Jena followed the highly successful ICVM-5 held at Bristol in 1997, however attendance numbers were up by 25% to a whopping 760 delegates. This huge conference is staged every three to four years. It is the largest of its type held anywhere, and is the most prestigious (along with the American SICB meetings). During the course of five days of scientific sessions, seventy-six presentations (including six one-hour plenary lectures) were given on nearly all aspects of vertebrate morphology. Mornings were given over to eight twenty-minute lectures, and the afternoon sessions were devoted to six half-hour symposia presentations. Unlike the situation at Bristol four years earlier, the six lecture rooms were all situated in the same building, and furthermore were located right next to each other. Given the range and interest of many talks this was an important point, as was their location adjoining a spacious and light atrium that was ideal for meeting colleagues and co-workers over coffee and nibbles. Parallel talks could be visited quickly with the minimum of fuss.

For vertebrate morphologists this conference is the ultimate in terms of quality (as well as quantity); the breadth of the subjects was immense. Topics spanned everything from the adaptations of birds to climbing in pine needles, through the modularity of body plans and character conservation, to the fluid mechanics of venom flow in rattlesnakes. Symposia topics ranged from quantitative biomechanics of locomotion, cranial anatomy, enamel microstructure, to muscle biology. Make no mistake, this conference is not for the feeble; the most junior presenters were fourth year Ph.D. students, and individuals with towering scientific reputations gave many of the talks. Having said that, the ICVM is a great forum in which to meet peers and interested colleagues, and to discuss the deeper points of vertebrate morphology. Admittedly, two or three talks of rather poor quality did sneak in under the carpet, but out of 76 presentations this can be excused.

Despite its sheer size, the most galvanising aspect of this conference is the remarkable scientific quality of the research presented in it. Nothing along the lines of "A new Ginormodon femur from the Isle-of-Wonder" or "Members of the Stupendosaurus group do have intertemporals" will find its way in to this meeting; analysis, testing, experimentation and deep synthesis were the watchwords of ICVM-6 and it was wonderful! Some presentations involved highly novel and deeply refined approaches to systematics and phylogenetic analysis, and a number coupled highly complex geometric morphometric techniques with phylogeny to gain better insights into adaptive radiations. High quality researches into vertebrate development were regularly encountered if one wished to take a peek into the appropriate symposia.

Nevertheless, the ICVM meetings are particularly notable for the phenomenal quality of their biomechanical and functional morphological presentations. Just a very small number of these focused on the application of neontological data and engineering principles to the analysis of form and function in extinct vertebrates. It would have been highly instructive for at least one all-too-visible scientific journalist to have attended the talks on functional morphology in this extremely high calibre meeting. There was no vague arm waving but simply a series of rigorously tested and underpinned analyses of fossil function and biomechanics, presented in

Ian Jenkins and his biomechanics posse, mid-quaff.
Left to right: Audrone Biknevicius (Ohio), Mark Teaford (JHU), Ian Jenkins (Bristol), Bridgette Demes (SUNY), Joan Richtsmeier (Penn State Uni), Rebecca German (Cinncinnati)

a clear and lucid manner. As for the biomechanical analyses on living animals, many of these involved highly sophisticated kinematic, cineradiographic, mathematical, force-platform, and electromyographic techniques, all of which were put into evolutionary perspectives. Those few practising biologists who take the misguided stance that functional morphology is 'unscientific' would be dismayed to find their long held and cherished beliefs so thoroughly refuted. Put simply, this is the meeting to attend if you wish to get information and expertise in order to refine your developmental framework or obtain neontological and biomechanical data for application to an extinct vertebrate, or vertebrate group.

Only a small number of UK morphologists attended and the most entertaining presentations from this small band of intrepid anatomists came from one or two of the 'UK finite element modellers association' (ahem) and the 'agnathan research group UK'. With reference to the latter, their deserved reputation as the main 'social' group at the annual Pal Ass meetings was further enhanced at this congress, as they kept the UK's social colours flying; which brings me neatly to other aspects of the ICVM-6. The sessions were held in a gleaming modern construction, in an equally modern university square, both of which are so characteristic of post-war Germany. But much of surrounding Jena was old and quaint, with a large smattering of 'Grimm's fairytale' style architecture. A two-minute walk from the venue took the assorted attendees to the Wagnergasse; a narrow cobbled alleyway running West-East whose South side was composed entirely of wonderful bar-cafes. At lunchtimes and evenings these bars were inundated with ICVM attendees; the tables out on the road were wonderful and allowed discussions that had been initiated during the scientific sessions to continue in the most conducive surroundings imaginable. Discussions and friendly arguments were facilitated by large tall glasses of the local brew, the Köstritzer schwartzbier (black beer). This gorgeous smoky, inky black brew was a huge favourite with the UK delegates and was soon introduced to the US attendees, with favourable results.

North Europeans talk vaguely about 'German efficiency', but this congress supported this view; Matthias Starck had assembled a large and skilled band of helpers into the congress secretariat, and all went with a tremendous smoothness. However, Matthias Starck really found a winner when he recruited an expert in multimedia from a sister department to look after the media side of things. The congress was especially notable for the superlative facilities for PowerPoint presentations, some of which included slow-motion kinematic footage; at least 50% of all the presentations were given using this method.

In summary, the ICVM-6 at Jena was a spectacular success; the standard of the science presented was terrific, the organisation superb, the location wonderful and the breadth of topics highly impressive. Matthias Starck and colleagues deserve a huge vote of thanks for organising such a stimulating conference. ICVM-7 is to be held in Florida in 2004, and I can't wait for it.

Ian Jenkins
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If you have been to a scientific meeting—far away or close to home, hot and sweaty, freezing or temperate—please send in a report for the newsletter, to <**newsletter@palass.org**>.

>>*Future* Meetings of Other Bodies

Society for Comparative and Integrative Biology 2002 Annual Meeting
Anaheim Marriott, Anaheim, CA, USA *2 – 6 January 2002*

Symposia:

- The promise of integrative biology. *Organized by: Marvalee H. Wake and John Pearse as a Society-wide Symposium*
- Symposium on comparative immunology. *Organized by: Edwin L. Cooper as a Society-wide Symposium*
- Integrative and evolutionary roles of extracellular hormone-binding proteins. *Organized by: Kevin M. Kelley and Cunming Duan for DCE*
- Dynamics and energetics of animal swimming and flying. *Organized by: Malcolm S. Gordon, Ian K. Bartol, and Jay R. Hove for DCPB and DVM*
- Ecological developmental biology. *Organized by: Scott F. Gilbert and Jessica Bolker for DCDB and DEDB*
- The Cambrian explosion: Putting the pieces together. *Organized by: Graham Budd for DEDB*
- New perspectives on the origin of metazoan complexity. *Organized by: Ruth Ann Dewel, James G. Gehling, and Julian P.S. Smith III for DEDB, DIZ and AMS*
- Physiological ecology of rocky intertidal organisms: From molecules to ecosystems. *Organized by: Lars Tomanek and Brian Helmuth for DEE*
- Integrative approaches to biogeography: Patterns and processes on land and in the sea. *Organized by: Rachel Collin and Marta deMaintenon for DEE, DIZ and DSEB*
- Retirement mini-symposium in honour of Russel L. Zimmer. *Organized by: Scott Santagata and Michael Temkin for DIZ*
- Neural mechanisms of orientation and navigation. *Organized by: James A. Murray for DNB*
- Recent developments in neurobiology. *Organized by: Richard Satterlie for DNB*
- Biomechanics of adhesion. *Organized by: Kellar Autumn and Robert J. Full for DVM*
- Tendon—bridging the gap. *Organized by: Adam P. Summers and Thomas J. Koob for DVM*

For further details: <**www.sicb.org**>

Taphos 2002 3rd Meeting on Taphonomy and Fossilization
Valencia, Spain *14 – 16 February 2002*

The "International Conference Taphos 2002" is a meeting about the problems relating to the formation of the fossil record and its dynamics. This Conference follows the two previous meetings held in Spain on these subjects under the heading “Reunion de Tafonomia y Fosilization” (Madrid, 1990 and Zaragoza, 1996 respectively). The success of the two earlier meetings (with many foreign attendants) has convinced us to give an international character to our forthcoming Conference, and we expect a high level of participation.

The “International Conference Taphos 2002” will be held in Valencia on the 14th, 15th and 16th of February 2002. The meeting will be mainly supported by the “Universidad Internacional Menendez Pelayo”, in collaboration with the “Ayuntamiento de Valencia” and the “Universitat de Valencia”.

We propose five broad topics and encourage contributions to them:

- Taphonomy in archaeology
- Taphonomy in analysis of patterns of evolution and extinction
- Taphonomy in biostratigraphy
- Theory of taphonomy
- Taphonomy in other fields: palaeoecology, sedimentology, exceptional preservation, and so on.

The official languages of the Conference are English and Spanish, with simultaneous translation. Oral presentation of contributions can be in Spanish or English.

Three invited lectures of one hour will take place during the Conference. There will also be eight invited talks of half an hour about the suggested topics. Ordinary contributions will be presented as posters in special sessions devoted to them. The text of the posters should be written in English. A chairman will lead each session. Discussion will follow a short presentation of the poster lasting five minutes.

Ordinary contributions will be edited in a special volume with the title “Taphonomy and fossilization” published by the Ayuntamiento de Valencia. This book will be delivered to the participants at the beginning of the Conference. Original manuscripts will include up to a maximum of eight pages of text, with 30 lines per page and 70 characters in each line. In these eight pages you must include figures, tables and bibliography. In a new circular, you will have new instructions about address and sending of manuscripts.

The price for subscriptions is about 20,000 pts. ($110/€120); students will pay about 10,000pts. ($55/€60).

Correspondence about the Conference has to be addressed to the Secretary of Taphos 2002: **Dr Margarita Belinchon**, Museu de Ciencies Naturals. C/ General Elio, s/n; Jardins del Real, E-46010 Valencia, (SPAIN), e-mail <**Taphos2002@paleopolis.rediris.es**>.

The Amateur in British Geology

London, UK *14 – 15 March 2002*

This is a two-day joint meeting organised by the History of Geology Group of the Geological Society and The Geologist’s Association, to be held at the Geological Society’s premises, Burlington House, Piccadilly. If you are interested in giving a paper on any aspect of Geology or Palaeontology, please contact the convenor, Stuart A. Baldwin, Fossil Hall, Boar's Tye Road, Silver End, Witham, Essex, England, CM8 3QA (tel 01376 583502, fax 01376 585960, e-mail <**sbaldwin@fossilbooks.co.uk**>).

ECOS VIII Eighth European Conodont Symposium

Toulouse and Albi *13 June – 1 July 2002*

For the first time the International Conodont Symposium held in Europe (ECOS VIII) will take place in France and Spain. As well as the scientific sessions, two other important events will take place: the final meeting of International Geological Correlation Program (I.G.C.P.) 421, and a meeting of the Subcommission on Devonian Stratigraphy (S.D.S). The meeting will be hosted by the Université Paul Sabatier in Toulouse and Albi. The Scientific Conference will focus on all aspects of conodont research; a special Session on "Bias and Completeness in the Conodont Fossil Record" will be organised by Mark Purnell (Leicester, UK) and Philip Donoghue (Birmingham, UK). An eight-day pre-conference field trip to visit Palaeozoic sequences of Cantabrian Zone, Iberian Chain and East Pyrenees (Spain) will take place 13-21 June, 2002. A six-day post-conference field trip of Montagne Noire and Pyrenees (France) will take place from 26th June to 1st July. Both excursions are planned for a maximum of 35 participants.

For further details contact Marie-France Perret-Mirouse, Laboratoire de Dynamique des Bassins, 38 rue des Trente-six Ponts, Toulouse, France (tel: +33 (0)5 61 55 84 41, fax: +33 (0)5 61 55 82 50) e-mail <**mfperret@cict.fr**> <**www.le.ac.uk/geology/map2/con-nexus/ECOS/ECOS_VIII.html**>

First International Palaeontological Congress

Sydney, Australia *6 – 10 July 2002*

The First International Palaeontological Congress, sponsored by the International Palaeontological Association, and hosted by the Australasian Association of Palaeontologists and the Macquarie University Centre for Ecostratigraphy and Palaeobiology, will take place in Sydney on 6-10 July 2002. It is programmed to follow on from the Australian Geological Congress (30 June-5 July) to be held in Adelaide. Formal sessions of IPC-2002 will take place principally at Macquarie University.

Coupled with the Congress will be meetings of IGCP 410 The Great Ordovician Biodiversity Event: implications for global correlation and resources and IGCP 421 North Gondwanan mid-Palaeozoic bioevents/biogeography patterns in relation to crustal dynamics. The Congress will be an appropriate venue for showcasing other activities of IUGS subcommissions on stratigraphy, and IGCP projects with a significant biochronologic focus. Suggestions of associated meetings and workshops, and additional or alternative symposia, are welcome. Associated with the Congress will be a Symposium in honour of Prof. Geoffrey Playford's sustained contribution to palynology and micropalaeontology, and the Jane Gray Memorial Symposium celebrating Jane's lifetime commitment to innovative research.

To receive the second circular fill in the form at <**http://www.es.mq.edu.au/mucep/**> or e-mail <**IPC2002@mq.edu.au**>.

Third International Congress on Environmental Micropaleontology, Microbiology and Meiobenthology
Institute of Paleontology, Vienna, Austria *1 – 6 September 2002*

The conference will cover a wide range of topics, with special focus on: micro- and meioorganisms as indicators of past and recent environments; micro- and meioorganisms as indicators of pollution for ecological risk assessment; industrial application of micro- and meioorganisms; application of micro- and meioorganisms to archaeology and medicine.
Dr. Irena Motnenko Osorno Enterprices, Inc., Suite 301, 162-2025 Corydon Avenue, Winnipeg MB R3P 0N5, Canada Phone: +1 (204) 488-1538; fax: +1 (204) 488-1566; e-mail <**congress@isemmm.org**>.

Jurassic Symposium 2002
Sicily *12 – 22 September 2002*

The First Circular for the 6th International Symposium on the Jurassic System has been circulated. The Symposium will be held in Sicily from 12th to 22nd September 2002. These dates include pre- and post-Symposium field trips. If you have not received the First Circular (return due by 1st March 2001) you can contact the Symposium Secretary Dr Luca Martire (Torino), e-mail <**martire@dst.unito.it**>. You can also get further information from the Web site at <**www.dst.unito.it/6thISJS/**>.

6th International Congress on Rudists
Institute of Geology and Faculty of Science, Department of Geology and Palaeontology, Zagreb, Croatia *September 2002*

The conference is dedicated to the exchange of knowledge on rudist taxonomy, shell structure, biostratigraphy, evolution, palaeobiogeography, palaeobiology, stable isotope analysis, palaeoecology, and modern analogues, as well as sedimentology and stratigraphy of rudist strata and associated microfossils.

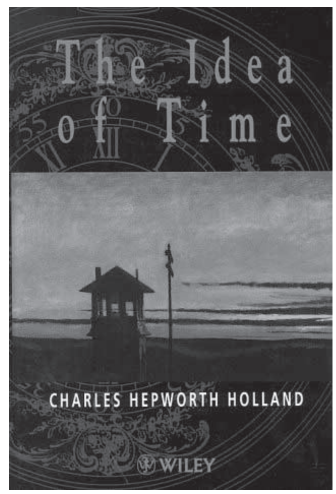
Alisa Martek, Institute of Geology, Sachsova 2, 10000 Zagreb, Croatia (tel +385 1 6160786, fax +385 1 6144718, e-mail <**amartek@igi.hr**>).

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

Book Reviews

The Idea of Time

Charles Hepworth Holland, Wiley, 1999, 150pp. ISBN 0-471-98545-7
£34.95.



As geologists and palaeontologists, there is a very real sense in which time is our stock-in-trade. We deal with events that took place over vast spans of time, and with creatures that lived an immensity of years ago. Even though we may study the anatomy of a finely-preserved though long-dead plant or animal, as if it were almost fresh, the fact remains that it died ages long ago, far before the fleeting life of the observer began.

So here is a book upon the concept of time, an extended meditation, written by a polymath and elder statesman of geology. And what an erudite, cultured, and poetic vision it is; few of us could match such breadth of reading. It is profuse with quotations from poets, philosophers, scientists, artists, and is illustrated with reproduced paintings, photographs of slabs of graptolites, and of distant galaxies. Professor Charles Holland, for many years Head of Department at Trinity College, Dublin, and known for his voluminous researches on the Silurian, and on fossil cephalopods, provides a philosophical first chapter … "questions like 'What is time' are remarkably like children's questions…". Who could disagree? Chapter 2, Clocks and Calendars, is concerned with the measurement of time. The discussion ranges from the penetration of light into the inner recesses of the Newgrange chambered tomb only at the winter solstice, to the measurement of longitude, taking up the theme of Dava Sobel's recent book, and with a picture of one of John Harrison's watches. The third chapter, Time and Life, covers biological clocks and rhythms, reproductive cycles, how the growth of trees can be used in dendrochronology, and how fossil corals have been used to establish the number of days in ancient years. Chapter 4 concerns Human Time, the different perception of time in child and adult, the ending of personal time with death, our human feelings about this inevitable event, the nature of dreams. A painting effectively represents a frozen moment of time, however long it has taken to complete, while a photograph is instantaneous. Yet in the realist paintings of Edward Hopper for example, discussed in Chapter 5, The Artistic View of Time, the tension of a single moment, be it erotic or despairing, is encapsulated vividly, for as long as the painting lasts.

In the remaining chapters, apart from the final one, we are back to science. Chapter 6, A Growing Sense of Geological Time, is a finely written and concise history of how we came to understand that the Earth is infinitely older than had been envisaged. Xenophanes, Steno, Hutton, William Smith, Lyell, and various nineteenth century geologists are noted here, and while this may be known to many of us already, the eloquent style is gripping. Chapter 7, Geochronometry, traces the transition from the inconceivably long, but vaguely defined sense of time of Hutton and Lyell to the precision we now have, on the basis of radiometric dating. This, and the following Chapter 8, Stratigraphy, embody principles familiar to us, but once more so clearly written that we can still learn from them. The following two chapters concern the solar system and beyond, and cosmology, respectively. Deep time is matched by deep space, the vastness of both opening up perspectives never dreamed of, even a few generations ago. The Big Bang. Black holes. The idea of time, on a cosmic scale giving place to the concept of space-time. And yet more unanswered questions...

In the final two chapters, 11, The Philosophy of Time, and 12, What do we understand when we think about time? lead us into other dimensions. Here is a summary of what various philosophers, from Augustine of Hippo onwards have thought about time. Does time flow? Has it a beginning and an end? Time on Earth may be regarded most simply as a measurement of duration, of expressing rates and placing of successive events. The real problems enter with space-time. And the ultimate problems, as one must agree with Professor Holland, still elude us—the nature of consciousness, what happened before the universe supposedly began, the extent of space. Some people believe that the answers to these questions lie just around the corner. Charles Holland does not believe in such immediacy, no more does this reviewer. Others, *e.g.* J.A. Wheeler, embrace the anthropic principle, that not only is man adapted to the universe, but the universe is adapted to man—“if one or other of the fundamental dimensionless constants of physics differs from this world’s values by a few percent one way or the other...man could never have come into being”. Interesting, certainly. But debates of this kind will rumble on indefinitely. So meanwhile, where do we, as ephemeral human beings in this vast universe of deep time and deep space, go from here? Charles Holland does not try to dodge this issue. He concludes, rather touchingly with a comment from his small granddaughter. She announced “I like my life”.

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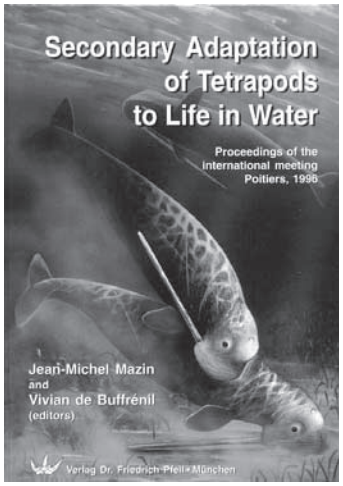
Secondary Adaptation of Tetrapods to Life in Water

Proceedings of the International Meeting, Poitiers 1996. Edited by Jean-Michel Mazin and Vivian de Buffrénil. Verlag Dr. Friedrich Pfeil, München 2001. ISBN 3-931516-88-1 (DM136.91).

After a long evolutionary struggle towards full terrestriality, amniotes (reptiles, birds and fish) have repeatedly reinvaded the water. This adaptive theme was the focus of an international meeting held in 1996 in France, and the presentations in that meeting have finally appeared in print in the form of this book. The five year delay is unfortunate (especially since another such meeting took place in the interim), but, as most people who have edited books will testify, probably inevitable. Also, most of the contributions have been updated and



incorporate the literature up to 1999. This is important, since most are reviews rather than reports of new findings, and reviews tend to lose their importance rapidly if they are not right up to date.

Some introductory chapters on marine environments and food webs help to integrate the book, but as with all symposium volumes, coverage of the field is patchy: marine mammals and birds are well represented, but there is almost nothing on marine reptiles, or on freshwater forms. The highlights include two excellent review chapters, on the evolution of cetaceans (Fordyce and de Muizon) and of pinnipeds (Berta and Adam), which integrate and critically evaluate information on these topics, focusing on recent advances. Some of the other chapters, however, are mainly summaries with few original insights, and might date rather quickly.

There are repeated and extensive convergent adaptations between the numerous aquatic amniote lineages, and regularities across these groups could provide a wealth of insights into evolutionary processes (*e.g.* adaptation versus phylogenetic constraint). There are some papers which address these patterns within each major group, such as an illuminating one on biomechanical trends in mammals (Fish). However, only one chapter (on bone histology: de Ricqlès and de Buffrénil) evaluates trends across all the groups (reptiles, birds, and mammals). Also, another intriguing question is the frequency of aquatic reinvasions which have occurred in land vertebrates—few other terrestrial clades have had such success moving back into aquatic habitats (*e.g.* there are few marine insects, angiosperms, or pulmonates). Getting experts on different groups together to address these big-picture questions is potentially one of the most important parts of meetings such as this. The first meeting should hopefully have forged these collaborations, and one looks forward to the fruits of the second meeting.

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Ordovicische Zwerfsteensponzen

Rhebergen, F., Eggink, R., Koops, T. & Rhebergen, B. 2001. Staringia 9, 144 pp. *f*35 / £16.

It was with a certain amount of trepidation that I took on this volume, despite the delight in finding a book—any book—about Ordovician sponges. The main problem many of you will probably sympathize with, and despite having no bearing on the quality of the content, must inevitably reduce its value to palaeontologists in this country: it's in Dutch (although mercifully only single). There are, however, English and German summaries of the introduction, and brief German summaries of each taxon.

The aims of the book are to provide a guide for amateur palaeontologists in northwest Europe, to summarize present knowledge of the subject area, and to attract the global attention of poriferan specialists to this fauna, which has been sorely neglected in recent decades. The first of these is very well achieved, the second appears to be, at a certain level (although here I am linguistically challenged), but the third, I fear, may be largely missed. In outline, the volume is sensibly and clearly designed, but it should be stated immediately that the taxonomic scope includes only the lithistids recovered from North European erratics (plus a solitary hexactinellid "root tuft"). This may well be more obvious to those who can translate "Zwerftsteensponzen," but is not immediately apparent to most mortals.

Starting with the introduction, the English summary provides useful background regarding the diversity, distribution and provenance of the material, but is a pale reflection of the Dutch introduction, being reduced from 31 pages to three; for example, there are sections on biology, ecology, taxonomy and identification that find no counterpart in the summary. The Dutch text is illustrated with some excellent photographs and drawings, as well as numerous somewhat crude, but perfectly adequate maps and other figures. It is a pity that these figures are not cross-referenced to the English summary, since many of them are appropriate. In particular, the section dealing with the provenance and glacial transport of the material is a significant contribution, and deserves wider appreciation. This introduction contains not only a review of necessary background, but also some meaningful new information. There is also a page or three celebrating such European luminaries as Rauff, Roemer and van Kempen, with a truly startling portrait of W. Staring, whose spectacular visage also adorns the front cover. It's almost worth buying just for that.

The systematics section is preceded by a substantial reference list, in which appear at intervals occasional publications by non-Europeans (one suspects with some reluctance, since several taxa would have benefited from reference to other faunas); nevertheless, this is an important source, containing many specialist references that were new to me. I hope I'm not completely alone in my ignorance of such journals as Schocklandreeks, Grondboor & Hamer and Geschiebekunde Aktuell.

The systematic section (I use the term loosely) is almost entirely in Dutch, with a final paragraph for each taxon in German. Each species, with rare exceptions, is dealt with over one A4 side, although sometimes with two related taxa treated simultaneously. There are no synonymy lists, and no new taxa are erected, but undescribed species are represented as, *e.g.* "*Aulocopella* sp. B = *Aulocopella* cf. *hemisphaericum* Roemer, 1861." This is illustrative of a level of precision and detail that is unusual in amateur guides, another indication of the somewhat mixed audience for which it is intended. There is also a brief etymology, although this has no useful grammatical details, and serves primarily as a "translation" for the curious. The description is detailed, and subdivided into form, canal system, skeleton, vergelijkbare soorten and verdieping, whose translations I leave as an exercise for the student. Although not at the level of detail of a scientific journal, a significant amount of information is transmitted by means of a strange mix of scientific and colloquial language. For example, the skeleton of the above-mentioned *Aulocopella* is described in terms of "ladders" radiating in all directions, these ladders being composed of dendroclones. Although I say "strange," this actually seems an ideal approach, in that it is accessible to both specialists and amateurs, providing enough detail to be useful but with sufficiently colloquial terminology to be intelligible with only the essential terminology. This aspect was to me the most impressive of the monograph, and I very much hope will set a standard for semi-amateur guide descriptions in future.

Illustrations are generally of a very high standard, with on average 8-12 specimens, showing all necessary orientations. Where the material allowed, this includes internal sections. The only criticism I have of the illustrations regards the lack of fine skeletal details; although in some cases, accompanying drawings or photographs are provided as additional figures, these are uncommon. This limits the usefulness of the volume significantly in taxonomic terms, since although the external form is the primary guide for the collector, precise spicule arrangement and morphology are necessary for research purposes.

Overall, the book caters for an audience intermediate between the lay fossil-hunter and the serious researcher, a category with sadly few inhabitants. However, I hope the approach will be accessible to all Dutch-speaking amateurs, and appreciated by them. The comprehensible style will hopefully appeal to all those interested in the fossils for the organisms' sakes, rather than purely as collectors' items. For the specialist, it is a very useful literature source, and quick identification guide; while not possessing the necessary detail as an information source in itself, it provides an ideal entrance to the often elusive material.

So why the cautionary note at the beginning? I suggested that it would largely fail in its third objective, that of attracting the attention of sponge specialists worldwide. The reason for this is simply that it does not appear to be as open and accessible as it could be. Rather than saying, "Hey, look at these wonderful fossils!" it's saying, "Look at our wonderful fossils." This isn't just the language barrier, although that is certainly a significant point; although German is widely spoken, even these sections are far more limited than the Dutch. Perhaps I am being unfair, and I hope I am; but there is notably little locality information, or advice on how to collect specimens oneself. Sadly, I also suspect you won't stumble across this volume very regularly. But to return to my primary reaction: it is a very welcome addition to the amateur guidebook genre, which I hope will set a standard to be followed more widely, providing substantial detail and a link to the specialist literature for those interested. It is also a very welcome addition to my bookshelf, acting as an index that one day may save a lot of time and effort. And for £10, no one can complain much.

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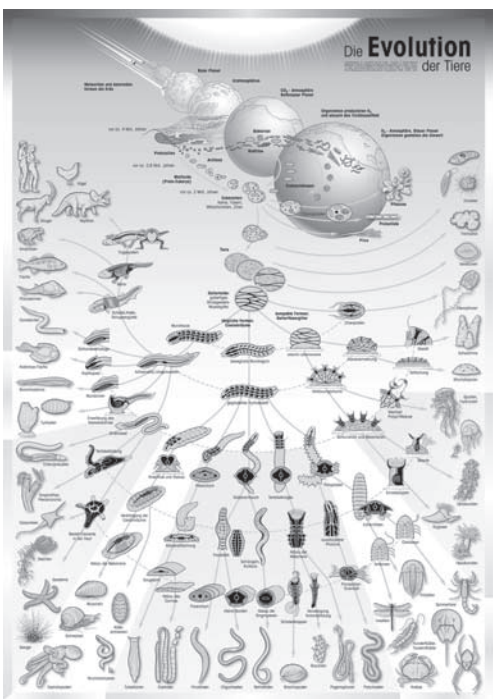
The Evolution of Animals

Grasshoff, Manfred and Gudo, Michael. (with Hilsberg, Sabine, Oschmann, Wolfgang, & Scholz, Joachim) 2001 Senckenberg Poster, with accompanying booklet, 16pp. ISBN 3-510-61325-2 c. 26DM.

There seems to be a great resurgence of interest in metazoan phylogeny at the present time, and one trigger for this has been the Burgess Shale and Chengjiang discoveries. Where do these strange creatures fit in? We have also the present debate about whether the Cambrian explosion of life is real or an artefact, and the apparent conflict between the molecular and palaeontological data. So, there is a very real interest at the present time in how the various phyla diverged, as well as when. The new Senckenberg poster is a very original contribution to the present discussion, but before making comments thereupon, let me consider something of the history of ideas about metazoan phylogeny.

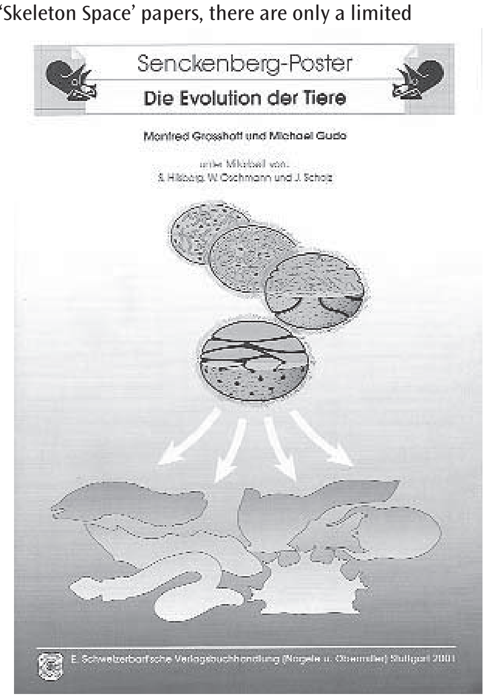
When I was an undergraduate, over forty years ago, we readily learned that the invertebrate phyla were very much separate from one another, each with a common plan of organisation, but that the relationships between them remained much more obscure. Standard textbooks, such as G.S. Carter's *General Zoology of the Invertebrates* lucidly expounded the model most in favour at that time, and an elegant and straightforward concept it was. From a protozoan ancestor came the sponges, a side branch which led only to more sponges. Diploblastic animals represented a higher grade of organisation and probably gave rise to triploblasts, represented in their simplest form by acoelomate platyhelminthes. From these came coelomate triploblasts, which could be divided into two main groupings. In the 'Echinoderm Superphylum' (properly deuterostomes) which includes echinoderms, hemichordates and chordates, the larva is a pluteus, cleavage is radial, development equipotential, and the coelom enterocoelic, *i.e.* arising from pouches in the enteron. In the 'Annelid superphylum' which includes most other groups, shared characters include a trochophore larva, spiral cleavage, mosiac development, and a schizocoelic coelom, arising from splits in the mesoderm. In concluding his book Carter comments "We can say nothing of the differences between the adults of the ancestral groups of the two superphyla...all these early metazoans were simple, soft-bodied,



triploblastic, bilaterally symmetrical, unsegmented, bottom-living animals with slight cephalisation, a ventral mouth, an anus, and probably tubular excretory organs. Beyond these statements it is not possible to go".

That was written a long time ago. Where do we stand now? The problem was tackled afresh by Pat Willmer (1990) in her *Invertebrate Relationships*. Her elegant analysis leaves us with a picture fairly close to that of the traditional model, though refined and extended. Willmer believes that convergence is so common that the use of cladograms may distort or conceal original relationships, and that molecular biology may hold the ultimate key. Needless to say the cladists do not like this at all. More recent views, such as that espoused by Simon Conway Morris, again retain many of the older concepts. Thus sponges are an early side branch (now known from the Ediacara fauna), and the diploblasts, a separate two-layered clade. While the deuterostomes (the old Echinoderm Superphylum) retain their integrity, what Carter regarded as the 'Annelid Superphylum' now separates the Ecdysozoans (arthropods, priapulids, nematodes, lobopodians, and anomalocarids) from the Iophotrochozoans (nemerteans, platyhelminthes, molluscs, haleriids, annelids, and brachiopods). The platyhelminthes no longer seems to have a key position. One can readily draw cladograms for the animals within these groupings, but the relationships of these major packages to one another still remain obscure. We seem, therefore, to have advanced, and no doubt increasing molecular data may help us in understanding more about invertebrate relationships, though the problem of convergence returns to haunt us.

Metazoans have skeletons, whether rigid or hydrostatic, and as is clear from the arguments developed by Thomas and Reif in their 'Skeleton Space' papers, there are only a limited number of functional skeletal types. And Simon Conway Morris, in a recent paper, comments "The question we need to ask is whether a structure (molecular or organismal) is similar because it shares a common ancestry, or because there is no (or very few) alternative … how do we balance the process of change against the emergence of form?" Can we escape from this conundrum?



Now I am sorry about this long preamble, but it is all relevant to this present review. For over the last years a rather different approach has been developing in Frankfurt-am-Main, that of Evolution and Engineering Morphology. The basic concept here is that the great variety of organisms that arose and changed during evolution could only do so under specific structural and functional constraints, best understood in terms of engineering analogues. This approach, though in some ways paralleling more traditional concepts, offers unique perspectives. While some of these will certainly prove controversial, they are surely worthy of attention.

The poster illustrating these is large, 118cm long, 84cm wide, and attractively presented, with the complete organisms themselves represented in pale yellow, but where sections through the animals are shown, they are picked out in pale blue with the internal cavities in black. At the top are serial snapshots of Planet Earth, from its origin in colliding meteorites and asteroids to the young blue planet. Corresponding illustrations are shown of steps leading to early organisms, biofilms, protocells, archaea and bacteria, protoeukaryotes (motiloids as they are called here), and to representatives of the four eukaryote kingdoms. So far, there is nothing very controversial. The rest of the display is given to the evolution of multicellular animals.

So what were the most primitive of all animals? According to the Frankfurt school, these were gallertoids, animals with a gelatinous body of many cells and cell-complexes, stablised and fused with connective tissue. Only with such an organisation could muscle contractions on one side be transmitted to the other, where muscles would extend automatically. Some living animals, *Trichoplax*, and possibly flagellates, also the fossil Vendozoa, may be close to the ancestral gallertoid. All the evolutionary pathways in the animal kingdom are regarded as modifications of the ancestral gallertoid, and each successive development acts as a springboard to the next. So, a schematic gallertoid is represented in the centre of the poster, and subsequent developments are presented as radially diverging from it. While the arrangement reflects in a broad and general sense the major groupings to which we have already referred (diploblasts on the right, deuterostomes on the left), it is what lies in between that fits less well with traditional categories. But let us remember that it is engineering principles that are being considered here, not direct phylogeny. Let us then consider some of these evolutionary pathways. Gallertoids of compact body shape, and with cilia, could become sessile or mobile, leading to the swimming ctenophores on the one hand, and to sponges, stromatoporoids and corals on the other. Elongated gallertoids, on the other hand, replaced ciliary propulsion with lateral bending. Internally widened cavities would result in a system of flexible membranes with a fluid filling. From the engineering point of view such a coelomate organisation is highly efficient and could lead on to new developments, only possible on the basis of what already exists. A segmented coelomate hydroskeleton such as this would lead to further functional types, and the bulk of invertebrates (diploblasts and deuterostomes excepted) are seen here as derived from such an ancestor. Arthropods, for example, arose from such an ancestral type when they developed appendages, platyhelminthes by flattening the body, reduction of the gut and loss of coelom, molluscs by development of a creeping foot and radula, compression of the coelom, and ultimately loss of metameric segmentation. Deuterostomes, according to this model, evolved along a different line, from a segmented coelomate organism, but with a rostral filter-feeding mechanism, subsequent development of a notochord, and with subsequent key innovations leading to the echinoderms and chordates known from the Ordovician onwards.

Before commenting further, let us hear what the authors themselves have to say. “The evolution of animals is presented here is a new way, which is not like that of the standard textbooks. The engineering-like explanation of evolution and the reconstruction of evolutionary pathways contrasts sharply with morphometric and genetic phylogenetic trees. However, explanations are provided, which are missing in most traditional presentations. The results which are the basis of this poster have been developed since 1970 by the group "Kritische Evolutionstheorie". Continuous discussions with philosophers and testing improved the coherence of the methodology".

Now not everybody is going to like this approach. If you are looking for cladograms you will not find them here. The Ecdysozoans are split across several lines of descent, and diploblasty and triploblasty are not directly referred to. But that is not the point. This is something different. It is the product of a very able group, working in some degree of isolation, and focusing on issues which have not otherwise received much attention. This novel way of looking at the relationships of metazoans, whether or not we agree with the actual pathways showing how animals diverged, merits careful consideration. Animals, living and fossil, are not just sources of data for plotting on cladograms, at least I do not regard them so. Undoubtedly the Senckenberg Poster will fuel an interesting discussion. But let it be the kind of debate which engenders more light than heat.

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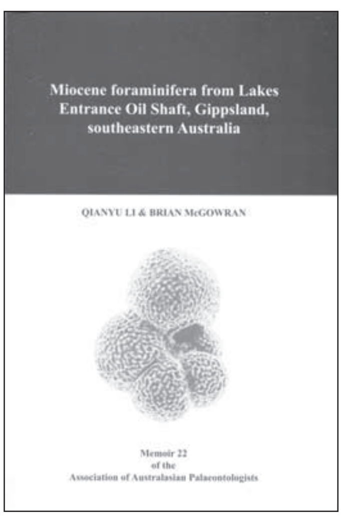
Miocene foraminifera from Lakes Entrance Oil Shaft, Gippsland, southeastern Australia

Qianyu Li and Brian McGowran. 2000. Memoir 22 of the Association of Australasian Palaeontologists, Canberra. 142pp. ISBN 0-949466-20-4. AUS$45.00.



Despite the garish AAP memoir front cover, this volume is a useful précis of the fauna from the Gippsland lakes entrance oilshaft. For those of you who revel in systematic foraminiferal taxonomy, then this is for you; after all the taxonomy of the planktonic and benthic assemblages encountered at this site occupies 75% of the publication. This volume is essentially an extended paper on the foraminifera of this site. It is not likely to appeal to many as general palaeontological reading.

The beauty of this site is that it is one of the southernmost, complete Neogene (late Oligocene to late Miocene) onshore sequences sampled at high resolution. This study concerns a total of 228 samples from which 68,000 foraminifer specimens were picked, of which 15,000 were planktonic and 53,000 benthic. This includes 65 planktonic species and 410 benthic species. At an average of 530 specimens per sample, this is no mean micropalaeontological feat! Clearly the emphasis naturally lies with the benthic foraminifera.

The publication is divided into two parts: a faunal statistic section and the taxonomy of the foraminifera involved. The majority of the first part of the volume is a series of statistical tests carried out on the planktonic and benthic data matrices to establish evidence for species turnover, diversity changes, biofacies, palaeoenvironmental and climatic variations. One of the most interesting parts of this study is the extensive graphical abundance plots of the foraminifer species and the palaeoecological implications of such variations. This part includes multivariate statistical analyses on the benthic foraminifera, the results of which are linked to eustatic, $\delta^{18}O$ oceanic and glacial curves. My only criticism of some of the multivariate tests is that they are not clearly explained for the benefit of those with a lesser statistical background. This section of the publication also contains useful range charts/ biostratigraphic zone markers for the Gippsland fauna compared to well-established global zonations of the tropical, subtropical and transitional regions.

The taxonomy, although quite comprehensive, is more of a fully referenced brief morphological summary without genera type descriptions. There is no discussion about species similarities or phylogenetic relationships. The plates in the taxonomic section exhibit moderately to well-preserved foraminifera in mediocre-quality photomicrographs. Notwithstanding these criticisms, the taxonomy is a very useful guide to Neogene foraminifera, especially for those of us who generally specialise in either planktonic or benthic foraminifera. It is also refreshing to see the proper use of one or two of the generic senior synonyms.

Although this volume is basically an extended case study, it is still at the very least a pragmatic account of Neogene foraminifera. For those who would purchase it, the primary utility of this publication would be as an aid to faunal identification and biostratigraphy for the Southern and other oceans. For this use alone it is well worth the Aus$45.00 price tag.

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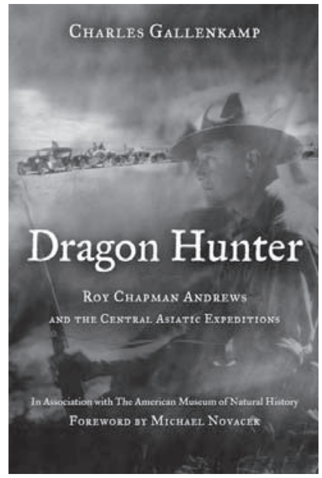
Dragon Hunter, Roy Chapman Andrews and the Central Asiatic Expeditions

Charles Gallenkamp, foreword by Michael J. Novacek, 2001. Viking Penguin, Penguin Putnam Inc., 344 pp. US$ 29.95, ISBN 0-670-89093-6.

This is a fascinating biography of an unusual man—Roy Chapman Andrews, the *spiritus movens* of the Central Asiatic Expeditions, which were carried out between 1922 and 1930 by the American Museum of Natural History. What a man, and what a life!

In the twenty-two chapters of his book, Charles Gallenkamp leads us through the whole, exciting life of this remarkable man. Born in a small Wisconsin town to a rather conventional, middle-class American family, and never an exceptional student, Andrews managed to get to the top of New York high society, famous and wealthy. According to his own words, Andrews was born to be an explorer, and he certainly fulfilled his destiny.



The main body of the book concerns the Central Asiatic Expeditions to China and Mongolia, organized and led by Andrews. This part is based on Gallenkamp's meticulous studies of many sources, including the archives of the New York American Museum of Natural History, several of Andrews' books, and over 40 of his articles. There is a concise overview of all of Andrews' Asiatic journeys, their scientific aims and results. However, it was not the records and scientific facts, though important, that were of greatest interest to me, or the most appealing subjects in this book. Gallenkamp succeeded in exposing the adventurous side of the expeditions. The historical moment, at which the Asiatic expeditions started, was the most disadvantageous one for such a scientific enterprise. China was on the verge of a civil war, and political events became controlling factors of all Andrews' later activities. Chinese authorities, moderately helpful at the beginning, became openly hostile, and in the field, bandits. In spite of all these obstacles, Andrews managed to assemble collections of fossil mammals and reptiles, which documented some unknown evolutionary stages of these vertebrates.

My impression is that Gallenkamp's choice of Andrews' life-episodes resulted in a very impartial portrayal of this fascinating man. As men of passion often are, he might certainly have been difficult in personal relations, not always likable, and very much self-advertising. But in spite of this, or probably because of this, he was so successful in realization of his great mission to bring all the Asian dinosaur and mammal collections to the USA.

I enjoyed Gallenkamp's book for a very personal reason. In 1963-1971 I was a member of the Polish-Monglian Palaeontological Expeditions to the Gobi Desert. We have often worked in localities that were discovered and explored by the Andrews team. But circumstances in the 60s were so drastically different from those in Andrews' days—no bandits, helpful authorities, and friendly Mongolian people everywhere! Well I know, I should not complain, but weren't the palaeontological explorations in those days much more adventurous and exciting?

The book will appeal to the audience of general science readers. I would recommend it especially to all people who are able to cherish the romantic side and excitement of scientific exploration. They will find the book delightful. And last, but not least, this well-written, information-packed, 344 page volume is really inexpensive.

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Victorian Sensation: the Extraordinary Publication, Reception, and Secret Authorship of The Natural History of the Vestiges of Creation

James A. Secord. 2000. 624 pp. University of Chicago Press.
ISBN: 0-226-74410-8 (hbk.) £22.50.

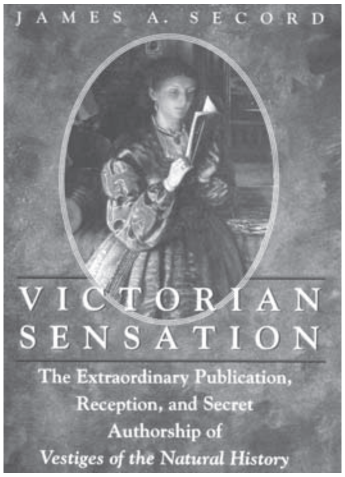
The Natural History of the Vestiges of Creation, published anonymously in 1844, is a very remarkable book. Because it promoted evolution in the period before Darwin's *Origin of Species* but failed to convince the scientific world, it has usually been regarded as a curiosity and a sort of failed precursor to Darwin. But James Secord argues in his new book that this view does little justice either to the *Vestiges* or to the *Origin*. In *Victorian Sensation*, we are given a detailed treatment of *Vestiges* on its own terms. We learn why and how it was written, and more importantly, how it was received by a broad cross-section of metropolitan and provincial society.

Vestiges itself (which is also available from Chicago University Press) is a very readable book that, as Secord points out, is difficult to classify. In scope and subject matter it owes much to the cosmologies of the late eighteenth century and the romantic science of the early nineteenth century. Its theme is cosmic, biological and social progression, divinely inspired, but occurring through natural evolutionary processes. Its prose, however, is written in the measured and persuasive tone of mid-nineteenth century scientific discourse.

To the scientific elite of 1845, *Vestiges* was an imposter. Whereas responsible scientists were used to treading carefully on matters of religious sensibility, and theorizing in general was widely frowned upon unless copious factual evidence could be produced to support it, *Vestiges* "looked the part" but was flighty and riddled with errors. It was condemned with equal fervour by religious fundamentalists and top scientists alike. Only the more "dangerous" elements of society such as the freethinkers, socialists, phrenologists and atheists spoke up in its defence. Despite this everybody read it, from the queen down and, it seems, everybody had an opinion as to the likely author.

Vestiges was in fact written by Robert Chambers, the Scottish publisher and frequent author of *Chambers's Edinburgh Journal*. Secord tells the fascinating story of how the wave of sensation was expertly planned and executed by this remarkable man, making the most of his detailed professional knowledge of the world of publishing. Money-making does not seem to have been the motive; rather it was a case of "intellectual philanthropy". It appears that Chambers, who had been publicly criticised for not realizing his early promise and producing anything original, longed to make an intellectual mark on the world and had the nerve to tackle the most controversial subject he could think of. Nevertheless, anonymity was necessary to protect himself and the family business from a conservative backlash. Inspired by his hero Walter Scott's anonymous authorship of the *Waverley* novels, it was also a conscious tool used to stoke the flames of sensation.

Secord's book tells the story in gripping detail, and then moves to a long dissertation on how *Vestiges* was received in the various levels of society across different towns and cities in Britain. *Victorian Sensaation* is a scholarly and ambitious account, and even claims to be the most comprehensive analysis of a book's reception, other than the Bible, ever attempted. Whether this is true or not, lovers of the Victorian world and serious historians will find it instructive



and enjoyable. Secord is particularly impressive in his even-handed treatment of the various strands of society and religious opinion. *Victorian Sensation* could be criticised as being too lengthy and a little repetitive, but it must be appreciated that Secord takes a new and decidedly analytical approach to literary history. In effect he develops new ways to analyse how ideas are packaged, transmitted, received and modified, and *Vestiges* happens to be the subject at hand.

I was particularly interested in how Secord tried to reconstruct the drift of fashionable conversation in clubs, parties and among small groups of friends. Of course there were no tape recorders running, but there are huge archives of letters and diaries, and no effort has been spared in collecting written reactions to the book from all possible sources.

What is missing (arguably) from *Victorian Sensation* is an evaluation of *Vestiges* and a discussion of its place in the history of science. What, within its pages, was good, what was bad, what was right, what was wrong? Like all serious historians, Secord eschews the "Whiggish" approach and does not see it as his role to be judgmental or even, especially, to focus on the technical content of the book. However, readers of this review are presumably bound by their interest in the science of fossils, first and foremost, and may not feel the need to be so disciplined. To me, *Vestiges* is a good fluent read with many challenging ideas and, from a modern perspective, many crazy errors. Although Secord explicitly rejects the term as an inappropriate neologism, *Vestiges* is clearly a work of popular science, sloppy in places, and almost everything in it is derivative. While one can't help developing deep respect for Chambers and his brave views, the work is in no way comparable to the great works such as Lyell's *Principles* or Darwin's *Origin*.

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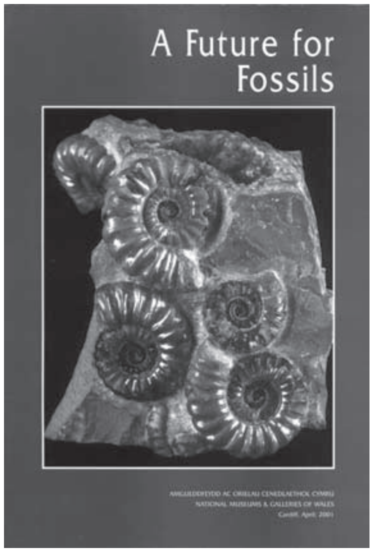
A Future for Fossils

Edited by M.G. Bassett, A.H. King, J.G. Larwood, N.A. Parkinson and V.K. Deisler (2001). 156 pp. National Museum of Wales Geological Series No. 19. National Museum of Wales, Cardiff. ISBN 0-7200-0479-9 (pbk). £14.00.

The title of this book will confuse some potential buyers, so close to that of the recent volume *Fossils and the Future* (Lane *et al*., 2000); in addition to titles, both volumes arose from conferences, but with very different intentions. Is there a future for fossils? Having read *A Future for Fossils* (*AFFF*) my answer is yes, I think so, providing the various contributors of evangelical chapters can find ways of ensuring that the real or perceived warring factions within the congregation don't throttle each other first. The title is a teaser—the focus of this



volume is the conservation of fossil sites, rather than fossils *per se*, arising from a meeting in Cardiff in October 1998. However, the thrust of this book isn't obvious until you get to Mike Bassett's 'Foreword' on page 5, unless you are observant enough to note that editors from English Nature outnumber those from the National Museum of Wales.

This book is pleasingly produced at A4 size on glossy paper in a double column format. The reference list is extensive and the index appears adequate. A short summary of acronyms and their meaning might have been useful. The editors have left rather more spelling errors in the text than they should have done, although a couple are obviously the result of mistakes in translating between word processing programs, most glaringly "Prídoli" (p. 12) and "10.0_ centigrade" (p. 116). Although the illustrations are numerous and generally adequate, I feel for Alistair Bowden, whose paper on my beloved Salthill Quarry, Clitheroe, was attacked by particularly malicious gremlins; Figure 33 is OK, Figure 34 includes the image for Figure 35 and, having lost(?) Figure 34, Figure 33 is repeated as Figure 35!

There are only a limited number of messages that the editors could have hoped to provide in such a book. However, it is unfortunate that so many of the authors repeated so many platitudes (*e.g.*, 'current legislation is adequate'), making some contributions repetitious and trite. Despite having such a glut of editors, the quality of contributions to *A Future for Fossils* (*AFFF*) is variable and there are those chapters that contribute little, if anything, to the overall message of the book. Somehow, 21 oral presentations were allowed to grow into 25 chapters. Despite assurances that papers were "… subjected to peer review and editorial vetting" (p. 4), some would have been better off being drastically edited and revised, or just left out. Thus, and unfortunately, *AFFF* is typical of many conference volumes, focused, but untidy, with the good papers diluted by the less good. Nevertheless, this is the book we have and it does contain several worthwhile contributions of particular interest to the active field palaeontologist.

The book is divided into five sections. Section 1 (National perspectives and policies) enthuses the reader with an opening chapter by Euan Clarkson that is a personal Cook's tour of the fossiliferous rocks and significant localities of the British Isles—in only eight pages! This is followed by six more or less technical chapters explaining policies (and acronyms) of site conservation, with an interesting contribution by a representative (John Harvey) of one large and interested land owner, the National Trust. Despite these topics being rather 'dry', the authors in this section generally attacked their subjects with enthusiasm; for example, John Harvey supplemented discussion of National Trust policies relating to field palaeontology with a brief survey of attitudes of some other major landowners. However, considering the tone of some later chapters, what might be regarded as an anachronism here and throughout the book is the use of detailed information on important sites to illustrate points in discussions. In explaining where sites are and why they are important, the authors make this book an excellent source of information for those unscrupulous collectors who might want to ransack them—just the sort of person that is vilified throughout *AFFF!* The worth of the volume is undoubtedly enhanced by contributions concerning site conservation efforts in Sweden and, particularly, Germany, Wuttke's concise contribution explaining the advantages and pitfalls of having a 'multiple-umbrella' system of site conservation. However, it is a pity that no further international perspectives are presented in later chapters. Overall, this section holds together well.

In Section 2 (Policy into practice: local and regional case studies) we meet some old friends, including such famous localities as the West Dorset Coast, the Isle of Wight and the Wren's Nest, Dudley, in a series of accounts of how the conservation of a range of sites has worked (or otherwise). To give one constructive example (chapter by Richard Edmonds), the West Dorset Fossil Working Group was set up to hammer out (no pun intended) a Code of Conduct for palaeontologists working on this coast that is acceptable to all parties concerned. The group included representatives with a wide range of official affiliations, as well as amateur and commercial collectors. The Code was launched in tandem with a Recording Scheme for important fossils. In a slightly different vein, two papers on the Isle of Wight, by Martin Munt and Martin Simpson respectively, provide views from dugouts on both sides of what appears to be a 'them *vs*. us' confrontation between the Museum of Isle of Wight Geology and what are referred to as 'dealers', that is, commercial collectors. The main products of this conflict were, again, a voluntary Code of Conduct and the formation of the Isle of Wight Geological Society. Although discussing the same issues, there are obviously strong differences of opinion and interpretation of events between the two sides. However, not all examples are tainted by the actions, real or perceived, of unscrupulous collectors, professional or amateur (I get the strong impression that they are considered even worse if they are foreign, the blighters). The positive tales from Conesby Quarry, Writhlington and Valentia Island form a calming conclusion to this section, which in some ways forms an informative adjunct to Clarkson's earlier chapter.

Section 3 (Users of the resource) begins with Eric Robinson stating the case, in his amicable fireside manner, on behalf of the amateur collector, who would probably stand most to lose if new legislation placed further restrictions on field palaeontology. Eric quite rightly points out that we can all play a part in educating the beginner—we were all beginners once. An interesting contrast, in content if not in tone, is David Sole's personal accounts of two projects where commercial collecting was a boon to museum collections. Any complaint I might have with this contribution is that it repeats much of what was said in an earlier paper on Conesby Quarry, Scunthorpe; perhaps these two contributions would have been better combined as one joint paper? An evangelical tone also sounds from Phil Manning's contribution, in which he makes the candid observation that all palaeontologists are interested in palaeontology and the good health of the subject. Given the chance and the right encouragement, amateurs, commercial collectors, museum curators and academics will work together to achieve a common goal. Phil seems to be making a success of this approach at the Yorkshire Museum. Are the other, less successful interactions documented in this volume the result of poor 'management' dominated by prejudice on one or both sides?

Section 4 (Valuing the resource: the sustainable approach) contains a mixed bag of papers, including an account of some of the apparently few major British specimens that are being offered for sale overseas (Mike Forster), and a brief, but interesting, guide to the uses of replica fossils (David Williams), which nevertheless seems somewhat peripheral to the main thrust of this volume. Three papers on the sustainability, or otherwise, of the fossil resource fail to recognise, or at least emphasise, that mining of any sort, including collecting fossils, must be incompatible with 'sustainability'. However, amongst these, I admit to particularly enjoying the account of the Banwell Bone Cave by Dennis Parsons. Dennis has two feet firmly planted on the ground and emphasises how management of this important Pleistocene site is entirely pragmatic.

Section 5 (Debate) is a transcript of the panel discussion, entitled "Are changes required to current legislation to help protect our fossil resource?", at the end of the conference. The Reverend Tim Palmer introduced his four 'preachers', Colin Prosser (English Nature), Paul Ensom (Natural History Museum, London), Steve Etches (independent collector) and Dave Martill (University of Portsmouth), each of whom had a slightly different interpretation of how to protect our tablets of stone. I normally avoid such events at meetings, as organised discussion without a recognisable final product is rarely satisfactory for anyone involved, but this section is entertaining, not least for the opening line of Dave Martill's address. Tim Palmer seems to have kept the congregation well in hand, but as is often the case, time rather than a natural conclusion seems to have terminated the discussion.

Although I've made some negative comments, this book probably contains something of interest to most palaeontologists, particularly those involved with the British succession; nevertheless, site conservation is a specialist area even within palaeontology, so few readers will want their own copy, although *AFFF* deserves to be widely available in libraries. This book took three years to publish following the meeting and an obvious question that ought to be asked is "If it wasn't worth rushing, was it worth publishing?" Certainly, as many of the papers are still relevant and a short postscript does try to bring the British situation up to date, but what of the status of Sweden and Germany? If this volume has a take-home message, it seems to be that current legislation in Britain seems to be about adequate, despite rare outrages by unscrupulous collectors, although over a third of the delegates nevertheless voted for changes, perhaps involving stricter 'policing' of some sites (see Section 5). As always, such suggestions have strong resource implications and, dare I say as usual, what I didn't see was a constructive plan for where the resources were to come from to enforce this stricter control. As for commercial collectors, those that contributed to the meeting more than held their own and pointed out some of the benefits that they have brought to British palaeontology, to which they've been contributing since the time of Mary Anning.

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Palaeontology

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POSTGRADUATE OPPORTUNITIES

Introduction

This issue of the *Newsletter* contains a digest of the palaeontology-related postgraduate courses and research programmes scheduled to begin in October 2002. This follows a series of short biographies from scientists who are currently on their way to obtaining a M.Sc. or Ph.D. in palaeontology, as well as others who have achieved such qualifications and made their way in lecturing, research, museums, and the scientific media. Most, like myself, are mere whipper-snappers, but the first biopic has been provided by Professor Euan Clarkson, who draws upon several decades of experience. Euan needs little introduction; he has been one of the pillars of European Palaeontology for longer than he may care to mention and has only recently passed the baton of *Palaeontological Association* President to Professor Chris Paul. Most undergraduates will no doubt know of Euan from his now classic student text *Invertebrate palaeontology and evolution*, and they could well to continue to learn from his example.

I hope the advice proves useful in your career decisions!

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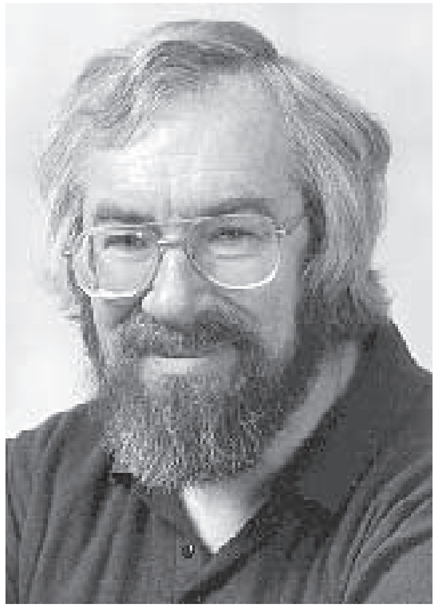
How did you come to be a palaeontologist? I was always interested in fossils, ever since I saw two giant *Titanites* specimens in a museum in my native Newcastle-upon-Tyne when I was eight years old. At school I was hopeless at mathematics, but good at geometry and drawing. I wanted to be a scientist, and I struggled with physics and chemistry, but I had two really inspiring biology teachers, who got me interested in animal and plant anatomy and embryology, and who first introduced me to the geological time scale. After National Service I read Botany, Zoology, and Geology at Cambridge. Although most of the teaching wasn't especially good, Oliver Bulman and Bertie Brighton were really magnificent. Meanwhile, living in Cheltenham at that time, I explored the geology and palaeontology of the Cotswold Hills by bicycle. By this stage I was thoroughly hooked on palaeontology. So I stayed on in Cambridge, completed a Ph.D. on trilobite functional morphology under Martin Rudwick, and looked for employment. Fortunately there was a job in Edinburgh

Have you spent all your professional life in Edinburgh? Yes, it will be 39 years when I retire next year. It has been immensely hard work, but fully rewarding. In addition to teaching and administration I was twelve years as Director of Studies and three as Associate Dean. I have always believed that you have to put your students first, and that research is what you do in your spare time. But with the increased numbers of students, the pressure to bring in huge



research grants, and to publish more and more, I fear that such a philosophy will be hard to maintain, and that the universities will become less student-friendly. Perhaps what has kept me in Edinburgh has been the quality of our undergraduate students here in Scotland. Most have been delightful people, hardworking and fun; many remain good friends. Secondly the local area has such marvellous geology, and I have not had to go far for research projects.

So what have been the highlights of your research in Scotland? The Lower Palaeozoic of the Midland Valley of Scotland, especially the Silurian of the Pentland Hills, has not only been a wonderful area to research in, but also has been an excellent training ground for students. Field training is essential for any geologist. For me, research and teaching must go hand in hand, and the stimulation of student participation is by no means all in one direction. We have the Pentland palaeoenvironments worked out now, and the taxonomy is catching up. The Southern Uplands too have proved of great interest—debris flows with shelly fossils, graptolite shales, the overall tectonic setting. We also have Carboniferous Fossil-Lagerstätten in the Edinburgh district, with exquisite crustaceans, which Derek Briggs and I studied in detail, and this led to the discovery of the first conodont animal.

That seems to have been an inspired collaboration. Who else have you worked with over the years? I already mentioned the Southern Scottish work, with such excellent collaborators as Dave Harper, Alan Owen, Colin Scrutton, and Howard Armstrong, linking the universities of Glasgow, Edinburgh, Durham and Galway and bringing in colleagues from the British Geological Survey. In France, a vigorous collaboration on trilobites with Jean-Louis Henry and Raimund Feist encouraged me in the French language, and helped me to become fluent. Even though English seems ubiquitous these days, this is not necessarily so, and I would encourage any young scientist to persevere with language skills. At present my main work is in Sweden, with Per Ahlberg and colleagues in the University of Lund, which seems like my second academic home, and in which I spent my only sabbatical (three months) in 1993. Such external dimensions are essential to balance a career in one department. Most importantly, I have had the assistance of my magnificent friend Cecilia Taylor over the last 16 years. In the Swedish work, and back home in Edinburgh she has given an innovative input into every level of teaching and research. We built up together an effective Invertebrate Palaeontology course, which is open also to biologists as well as geologists. We also set up and supervised extended projects for final year zoologists on fossil topics. Several of these students have gone on to do higher degrees in palaeontology.

As you approach retirement, what do you regard as your main legacy to palaeontology? Probably the textbook. But it took a lot of time, nearly three years for the first edition, a year for each of the following editions. Obviously the conodont animal study had quite an impact. I have already alluded to research in south and central Scotland, which triggered developments in other Earth Science disciplines. The early trilobite eye work was pioneering and still continues. My main interest now, which will see me out, is the ontogeny and evolution of the olenid trilobites in Scandinavia, with Cecilia and Swedish colleagues. Our emphasis has been on meticulous observation and recording which is already acting as a springboard for evolutionary theoreticians, and also geochemists and sedimentologists, working on the wider implications of the black shale environment.

You retire after 39 years in September 2002. What will you miss? My students, emphatically. Definitely not the politics! I'm not being replaced (or rather, my official 'replacement' is a structural geophysicist). Palaeontology will continue in Edinburgh, but on a much reduced scale. There will be no more day excursions, no more Zoology students. All rather sad…

How do you see the future of palaeontology generally? At the present time, more students than ever before, and the general public too, seem turned on by palaeontology as a science. The *Palaeontological Association* shows tremendous vigour as witness the *Annual Meetings*, *Progressive Palaeontology*, the *Newsletter* and all the other things. We know the value of our subject. Yet as Earth Science becomes increasingly technical, we have less influence than we should. We have to stand up and be counted, and make our voice heard. This will be the role of the next generation.

So what further advice would you give to prospective professional palaeontologists? You will not have to be afraid of hard work! Teaching and research is only part of the job in a university, something not appreciated by outsiders, perhaps until the currrent fashion for TV fly-on-the-wall documentaries catches up with us! So much time is taken up with editorial matters, and that is only part of the important involvement with learned societies and allied institutions. Within the Department you have to pull your weight. In my second term as Director of Studies, which brings its own, not initially expected, workload—I last year wrote no less than 147 testimonials for students. If I was starting my career over again I would relish the increasing involvement with people in other disciplines, whilst enjoying the intimacy of the immediate palaeontological community. Unlike some of the 'big sciences', we all still know each other. Above all, you have to be student-friendly, for they will be your future. It is a career for the dedicated, but if you are then the rewards are immense.

So you want to be……a lecturer!

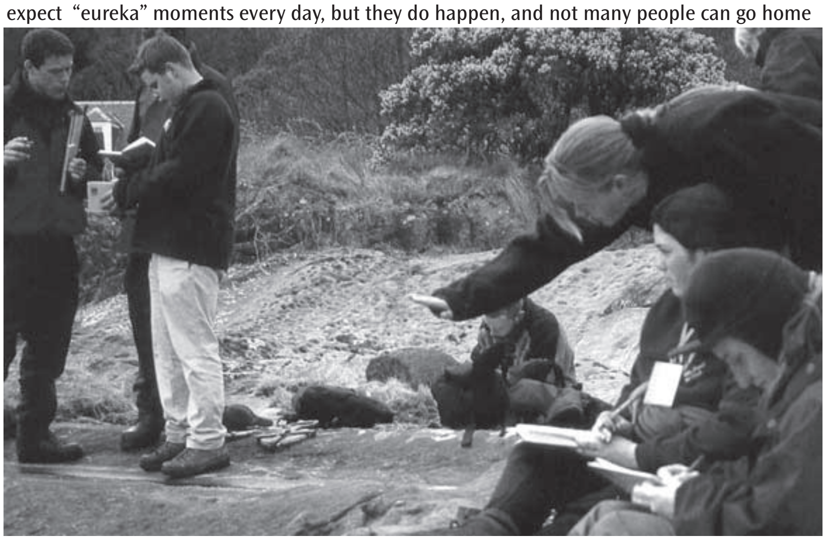
How did you get to where you are? The short answer is hard work, luck and a fascination with animals. I believe that I have taken a fairly conventional route to becoming a lecturer via A levels, a degree from Southampton University in Geology, a Ph.D. from the University of Leicester and a two year postdoctoral research assistantship, also at Leicester University.

After the post-doctoral money ran out, and I was (repeatedly) unsuccessful in gaining anymore grant funding, I subsequently spent a year with periods of unemployment and living on 'soft' money. I was extremely fortunate during this time to have great support from the department at Leicester and encouragement from several individuals (thanks especially to John Hudson).

Unless you are extremely lucky and/or brilliant you may face the possibility of some time living in the financial twilight zone between grants. A number of my more deserving contemporaries have also experienced this situation. I started my lectureship in Leicester in September 1999.

Would you change your career route if you had the chance again? I feel very fortunate that I am where I am, and except for the unemployment doldrums the getting here has been fun and rewarding. I was considering taking a year out after my degree to do conservation work, travel and learn to surf but then a lagerstätten Ph.D. topic became available, so the surfing had to wait. Seriously, a gap year, if spent fruitfully, can be a good opportunity for post-degree reflection where you can assess whether academia is really for you. Many people now choose to do a Masters after their degree, to better their qualifications and see if academia is for them. Whatever your route to academia you will need to be determined.

What do you do on a day-to-day basis? This very much depends on whether its term time or not. Outside of term time then my efforts are focused on research. This may involve fieldwork, lab work, trawls through the library etc. Research has its more mundane side; don't expect "eureka" moments every day, but they do happen, and not many people can go home



Sarah Gabbott, upper right, mid-flight from work knowing that they discovered something new about the world—however small a something that may be.

In term time research becomes something that I squeeze into spare time. In the first year or two of lecturing (I'm just starting my third academic year) a lot of time is spent preparing and panicking about lectures and tutorials. In any one day I will be reading up on molluscs, sorting out some igneous rocks for a tutorial, replying to administrative e-mails, correcting a Ph.D. student's thesis text, finding a paper for a 4th year undergraduate, sorting out slides for a lecture on the origin of life, preparing for the next admissions day……

As well as lecturing and tutorials I usually undertake three weeks, and the odd day or weekend, of fieldwork teaching per year.

What are the best things about being a lecturer? Teaching enthusiastic students is a real joy, as is the moment when a student understands a difficult concept because you managed to explain it. Teaching students in the field is rewarding because you get constant questions and feedback, and when in breathtaking scenery you can feel smug by reminding yourself that this is actually work.

Having the opportunity to do original research on something you feel passionate about means the job will always be stimulating. There is still a large degree of freedom in research. Nothing is formulaic, you can vary the research you do, work on your own or within a team, read, do fieldwork, lab work or just think. And as an added bonus, you may travel to beautiful and interesting parts of the world (not as a tourist) to collaborate with people from other countries.

What are the worst things about being a lecturer? As a Ph.D. student and postdoctoral researcher you are focused solely on your research and you don't appreciate how privileged a time that is until you don't have it any more. Lecturing involves a lot of multitasking and after a long period of being single minded it can be very difficult (it was for me) to switch to this. It can be frustrating that there never seems enough time in a day to get around to looking at that data you just got back from the lab, or to look at that new fossil, or to read that paper etc. I am assured that this gets easier after the initial couple of years!

In addition, the route to lecturing can be beset with uncertainty. There is no guarantee of a permanent post even after a successful postdoctoral period. Something else to consider is that often you will be expected to move around the country to get grant money or contracts. This is fine when in your early twenties, but in late twenties, thirties and beyond you might actually have a life! a partner, a house, children. Moving around the country to obtain contracts can then be a real problem. However, some funding bodies, such as the Royal Society, are more flexible and appreciate people's life circumstances. Given this peripatetic period, with short term contracts, it is little wonder that many leave academia during this period. Those wishing to start a family during this time may have an especially difficult time—but it can be done and there are many young lecturers who have extremely successful careers, undertake top-quality research and have a family (they have my deepest respect).

What is your area of research and why? My Ph.D. was centred on the taphonomy and palaeontology of the Soom Shale, an Upper Ordovician exceptionally preserved biota from South Africa. Since then I have become increasingly interested in the sedimentary geochemistry and ecology of other exceptionally preserved biotas.

After undergraduate project work I knew that I really wanted to do palaeontological research but I wasn't entirely sure in which area, or whether I would be Ph.D. material. When I read the Ph.D. description for this project, supervised by Dick Aldridge and Kevin Pickering, I was instantly excited about it and had no doubts that this was a project I would really enjoy working on. Enthusiasm for your subject is really the starting point for a career in lecturing. This enthusiasm is transferred to the students, and means that you can always find the time for your research.

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So you want to work……in a museum!

My job. I work as Keeper of Geology for Warwickshire's County Museum Service. I am based at the Market Hall Museum Warwick, working closely with Keepers of non-geological collections, as well as designers, managers and administrative staff. I am employed to protect and promote Warwickshire's varied but threatened geological heritage, represented by existing collections and geological features in their natural field contexts. The work is extremely varied and during any working day I can find myself dealing with dozens of tasks and enquiries, geological and non-geological.

Working with existing collections remains a vital part of the job, but finding sufficient time is challenging. Ongoing work includes monitoring the physical conditions of stores, computer documentation of backlogs and augmenting the collections with new material. These tasks have to be juggled with demands from general enquiries, provision of events, exhibitions and talks, dealing with planning applications, updating site records, working with local groups and supervising volunteers, to name but a few.

Purely academic research, though encouraged and valued, remains a largely spare-time activity. Work-based fieldwork mainly involves documenting new geological exposures, which provides data for Warwickshire Museum's Geological Localities Record Centre.

How I got there. I first started collecting rocks at the age of six on a family holiday to the Peak District. I spent my teenage years living in Buckinghamshire where I became interested in the local late Jurassic succession. I ultimately studied geology at what was then Oxford Polytechnic (now Oxford Brookes). I later continued my researches into the late Jurassic Portland Beds at Keele University, writing up my results for a Master's degree in the late 1980s. After a brief spell as field geologist with the Buckinghamshire County Museum, I studied micropalaeontology at University College London, for another Master's degree. Whilst I enjoyed museums, job prospects at that time were poor and industrial micropalaeontology seemed a better bet.

Despite the scarcity of jobs I was offered the post of Assistant Curator at the Museum of Isle of Wight Geology, soon after finishing at University College. Here I gained my first real experience with museum collections and studied for a Postgraduate Certificate in Museum Studies (Leicester), an extremely useful qualification nowadays. I also developed interests in the dinosaur-bearing early Cretaceous Wealden beds, applying my previous experiences in palaeoecology, sedimentology and micropalaeontology to solve palaeoenvironmental questions. Publications arising from this work formed the basis of a part-time Ph.D. at Portsmouth.

Following a mercifully brief spell at Bristol City Museum in the mid 1990s I became involved in project work based at PRIS, University of Reading, drafting a major publication on Wealden sites with Prof. Perce Allen. As the contract ended I managed to get back into the world of museums (my current post in Warwickshire), but Perce and I continue our writing.

Is this the usual route? Purely geological posts are scarce in local authority museums, and competition is intense. My route into this field is certainly not typical. A good first degree is vital and a postgraduate museum qualification advantageous, but two Master's degrees and a doctorate are well over the top. However a postgraduate qualification in palaeontology can certainly help. Note that dinosaurs and marine reptiles remain extremely popular, so some knowledge of vertebrate palaeontology can go a long way in some institutions.

It should also be borne in mind that academic research often takes a back seat in local authority museums. However, a thorough understanding of geological and palaeontological principles leads to an enriched understanding and appreciation of geological collections, which is great for job satisfaction and work quality.

I consider myself extremely fortunate in working as part of a small but highly motivated team, dedicated to making the most of and protecting Warwickshire's human and natural heritage. Warwickshire's geology is sufficiently 'cryptic' to negate the sorts of pressures associated with highly fossiliferous coastal areas, but includes many features of outstanding interest and presents unique challenges in its own right.

Working in a well-managed museum as part of a strong team can be extremely rewarding and challenging. A position as geologist and/or natural historian will ensure the opportunity to tackle a wide range of tasks and contribute significantly to the public understanding and appreciation of palaeontology.

As for research, I still find spare time to pursue my interests in shell bed sedimentology and palaeoecology, both locally and further afield. In recent email correspondence, Susan Kidwell (University of Chicago) referred to the British Jurassic as a 'candy shop', with reference to the potential of its skeletal concentrations for information gain. This is no exaggeration and I'm starting to discover fantastic things right on my doorstep, keeping me busy between trips further afield. A range of new materials is now entering Warwickshire Museum's collections, some of which are already featuring in exhibitions and displays.

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So you want to be……in TV!

What do you do on a day to day basis? My official job title is 'Researcher' and I work for the Natural History Unit, which is part of the Factual & Learning division, BBC. Typically I'll be assigned to a particular production and work for one or several producers and assistant producers on that production. The actual ins and outs of the job vary depending on what type of programmes are being made—archive-based or specially shot (or a mixture of the two). The Natural History Unit makes a lot of archive based programmes for the American market (Discovery, Animal Planet, etc) and BBC Worldwide. A researcher's job on these productions is finding the footage that the producer needs to edit into a finished programme—firstly by physically locating the necessary shots in the archive database and obtaining the tapes, and secondly by checking the copyright information to see if the material is clearable and how much it will cost to use if it is not BBC copyright. There might be a little information research for these programmes, but most of what I do on them is the tedious daily grind of spooling through hours of video, running about Bristol's many edit suites looking for missing tapes, and lots of paperwork to keep track of everything.

Specially-shot programmes work slightly differently. They tend to start with a development period where my job is to research the subject in depth, obtain articles and books, and talk to scientists working in that field. The objectives are to obtain the information that will provide (a) the story backbone for the programme, (b) the detail for the narration, and (c) a list of likely places to film and/or people to interview. Once the production is in full swing, there may or may not be the chance to go out on film shoots, depending on things like budget, researcher experience and skills, particular types of programme/shoots, health and safety issues, etc. For instance, I don't drive and don't have any particular desire to spend 3 months in a South American swamp, but I have had great fun building models of cephalopod mouthparts and filming them in a studio. Once lots of shooting has been done, the routine becomes much more like that of an archive programme—logging the shots, looking for the odd filler shot that is needed, keeping track of tapes for the edit and doing the paperwork.

How I got there. I sort of ended up in television by accident—I never had any intention of pursuing a career in the media. I was obsessed by palaeo since I was a sprog, started a geology degree at the University of Aberdeen and then defected to the Zoology Dept because there I could do evolutionary biology without having to do mineralogy too! However, I kept the palaeo options open as both my Honours thesis and Ph.D. (also at Aberdeen) included some work on fossil cephalopods. That led to a three-year postdoc in experimental taphonomy at the Geology Dept, University of Bristol. Then the money ran out… After a year of still doing the experiments and writing up the papers but failing to get another postdoc or another grant, I applied for a 6 month job in the BBC Natural History Unit's film library—mainly because it required a biology degree and was ten minute's walk from the Geology Dept—intending to keep on applying for grants whilst working there. Badly paid and tedious although it was, the film library work continued, whereas the grants never materialised. Meanwhile, I was getting a handle on how production worked, starting to submit ideas to programme brainstorming sessions, and going for internally advertised researcher posts. About three and a half years after joining the BBC I got a six-month researcher job, and have been on rolling contracts ever since.

A more obvious route for a researcher is to go straight from first degree or M.Sc. into TV, usually after doing work experience for as many companies as possible. The Natural History Unit (and I suspect the Science Dept) take on more people with Ph.D.s than other parts of the BBC do. They also take on hardly anyone with Media Studies degrees—they are after scientific expertise, not television or film expertise, as you are expected to learn that on the job.

What was your area of research and why? My Ph.D. was on feeding and diet in cephalopods, which was a continuation of work I had done in my BSc thesis. It was a nice combination of traditional morphological studies, some basic biomechanical analysis in live tissues, and utilising some new techniques in antibody analysis of gut contents. The former two were pure science, the latter had fisheries applications (krill in the diet of Southern Ocean squid). Plus cephalopods are such cool animals!

There was a slight shift for my postdoc—taphonomy of exceptionally preserved invertebrates. Again lots of fun morphology stuff (if somewhat smellier and slimier than normal) and bucket chemistry to establish the baseline conditions for fossilisation of soft tissue in the lab. And I got to do more work on squid, including lovely specimens from Christian Malford (Jurassic).

If you were to start over, what would you identify as THE area in which to undertake research? To work for the Natural History Unit (NHU), someone with a Ph.D. in vertebrate behavioural ecology probably has a slight edge over other fields (*e.g.* physiology) and other disciplines (*e.g.* botany, palaeontology). People with field skills rather than lab skills are perceived as more useful. Those that work on the furry and feathery end of the vertebrates will find more programmes made about their species.

That being said, any area of expertise can stand you in good stead because ideas and contacts are the lifeblood of television. Being the world expert on black footed ferret mating behaviour is useful in the short term, but knowing that Dr X on the floor above you was an expert on lichens, or that Prof Y you met at a conference is pioneering new techniques in extracting ancient biomolecules is what keeps you useful in the media. Knowing how to talk science to scientists, being able to pull information from papers in disciplines as diverse as physics and anthropology, and spotting a good programme or sequence idea in the scientific literature are skills that all researchers need.

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So you want to be…a science-journalist!

My job. Senior Editor, Biological Sciences, *Nature*. When you send a manuscript to *Nature* about palaeontology, or indeed many other aspects of comparative biology, it will hit my desk. My job is to provide an initial evaluation, judging whether your manuscript would, in principle, be of interest to a broad swathe of scientists, over and above the narrow field in which you, the author, specializes. I reject more than 50 per cent of manuscripts after this first reading, often after consulting with colleagues. This doesn't mean that the manuscripts are bad science, just not sufficiently interesting for *Nature*. The rest I send to review: my job is to steer manuscripts through that review process. *Nature* receives around 180-200 new manuscripts each week, around a tithe of which eventually get published. At any time I have a caseload of 20-30 manuscripts at various stages of evaluation. Much of the job is routine desk work but it is relieved by attending meetings at home and abroad, learning about the cutting edge of science from AIDS to exploding galaxies, and occasional writing for *Nature's* Web site and elsewhere.

How I got there. An early interest in fossils combined with a broader interest in science as a whole led to a joint honours degree in zoology and genetics at the University of Leeds. A vacation studentship in the Palaeontology department at the Natural History Museum was invaluable for contacts (I do not believe that the NHM does these any more. If that is true, it should reconsider.) I went on to do a Ph.D. in zoology at Cambridge. By the end I had become disillusioned with research because of poor career opportunities (most of the people in the cohort above me were either unemployed or doing really lousy jobs) but did not know what else to do. My adviser pointed out an editorial vacancy at *Nature*. I was hired—but not for the job advertised. Instead, I was offered the job of a features writer left open as the intended candidate backed out at the last minute. It was really a case of being at the right place at the right time. I was hired, with no experience—something that would never happen nowadays—as a writer, on a three-month contract. Fourteen years later I'm still there. Manuscript work came later.

The most obvious route? Absolutely not. These days, intending science journalists might do the M.Sc. in science communication at Imperial, or take a postgraduate course in journalism. Despite the fact that I am an exception to almost every rule, there really is no substitute for learning traditional journalism skills. The very best science journalists have usually covered other areas as well as science. I rate Tim Radford, Science editor of the *Guardian*, who has covered everything from crime to the arts, and his experience shows in his peerless style and richness of allusion. If you already have a Ph.D. you should aim, as I did, straight for a job without any further qualification, as a Ph.D. in any subject—especially science—tells any employer that you have the capacity for patient research, careful thought and self-motivation. If you wish to pursue a career in writing, it is a good idea to research and pitch stories to science editors at newspapers, magazines and Web sites during your time as a research student. This will gain you a valuable portfolio of work to show a prospective employer. For scientists already up the career ladder and looking for a summer break, the *British Association* offers a Media Fellowship scheme in which scientists can work at newspapers, broadcast media—even the science writing section of *Nature*. It is worth knowing that there are as many wannabe writers in labs as there are wannabe actresses waiting tables in Hollywood. Journalism, and publishing in general, is a many-faceted career, involving a wide variety of skills. That aside, there are many good writers who started out as palaeontologists, pursuing writing and palaeontology side by side. Palaeontologists tend to be better writers than most other scientists, thanks to the discursive nature of palaeontological writing.

My area of research? I did my Ph.D. at Cambridge, concentrating on population-level studies of ice-age bison. This combined my interest in vertebrate palaeontology with quantitative techniques learned through population genetics. I had really intended to do something with fossil fishes, but bison are basically fishes with legs, so I was tolerably happy for a while.

If I were to start over… I don't think the area matters as much as interaction with lots of interesting people from diverse backgrounds. The best scientists are those who do a broad range of studies and collaborate with many people, each of whom has something unique to offer. On reflection I should perhaps have gone to study in the USA, where the potential for interaction exists, simply because there are more people who are into the same things. In a small community such as UK palaeontology you can end up talking to yourself. This saps motivation, is depressing, and rather defeats the object of furthering one's education through research, However, if I could pick a research area for palaeontologists, it would be evolutionary developmental biology, in which palaeontologists contribute to the general aim of elucidating the origins of morphological novelty—working alongside molecular developmental biologists and geneticists. But if I were really honest I'd have got out of science entirely and gone into merchant banking—an area where science degrees and Ph.D.s are valued, and you get a decent wage to show for it!

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So you want to be……in the oil business!

My job. Palynologist/Stratigrapher with a service company (Ichron Ltd.) Logging Cretaceous/Tertiary palynological slides from wells drilled for hydrocarbons, writing reports, reviewing data from other stratigrapher's reports, integrating biostratigraphic data with corresponding sedimentological and seismic work. The wellsite work is the most exciting, assessing stratigraphy as it is drilled, often being required to advise on critical operational decisions (*e.g.* "we've come out of reservoir, do we need to steer the drill bit up, down or straight ahead?")

How I got there. Interest in geography at school, went on to study geography, geology, statistics and computer science at A-level, B.Sc. (Hons.) in applied geology at Portsmouth, and an M.Sc. in palynology at Sheffield. Funding stopped there. I took part-time work in the palynology research labs in Sheffield, demonstrated to undergraduates, and taught visiting post graduates (including the editor of the newsletter!) dinoflagellates and palynological processing to fund my doctoral research. For the first few years after graduation, basic salaries are comparable to those for post-doctoral research posts. Significant additional sums may be earned through undertaking offshore assignments.

My area of research Mid-Cretaceous dinoflagellate cysts. My undergraduate research supervisor at Plymouth University, Prof. Malcolm Hart, introduced me to the problem of bug changes across mass extinction intervals, in particular the Cenomanian-Turonian Stage boundary. I became so interested in the issue, I carried on researching it for my M.Sc. and Ph.D. at Sheffield University.

But would I do it all again? I enjoyed the research I undertook at M.Sc. and Ph.D. level. I first applied for an industrial biostratigraphy job after my M.Sc. in 1992 but this was during a downturn in the hydrocarbon industry. I may have taken a post if I had been offered anything at that time, rather than pursuing a Ph.D. Opportunities to get in to the industry were limited for the next couple of years. My colleagues on the M.Sc. course managed to find work in the hydrocarbon industry but in fields other than biostratigraphy. As I wrote up my Ph.D. in 1996, there were three biostratigraphy vacancies and I took up one of these. Since 1996, employment opportunities have been fairly steady with the exception of the downturn of 1999. With the closure of U.K. palynology M.Sc. courses, there will be a shortfall in the supply of trained graduates to the industry. Anyone undertaking a Ph.D. in palynology or one of the M.Sc. courses available outside the U.K. will probably be in demand on qualifying.

Paul Dodsworth
Ichron Ltd, on a rig somewhere off the Shetland Isles!
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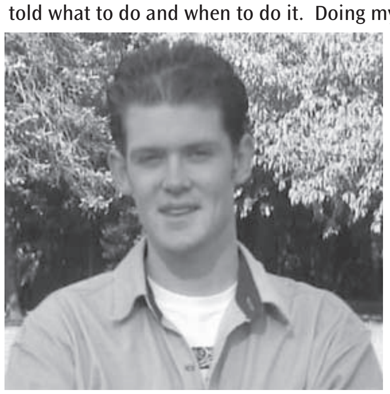
Three routes to a Ph.D.

The direct route

Your job—what is it that you do officially, as contrasting to what you do on a day-to-day basis? Each Ph.D. is unique, so the next few hundred words may reveal nothing more significant than my own idiosyncrasies, but I shall try to shed some light on just what it is postgraduate research students in palaeobiology do. I am funded for three years, full-time, having sworn that by the last day of September 2002 I will have produced a 50,000-word thesis on rare and problematical fossils of the Much Wenlock Limestone Formation, and I have no desire to find out what terrible fate awaits me should I still be in Birmingham on the 1st of October next year. As all my material comes from museum collections, I have done no fieldwork, and spend most of my time either in my office, reading obscure journals and trying to work out the systematic palaeontology of my problematica, or else in the departmental labs, drawing, photographing and sectioning specimens, and producing strange looking cladograms in an attempt to resolve the fossils' affinities. It can be quite a solitary existence, so self-motivation is important, but I have tried to get involved in plenty of departmental activities, and my demonstrating to undergraduates in practical classes and on fieldtrips is a pleasant break from staring down microscopes. I am also lucky in that my three office-mates know absolutely nothing about palaeontology, being structural geologists and geophysicists, so I can escape from very old dead things quite easily if I need to.

How did you get there? I never wanted to be a scientist, I wanted to be...a lumberjack! No, I actually wanted to be a journalist and was going to study English at university until I realized that I would get told what books to read. So I chose the only other academic subject I was consistently interested in—geology. My A-Level teacher, Nancy Reid, was wonderfully enthusiastic and convinced me to apply to do a degree in the earth sciences. I went to Liverpool to read Geology & Physical Geography, had a fantastic time there, and got good marks for my final year dissertation on the palaeoecology and functional morphology of Jurassic oysters from Dorset, suddenly making it clear that I could combine creative writing and fossil hunting and possibly make a living from it.

I have always disliked lectures and revision, probably because I have a problem with being told what to do and when to do it. Doing my own research gives me a fair amount of freedom to pursue my own interests, and at the pace I want to, although I now realize as I enter my final year that a strict timetable is important if I want to finish on time. I enjoy working on my own, asking myself questions and then trying to answer them, but with the knowledge that my supervisors are there to be interrogated if it gets too tricky. In the final year of my degree I thought about applying for a Ph.D., but decided to wait, and upon graduation was fortunate enough to be offered a position as a research assistant on a project investigating Carboniferous



turbidites. That gave me the chance to find out whether research was the thing for me, and I enjoyed it sufficiently to decide that I would become a student again, albeit one without any lectures, and no long summer holidays.

If I did it all again, it would inevitably turn out completely different, but I tend to let things take their course without really planning or worrying about the future. Life's too ridiculous and interesting to get bogged down by serious intentions, so instead I shall carry on being bogged down by ridiculous and interesting (extinct) life and see where I end up.

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The marine to land transition!

What 'sparked off' your initial interest in palaeontology? As a child I was fortunate enough to live a couple of minutes from some major marine fossil sites in Summerville/Charleston, South Carolina, USA. I went through the usual stamp-collecting stage where I used to collect mostly marine fossils like sharks teeth, fish vertebrae, and whale bones. Charleston and the surrounding areas are noted as one of the most prolific fossil marine mammal sites in the world. After dabbling in fossil collecting as a kid and helping Albert Sanders, a curator at the Charleston museum (and he's still there after a century) with digging up some fossil archaeocete whales in my neighbourhood, I didn't study palaeontology in a scientific way until I went to university in 1992. Aside from the enjoyment of collecting fossils as a kid, I was also totally obsessed with fish (the excitement of which was tempered when I discovered girls, skateboarding, and cars). It was a dream of mine to work with both fish and fossils which has now come true.

Was yours the most obvious route? The answer is a simple No and Yes. No, because before I came to study palaeontology in earnest, I spent ten years as a submarine logistician making sure that the attack submarines I was assigned to were properly equipped to complete their mission, which in case you were wondering, is to make the enemy 'extinct'. After leaving the Navy at the age of 28, I enrolled at the College of Charleston to study accounting (yes I'm a masochist). After about a year I was bored with that and changed my major to pursue marine biology, but soon got bored with that too. My wife, who is English, suggested that I try doing a year abroad. She cunningly said, 'England perhaps'. So I applied and was accepted by UCL where I liked the change so much, I stayed and did a complete honours degree in biology—one of only a handful of U.S. students insane enough to start over at a foreign university. From this point I have to revert to the 'Yes' answer. After graduating at UCL in 1997 I decided I wanted to pursue seriously the research game, where the requirement for a Ph.D. was an advantage. I was fortunate enough with the kind support of Adrian Lister (UCL) to secure a three-year NERC studentship. At present I am nearing the end of my thesis write-up which will be submitted by December 2001.

What was your area of research and why? Research area: Acanthodian ('spiny shark') systematics. Why? Because I enjoy inflicting large amounts of pain on myself. Mike Coates, my Ph.D. supervisor, approached me as an undergraduate with the idea of testing cladistically the idea of acanthodian inter- and intra-relationships. The problems with this group intrigued me because here you have a large array of primitive gnathostomes which nobody knew how to manage

systematically—not an uncommon story for those who study related Devonian taxa. So the acanthodian motto has been: Are we not sharks? we are devo, are we not bony fish? d-e-v-o, and so the story goes. The literature is rife with a sort of confused 'hand waving' which settles by default for the idea that acanthodians are most likely paraphyletic, so I and my colleague, Gavin Hanke (Univ. of Alberta) will be publishing in this area, hopefully adding some 'meat' to the acanthodian systematic skeleton.

If you were to start over… I would have gone into extant benthic fish studies. Unlike acanthodians which follow a fairly conservative body plan, today's deep-sea fishes are without a doubt a morphologist's dream or nightmare depending on your view of useful characters. Otherwise, I would most likely have entered the world of corporate mergers/breakups, where although the likelihood of a *Nature* paper is zilch, the monetary rewards could fund a group of hungry palaeontologists. Failing that I wouldn't mind being Dave Martill's stage manager at conferences.

What is it like to get through a Ph.D. without a relevant job waiting for you at the end? Like doing your own molar extractions without the benefit of a cocain-based drug. It has been demoralising at times, especially after you look at all of the years you have devoted to your science and don't see an immediate reward for your effort. But I must admit that I came into palaeontology with both eyes wide open. One of the wonderful things about our discipline is that one doesn't have to be affiliated with an academic institution (in a research capacity) to be productive and publishing. I was fortunate enough to have the experience and drive to do other things until the golden opportunity (a real palaeo job) rears its head. One way I combatted the jobless palaeo-blues was to publish in a major journal early. I did this in 1999 with Dave Martill as my co-author. I just couldn't wait 4+ years before seeing the fruits of my labours. If a student of mine asked me if they should publish while as a Ph.D. student, I would say yes if the drive and extra commitment are there. I have had two good bites at the palaeo-cherry if you will, but both opportunites fell through due to a lack of funding on one and some research council redtape on the other. But my experiences in trying to land a palaeo job pale in comparison to some others I'm sure.

How long are you prepared to hang around for an opening? With a growing family to take care of (just added the second branch to my cladogram in the form of my son, Theo, in June), it will be harder for me to jump from permanent bureaucrat to peripatetic researcher. But like many of you lurking out there, I too am waiting for someone to retire, die, or be found in a compromising position with a specimen or two, which will signal another rare opportunity for employment in our beloved science.

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Letters from America

For the past three years I have been working towards my Ph.D. at the University of Chicago, adding to tail end of the great Celtic Diaspora. This article is based upon my own experiences (sample size of one, always good science), and cannot possibly cover all of the experiences and procedures of the wide number of U.S. institutions that offer opportunities to pursue palaeontological research. I apologize in advance for my ignorance of the Ph.D. systems that operate in the countries of members of the Association who are not familiar with the U.K. system, which I have used as a comparison.

Outline of the U.S. Ph.D.

At Chicago the Ph.D. nominally takes about five years. This is similar to other U.S. universities. You take about two years of courses to prepare you for your independent research. The U.S. undergraduate system produces people with a very different set of skills from the U.K. degree. The emphasis in the U.S. is on a broad-based liberal arts education, which means that students usually have not taken many specialist courses in their chosen research area. Most universities can be fairly flexible in the courses that you take as part of your preparation for research, particularly if you have already taken advanced courses in geology/biology. This makes it possible to take courses in statistics, or a relevant foreign language. It is also possible to take courses at other universities, or participate in summer schools as part of your preparation. During this period you will also assemble a Ph.D. committee of about four or five people who will advise you, and assess your progress towards your Ph.D. After this preparation you will write up and defend a thesis proposal. This allows you to design your own research project, which is rather different from applying to an assigned project. This provides experience in "grant" writing that most people would have to wait until their first postdoc to gain. You may also have to sit a qualifying exam. If you don't have an M.Sc. it is usually possible to convert these first two years into an M.Sc. by writing up a research project, but this varies widely from institution to institution, so be sure to check. After this you will proceed with your research, write it up, and defend it to your committee.

The Application Process

The system for applying for a Ph.D. in the U.S. is somewhat different from the way that things are done in the U.K. You don't usually apply for a specific project. You apply to work in a department or a research programme, perhaps with a particular member of staff. So if there is a place or person that you would really like to work with, contact them, and get the process started as early as possible.

The Ph.D. application procedure begins much earlier than in the U.K. and the World Wide Web and email are invaluable in this respect. There is a lot more paperwork to fill in for a Ph.D. application to a U.S. university, though this will vary depending on the institution. I had to fill in application forms, collect transcripts of my degrees, and generally deal with a lot more bureaucracy than I encountered when applying for Ph.D.s in the U.K. On the upside, U.S. departments usually have a person dedicated to helping students with their applications, and I received a lot of help from these people when I applied to Chicago. I also had to write a "Statement of Academic Intent" for my application to Chicago. This is a short statement of the sort of research questions you might like to pursue in the course of your Ph.D. I certainly haven't been held to that document, it is just another means of assessing candidates, so you shouldn't feel that you are signing your life away in 2,000 words or less. You will probably find that there is a processing fee for your application.

The U.S. educational system loves standardized tests that generate three letter acronyms. I could rant at length about the inequities of standardized testing, but instead I'll recommend "The Mismeasure of Man", S.J. Gould's 1996 book about IQ testing, and leave it to you to draw your own conclusions. You will probably have to sit the General GRE as part of your application process. This again costs money (can you see a theme here?). After my own experience of the tests I recommend you try to look at the format of the tests. Kaplan has a Web site, **http://www.gre.org/**, but the employment service at your current university probably has some copies of the tests in its library.

Campus Visits

I did not actually visit the University of Chicago before I started work there. In fact I had never been to the States before I staggered off a 747 at O'Hare. However, many prospective students do visit the departments they apply to, often with financial help from the institution they are applying to. Do look into this possibility as it gives you a chance to talk to the graduate students already in the department, and will also let you meet potential advisers in person.
I received notification of my acceptance in the middle of February. You should be aware that you will probably have to commit to an offer from a U.S. university before you have even been interviewed for any U.K. positions commencing in the same academic year. It is possible to defer entry, or start at a different point in the academic year, but check with the institution.

Visas and Immigration

To become a student in the U.S. you will probably have to obtain either an F-1 or a J-1 visa. This should be fairly straightforward, but you may find yourself having to go to an embassy or consulate. The Immigration and Naturalization Service (INS), has a Web site with a lot of information, **http://www.ins.usdoj.gov/graphics/index.htm**. Even before the attacks of the 11th of September the INS was cracking down on people who overstayed on student visas, or who undertook work they were not cleared for under their visa conditions. There was also talk of compelling all J and F visa visitors to carry a special electronic card (costing yet more cash on top of your visa application fee). Considering the current mood in the U.S. I expect this proposal to come into force. Universities have an office dedicated to dealing with international students, and you should contact them as soon as you accept an offer, as they need to send you vital documents for your visa application.

Housing

Most graduate students I know live in rented private accommodation or university accommodation. A lot more form-filling is involved in getting a place to live in the U.S. than I am used to. I would recommend that you initially try to get into a sublet with other students, or possibly a member of staff. This can easily be achieved by getting an email circulated around the department. It also serves to establish your identity, as a U.S. address is important for setting up bank accounts, and having a credit history. Leases also tend to be for one year and are harder to get out of than in the U.K. If you take on a lease and leave early, you will be expected to arrange a sublet, or end up paying two rents. Local knowledge from current graduate students and the university housing office can be of great help.

Cost of Living

Contrary to what I heard before coming to the U.S., I have not found the cost of living significantly cheaper. In fact compared to U.K. supermarkets I have found the basics of the student diet on a par, or more expensive. This is based on my experience of living in an urban area, and does not encompass driving to the massive out-of-town stores. However, I have visited such places on field trips, and my experience is that they are not particularly cheap either. Quality beer does exist, but it ain't cheap.

Many consumer goods are cheaper, however. If you want good field gear, or computers, the U.S. is good for that. If you buy online you will find many bargains. Cars and fuel are also cheap in the U.S. When I describe the cost of a gallon of petrol in the U.K., people can't believe it. However, insurance can be very expensive, and driving in U.S. cities is not a pleasant experience. The problem is that there is an underlying assumption that people own cars. This varies from place to place, so once again talk to other graduate students at the university you are joining.

I cannot stress how important medical insurance is. You will be required to have a certain amount if you come in on a J or F visa anyway, but even if you are just visiting the U.S. make sure you have plenty of insurance. The University of Chicago has just started to pay for our healthcare, but until this year I was paying about $1,000. You can chance it with dental and vision insurance, but if you are unlucky you could end up paying hundreds of dollars.

Funding

Funding will vary from university to university, and even within the university. I mainly teach to earn my keep, although I have also acted as a research assistant. This has allowed me to get a lot more teaching experience than I could possibly have acquired in the U.K., but be aware that this will often take up 15 to 20 hours of your week. The only solid research days I get are usually weekends. I have worked with foreign nationals funded by their own home governments to study in the States, so you should explore that possibility.

Should I stay or should I go?: Pros and Cons

Here are some personal thoughts that may or may not be of help from my experiences out here. These are my own opinions, and some people may think the pros are cons and vice versa.

Pros

- There are many more universities in the U.S. than in the U.K., and with a lot more funding. This means a lot more chance of getting a place, and usually better facilities for your work. It also means there are many more postdoc positions in the U.S.
- It is easier to take advantage of relevant courses offered at places like Friday Harbor, the Santa Fe Institute, and Woods Hole.
- There are many more conferences at which you can meet people, find out about jobs/courses, and hear about new research.
- You will have far more freedom to develop your own research, take courses outside your field, and pick up skills such as grant writing, than you would in most U.K. Ph.D. programmes.

Cons

- You're looking at five years to complete your Ph.D., which is a significantly longer time commitment.
- If you are a foreign national it is difficult to get U.S. government grants, unless your adviser is involved. If you don't like the idea of teaching, you will probably find it difficult to fund yourself.
- You may find yourself working on the semester system, which is good for undergraduate teaching, but not so conducive to research.

I hope that this article has been of help to anybody thinking of pursuing Ph.D. research in the United States. If I can be of any help to anyone please feel free to drop me an email. My inbox is always open.

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Becoming a master! An insight into the M.Sc. Palaeobiology course, University of Bristol

Approximately 12 months ago, 14 fresh-faced strangers embarked on a palaeontological extravaganza comprising the M.Sc. Palaeobiology at Bristol. A multinational crew consisting of a former civil engineer and photographer in addition to graduates from geological, ecological and zoological backgrounds stepped aboard for a 3.5 billion-year journey in just one year. Would treasures galore be found over the horizon?

The course itself is divided into two components: a taught session consisting of lectures and practicals (with a few written examinations), and secondly by six months of research on a particular theme to produce a thesis.

The first half of the course (October to May) comprises the taught component, of which five core and four optional modules (from a choice of ten) are taken. The teaching block is divided into four demanding six-week sessions in which a student may take up to five modules per session. The mandatory units include palaeobiological research methods, palaeobiology, taphonomy and palaeoecology, current palaeobiological controversies and scientific communication. These combine to give a broad base in palaeontology and develop an attitude of scientific rigour throughout.

Of the core units, 'current controversies' is a firm favourite. Each week a particular topic is addressed. An introductory lecture outlines the background and focus of debate. This is followed by a short presentation on a particular aspect of the controversy by each student, and a group discussion concludes proceedings (or rather prompts a more lucid reading of the topic in the local pub). There is nothing like a good old-fashioned *argument* and red faces often emerge! The research methods module provides valuable training in the use of equipment and practical methods/approaches to palaeobiological research (*e.g.* scanning electron microscopy, photography, fossil preparation, and museum curation). Examples of module projects undertaken include laboratory preparation of a fossil and subsequent photography, and *camera lucida* drawings. As part of this course approximately mid first term a field trip (three-four days) is an excellent opportunity to meet fellow comrades and find a few fossils (not forgetting the local pubs!). The best geologists are those who have seen the most rocks and this can equally apply to palaeontologists. The 'scientific communication' course addresses the need for continued *good scientific practice* whether addressing the scientific community (producing a paper in the style of the journal *Nature*), or the public at large (compiling a Web page using HTML).

The optional units aim to cover a wide variety of topics, taking advantage of the presence of some of the UK's leading palaeontologists as well as the expertise of the Biology and Archaeology departments. Non-geologists have to take sedimentology whilst those from a geological background take the evolutionary biology course (but with such a diverse group of students, you're never short of a helping hand if it all seems too much!). There really is something for everyone with modules on dinosaurs, mammals, arthropods and hominids to name a few. There's also the chance to dabble in some of the key areas of contemporary palaeontology with courses on systematics and macroevolution. Assessed three-hour practical sessions require a good deal of attention and stamina but *knuckle down* and seek advice from the supervisors and they soon pass.

If you are still afloat by the end of May then it is time to begin your research project. Individual topics are chosen within the first few weeks and it is wise to begin early. Projects cover diverse topics, but if you have a burning desire to study say, hybodont sharks, or perhaps dinosaur egg shells then fear not, innovative ideas are always welcome. Fieldwork, museum visits and data collection from other institutions (world-wide) are all possibilities, with funds from various bodies (both within and outside the department) available. The project is for many an opportunity of a lifetime to begin new research directions, students often laying foundations for further Ph.D. study.

Palaeontology remains one of the most dynamic and original sciences. Many geological and biological degree courses only introduce or give scant coverage to the science leaving a huge gap between undergraduate study and a Ph.D.. The M.Sc. is undoubtedly the most rewarding and positive step to bridging this divide, providing lessons and insight into palaeontology from a strong academic perspective. Life in Bristol as a postgraduate palaeobiologist is energetic and busy, so *set-sail me hearty shipmates and go chart the palaeontological waters!*

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Ph.D. Palaeo projects for 2002

The following list includes Ph.D. titles offered to commence in October 2002. This is by no means an exhaustive list and the institutions listed, plus others that are not listed, may well extend this list over the next few months. Further details for many of these projects are already available on institutional Web sites (URL supplied); details for all will be available shortly. An email address is included for first point of contact for expressions of interest in any of the titles and it is advisable to make your interest known as soon as possible. Application deadlines can be as early as January, and interviews usually take place during the period January-April.

University of Birmingham: School of Earth Sciences

Palaeobiology of primitive armoured fishes. Philip C.J. Donoghue & Philippe Janvier (MNHN, Paris). <**p.c.j.donoghue@bham.ac.uk**>

The origin and early diversification of irregular echinoids. Philip C.J. Donoghue & Andrew B. Smith (Natural History Museum, London) (First 18 months to be spent at the Natural History Museum, London). <**p.c.j.donoghue@bham.ac.uk**>. This is likely to be a CASE studentship.

Exceptional preservation in the Upper Carboniferous Coseley Lagerstätte. Paul Smith & Jim Marshall (University of Liverpool). <**m.p.smith@bham.ac.uk**>

Architectural development of Silurian reefs. Alan Thomas & Paul Smith. <**a.t.thomas@bham.ac.uk**>

Further information can be obtained from <**http://www.bham.ac.uk/EarthSciences/research/palaeo/index.htm**>

University of Bristol: Department of Earth Sciences

Information will shortly be available from <**http://palaeo.gly.bris.ac.uk/**>

University of Cambridge: Department of Earth Sciences

The microstructure of Ediacaran preservation. S. Conway Morris <**sc113@esc.cam.ac.uk**>

Evolution of benthic dendroid graptolites. R.B. Rickards <**rbr1000@esc.cam.ac.uk**>.

Hydrodynamics of bizarre graptolites. R.B. Rickards <**rbr1000@esc.cam.ac.uk**>.

Carbon, phosphorous and the taphonomy of the Precambrian-Cambrian transition. N.J. Butterfield <**njb1005@esc.cam.ac.uk**>.

Early evolution of zooplankton. N.J. Butterfield <**njb1005@esc.cam.ac.uk**>.

Palaeobiological investigation of Ediacaran biotas on the Russian Platform. D. Grazhdankin and N.J. Butterfield <**njb1005@esc.cam.ac.uk**>

Bioengineering using Finite Element Analysis (FEA): quantifying its application in palaeobiological systems. D.B. Norman & E. Rayfield <**dn102@esc.cam.ac.uk**>.

Isotopic insights into sponge biomineralization and evolution of the silica cycle. C.L. de la Rocha <**christina00@esc.cam.ac.uk**>.

Palaeobiology of giant inoceramid bivalves. E.M. Harper & J.S. Crampton <**emh21@cus.cam.ac.uk**>.

Biomineralisation of molluscan shells. E.M. Harper & E. Salje <**emh21@cus.cam.ac.uk**>.

Relationships between Mo-cycle, N-cycles and the evolution of the biosphere through geological time: an isotopic approach. Albert Galy <**albert00@esc.cam.ac.uk**>.

Further information can be obtained from <**http://www.esc.cam.ac.uk/**>

University of Cambridge: Museum of Zoology

Carboniferous lungfishes. Jenny Clack <**j.a.clack@zoo.cam.ac.uk**>

Further information can be obtained from <**http://www.zoo.cam.ac.uk/museum/**>

University of Cardiff: Department of Earth Sciences

The Ordovician radiation of depth-related calcified algae. Robert Riding <**riding@cardiff.ac.uk**>

Glacial to Holocene abrupt climate change in the SW Indian Ocean. Rainer Zahn & Ian Hall <**zahnr@cardiff.ac.uk**>

Ocean-climate interaction in the North East Atlantic during glacial times. Ian Hall & Rainer Zahn <**hall@cardiff.ac.uk**>

Perispore: an overlooked feature in pteridophyte reproductive biology. Dianne Edwards, S. Blackmore (Royal Botanic Garden Edinburgh) & Alan Hemsley <**edwards2@cardiff.ac.uk**>

Coal Measure palaeoecology of Bohemia: pteridophyte reproduction and palynology. Alan Hemsley & Jiri Bek (Geological Institute, Prague) <**hemsleyar@cardiff.ac.uk**>

Early aragonite dissolution of shells leading to taphonomic distortion of the fossil record. Lesley Cherns & Paul Wright <**cherns@cardiff.ac.uk**>

Ammonites of the Lower Kimmeridge Clay. John Cope <**copejcw@cardiff.ac.uk**>

Seasonal- to decadal-scale climate changes from Quaternary organic carbon-rich sediments, Japan Sea. Jenny Pike <**pikej@cardiff.ac.uk**>

Late Quaternary palaeoceanography of the East Antarctic margin. Jenny Pike & Amy Leventer <**pikej@cardiff.ac.uk**>

Further information can be obtained from: <**http://servant.geol.cf.ac.uk/**>

University of Derby: Division of Earth Systems Science, School of Environmental & Applied Sciences

Bivalve shells as monitors of freshwater heavy metal pollution. Andy Johnson & S.R. Chenery (British Geological Survey) <**A.L.A.Johnson@derby.ac.uk**>

Investigation of Pliocene-Recent climate and hydrography of the North-Sea area by stable-isotopic and growth-line analysis of marine bivalve shells. Andy Johnson, T.H.E. Heaton (British Geological Survey) & P.S. Balson (British Geological Survey) <**A.L.A.Johnson@derby.ac.uk**>

Further information can be obtained from <**http://www.derby.ac.uk/seas/geology/**>

University of Durham: Department of Geological Sciences

Biogeography and evolution in the relic Iapetus Ocean. Howard A. Armstrong & Alan W. Owen (University of Glasgow). <**h.a.armstrong@durham.ac.uk**>

Non-linear dynamics in the biosphere. Howard A. Armstrong <**h.a.armstrong@durham.ac.uk**>

Controls on growth in the earliest vertebrate skeleton. Howard A. Armstrong <**h.a.armstrong@durham.ac.uk**>.

Geochemistry of biogenic phosphates. Howard A. Armstrong, Graham Pearson & Colin Macpherson. <**h.a.armstrong@durham.ac.uk**>

Further information can be obtained from <**http://www.dur.ac.uk/h.a.armstrong/**>

University of Edinburgh: Department of Geology and Geophysics

The hydrodynamics of graptoloid thecae. Sue Rigby & Barrie Rickards (University of Cambridge) <**sue.rigby@glg.ed.ac.uk**>

Further information can be obtained from <**http://www.glg.ed.ac.uk/**>

University of Leeds: School of Earth Sciences

Palaeoecology of Jurassic black shale bivalves. Paul Wignall & Cris Little <**P.Wignall@earth.leeds.ac.uk**>.

Palaeoenvironmental and climatic significance of exceptionally preserved Tertiary conifers from Antarctica. Jane Francis, Anne-Marie Tosolini, Alistair Crame (British Antarctic Survey) & David Cantrill (British Antarctic Survey) <**j.francis@earth.leeds.ac.uk**>. This is a CASE project with the British Antarctic Survey.

Further information can be obtained from <**http://earth.leeds.ac.uk/earth.htm**>

University of Leicester: Department of Geology

Exploiting the palaeobiological potential of conodonts: evolutionary trends, patterns and processes. Mark Purnell, Richard Aldridge & Philip Donoghue (University of Birmingham) <**map2@le.ac.uk**>

Major ecological transitions in early vertebrate evolution. Mark Purnell, Jan Zalasiewicz, & Jane Evans (NIGL). <**map2@le.ac.uk**>

Growth, function and evolution of the conodont skeleton. Mark Purnell & Philip Donoghue (University of Birmingham). <**map2@le.ac.uk**>

Further information can be obtained from <**http://www.le.ac.uk/geology/**>

The Natural History Museum: Department of Palaeontology

The Palaeontology Department of the Natural History Museum has the largest palaeontology collection in the country, the greatest concentration of palaeontologists, and outstanding facilities for fossil preparation, conservation and study. Groups covered span the complete range of fossils from dinosaurs to dinoflagellates. The NHM co-funds a limited number of CASE studentships and other students are co-supervised by Museum scientists. More broadly we would hope that all research students would regard the Museum as a resource available to them. For more information see the Department's Web site at <**http://www.nhm.ac.uk/**

palaeontology/>. Contacts can be made through any scientist relevant to the study, or to myself, Jeremy Young, Departmental Postgraduate Research Student Co-ordinator <**j.young@nhm.ac.uk**>.

The origin and early diversification of irregular echinoids. Philip C.J. Donoghue (University of Birmingham) & Andrew B. Smith (Final 18 months to be spent at the University of Birmingham). <**p.c.j.donoghue@bham.ac.uk**>

University of Portsmouth: School of Earth, Environmental & Physical Sciences

Soft tissue fossils from the Cretaceous of Brazil. David Martill <**david.martill@port.ac.uk**>

Further information can be obtained from <**http://www.sci.port.ac.uk/geology/research.html**>

Royal Holloway, University of London: Department of Geology

Fire as an indicator of palaeoclimate in the late Carboniferous. Andrew C. Scott <**scott@gl.rhul.ac.uk**>

Mid-Cretaceous planktic foraminifera evolution and ocean chemistry fluctuations. Darren R. Gröcke, Brian T. Huber (Smithsonian Institution, Washington DC) & Michal Kucera. <**d.grocke@gl.rhul.ac.uk**>

Biogeochemical processes in the oceans: new transition metal tracers. Derek Vance & Michal Kucera <**d.vance@gl.rhul.ac.uk**>

Further information can be obtained from <**http://www.gl.rhbnc.ac.uk/**>

University of Southampton: School of Ocean and Earth Science

Holocene climate/ ocean variability from laminated sediments, Saanich Inlet, British Columbia. Alan Kemp <**aesk@mail.soc.soton.ac.uk**>

Palaeoclimatology/ palaeoceanography from the Cretaceous Greenhouse, laminated Moreno Shale, California. Alan Kemp, Jenny Pike (University of Cardiff) & J. Barron (US Geological Survey) <**aesk@mail.soc.soton.ac.uk**>

Micro-chemistry of Jurassic fossil wood. John Marshall, S. Roberts & S. Hesselbo <**jeam@soc.soton.ac.uk**>

Mid Palaeozoic climate, sea-levels and provincialism. John Marshall & A. Racey <**jeam@soc.soton.ac.uk**>

Further information can be obtained from <**http://www.soc.soton.ac.uk/SOES/GRADSCHOOL/admissions/projects/by_supervisor.html**>

M.Sc. in Palaeobiology: University of Bristol, Department of Earth Sciences

The M.Sc. in Palaeobiology offers a broad-based overview of modern approaches in palaeobiology. Students study nine out of 16 possible options, and topics range from taphonomy and palaeoecology to mammalian palaeobiology, dinosaurs to trace fossils, systematic methods to macroevolution. 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 earth sciences subject, and conversion courses in evolution, basic palaeontology, and sedimentology are offered. Students also receive training in writing scientific papers, creating Web sites, applying for Ph.D.s and jobs (both in Britain and overseas).

So far, 60 students have graduated, and many have gone on to rewarding careers in palaeontology and related scientific areas. Full details of the programme, of former students, and how to apply are available on the Web site <**http://palaeo.gly.bris.ac.uk/opportunities/MSc.html**>. Application forms may be downloaded from the web site, or they can provided by <**shirley.sparks@bris.ac.uk**>

M.Sc. Micropalaeontology: University College London

The science of Micropalaeontology studies the microscopic remains of animals, plants and protists belonging to biological groups mostly of simple organisation and less than 1mm in size. These organisms were extraordinarily abundant and diverse in the past and continue to be so in modern environments, in many cases forming the primary elements in marine, lacustrine and terrestrial organic productivity cycles and food chains. The production of these organisms is a basic component of the global biogeochemical system, intimately linked to present and past environmental change. In this way microfossils are keys to palaeoceanography and palaeoclimatology and to understanding the evolution of the biosphere. Our ability to use the pattern of evolution of microfossil groups during the last 400 million years as a means of ascribing relative ages to sedimentary rocks and reconstructing their environmental histories is of great value for understanding global sedimentary geology, and has especially important applications, for example, in the hydrocarbon industry.

The M.Sc. and Diploma course in Micropalaeontology was founded in 1959, was the first of its kind in Britain and was specifically designed to train professional micropalaeontologists. The importance of the subject for biostratigraphy and palaeoenvironmental interpretation is firmly established through its application to hydrocarbon exploration, and also as a key to understanding the history of the continental shelf and oceanic basins. A high proportion of graduates have entered the oil industry, either following the M.Sc. course or after further research. Close links are maintained with the hydrocarbon industry.

The course is broadly based and covers calcareous, organic-walled and siliceous microfossils. Great emphasis is placed on the biostratigraphy and spatial distribution of the organisms and their application to problems of zonation and correlation and to environmental analysis. All major post-Palaeozoic microfossil groups are covered in the M.Sc. curriculum. Individual and team project work forms an important part of the course.

The entry qualifications for the M.Sc. in Micropalaeontology are: at least a Lower Second Class Honours degree in Geology, although joint combinations with Geography, Biology and Oceanography may be acceptable. We welcome enquiries from graduates with experience in oil companies who wish to obtain further qualifications.

Further details and application forms are available from:

Professor A.R. Lord
Department of Geological Sciences, University College London, Gower Street, London, WC1E 6BT, UK. Tel: (44) 020 7679 7131; Fax: (44).020 7388 7614
<micropal@ucl.ac.uk>

M.Sc. Advanced methods in taxonomy and biodiversity: Imperial College London

Imperial 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 M.Sc. 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 are 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 and veterinary science). Exceptionally students with different backgrounds or with related work experience will be considered.

Further details are available from:

Ms Amoret Brandt

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Overseas Representatives

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Canada: Prof RK Pickerill, Dept of Geology, University of New Brunswick, Fredericton, New Brunswick, Canada E3B 5A3.

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Dr Rong Jia-Yu, Nanjing Institute of Geology and Palaeontology, Chi-Ming-Ssu, Nanjing.

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TAXONOMIC/NOMENCLATURAL DISCLAIMER

This publication is not deemed to be valid for taxonomic/nomenclatural purposes [see Article 8.2 of the International Code of Zoological Nomenclature (4th Edition, 1999)].