



Newsletter

Number 14

October 1999

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From the President

Now is the time of year that we look forward to the AGM and times of change. The most significant is the election of a new President who will sit on Council as President Elect to take over as President in December, 2000. The date for nominations closed on October 1st (see last Newsletter). At that time I had received just one nomination, Professor Chris Humphries, so a vote is unnecessary and he is duly elected *nem.con*.

Chris is well known to most of you and has served on the Council of the Association for two terms and has been our treasurer 1986-9. He has been a regular contributor to our symposium volumes and has organised several of our meetings. Chris is a botanist and has worked as a curator, researcher and manager at The Natural History Museum for 28 years. He has contributed greatly to systematic theory and its dissemination through his writings, PhD supervision, teaching and through his work, with Norman Platnick, in setting up the journal *Cladistics*. His main taxonomic research has been in the systematics and biogeography of angiosperms – mainly Asteraceae, Mrytaceae and Fagaceae and his most recent research centres on the Malvales.

Chris is an experienced committee person, amongst other positions being the Vice President and Botanical Secretary of the Linnean Society for ten years. His dedication to systematics and ability to make things happen through committee mean guarantee that he will serve the Association well and I can think of no one more able to hand over to.

Dr. Peter Forey

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From the Editor

A rather fuller issue this season than July's, with lots of important notices about the association, a report on the successful Biennial meeting in Glasgow, and a couple of book reviews.

The Young Systematists' Forum is now fully subscribed as far as speakers are concerned, so thanks to all of you who have arm-twisted the budding generation of systematists into attending. The meeting is at the Natural History Museum on December 1st, and both Yvonne and myself would welcome anyone who felt like stopping by and listening to a few of the talks.

As ever, I am dependent on people sending in copy for this newsletter, so I look forward to hearing from you soon!

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Council News

Council Members

Come December and the AGM eight council members are due to step down through the system of rotation. Therefore we are looking for replacements. If there is anyone who would like to serve on council, or if you know of someone who you feel would be active in this capacity then now is the time for nominations. We need the name and address of the person, a proposer and a seconder as well as statement from the nominee that they are prepared to be nominated. Council meets only four times per year (plus the AGM).

Being on council allows you to comment on



upcoming meetings, to suggest ways in which systematics may be given higher profiles and gives you a good opportunity to push your case to gain financial support for holding a meeting, although I stress that you do not have to be on council to do this. Councillors serve a three-year term.

Please send your nominations to the Secretary, Dr Zofia Lawrence, International Mycological Institute, Bakeham Lane, Egham, Surrey TW20 9TY or e-mail z.lawrence@cabi.org. Nominations should reach her by 30th November 1999.

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From the New Membership Secretary

The current membership of the society is now 557 members. Unfortunately only 415 of these members have got round to paying their subscriptions. So the 142 of you—you know who you are!—please pay up as it wastes a lot of time and money to keep sending you reminders. There has been a rise in membership due to the Biennial meeting we have had 31 new members this year so far. Although a lot of people who claimed to be members at the meeting in fact owed a couple of years subscriptions and unfortunately paid the lower registration fee claiming to be paid up members—you know who you are!

Thanks to all of you who paid up on time

Dr. Geraldine Reid

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Taylor & Francis Advertising

As you know T & F are now our publishers. They are relatively inexperienced in the Natural Sciences but are trying to build up a reputation. Part of this process is the establishment of a good marketing base. We can help them by supplying lists of Societies that they could use to use mailings to spread the word about our publications as well as journals which review the kinds of books we produce. Our success at generating income from royalties as well as their success at selling are inextricably linked. If any of you can think of journal titles which could be used to review our books then please let me have them. Naturally different books will have different target journals but if we could build up a list then we could supply T & F with a sample as and when our volumes appear. Inserts advertising our books could also be mailed with the relevant journal. Any ideas to me please.

Dr. Peter Forey

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Web Site Manager

Many of our announcements and reports of meetings etc are now broadcast through the web. We have had a web site set up for some time now, at first through our old publishers and now on the Glasgow University site.

We are looking for a web site manager who is prepared to post new items and delete out of date material on our web site as well as redesign pages as and when required. We really need someone who is prepared to spend a small amount of time now and again to refresh the pages, insert and delete links, and someone with a good eye for design. This might suit a PhD student skilled in the relevant areas (who is not these days?) but we would like to hear from anyone prepared to commit themselves. There might be some financial remuneration available for this. If you think you may be interested please let me know.

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SA Grant Scheme

Information and application forms for the 1999/2000 round of the Systematics Association Grant Scheme are enclosed in the current mailing. Further copies of the forms can be obtained by writing to me or from the Systematics Association's web page:

<http://www.geology.gla.ac.uk/palaeo/syst99/>

A recent publication stemming from a Systematics Association grant is:

J.C.W. Cope. 1999. Middle Ordovician bivalves from mid-Wales and the Welsh Borderland. *Palaeontology*, 42, 467-499

The closing date for the 1999/2000 grants is 31st December 1999.

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Biennial Meeting—Report

Our second Biennial meeting was held at Glasgow University 23rd–27th August and attended by 160 delegates. It was a delight to see so many younger scientists there including a large number of research students. We therefore continued the spirit of the first Biennial and one of the objects of these meetings—namely, to bring young researchers together without the potential intimidation of the 'old buffers'. There was, of course, a sprinkling of the latter (myself included) but we were all very well behaved and offered encouragement without parental overtones. As with the first Biennial there was a preponderance of botanists reflected in both the presentations and on the delegates list. It is difficult to pin point why this should be so since I do not believe that zoology is less represented in the systematic community. So, whatever happens to the Biennial in the future more zoologists need to be encouraged to come. Despite the subject imbalance it was encouraging to see at least 23 nationalities represented from all permanently inhabited continents. The Biennial has established itself as truly international.



The talks reflected the participants and of the 88 presented papers and 12 posters, 55 were botanical (overwhelmingly angiosperm in nature) and 27 zoological, four describing techniques with the remainder theoretical, these last concentrated mainly within the two thematic sessions (see below). Amazingly, all but one of the talks promised were read and since abstracts are posted on our web site I can refrain from discussing each one and simply draw some generalities. The abstracts will be on our web site for a while so I encourage those who did not attend to go there.

<http://www.earthsci.gla.ac.uk/palaeo/systass/biennial/biennial.html>

One interesting phenomenon struck me. Of the botanical papers 60% were molecular, 10% molecular and morphological. This contrasted with 15% molecular papers amongst the, admittedly, much smaller zoological clique. Are these ratios symptomatic of the systematic work being done at present? Five years ago attendance at any meeting heavily laden with zoologists would have been replete with molecular papers. Possibly the botanists' recent drive to produce huge data molecular bases across vast tracts of plant diversity have provided this new impetus for younger scientists. And these botanical data bases, particularly for angiosperms, are certainly impressive (600 taxa x 10,000 nucleotides are known) but bring their own computational difficulties. Some of the papers addressed these difficulties.

The application of molecular data to problems of interrelationships of flowering plants was reported at a wide range of rank levels from species within a genus (e.g. *Virgilia* and *Streptocarpus*) to orders of angiosperms. In many cases the molecular signal confirmed the morphological phylogeny – all is well. But in others there was conflict. Of course conflict is always interesting, but it is one on which morphologically-based zoologists usually dismiss by saying that the taxon sampling for molecular data is too poor. We've just ground up the odd-ball taxa. This can hardly be said for angiosperms. There is an awful lot of molecular data out there and it needs explaining. No doubt the molecular analyses will go on increasing exponentially but I hope and expect that some of the results will stimulate morphologists to go back and rethink treasured groupings. Many of the talks mentioned conflict between molecular phylogenies and traditional Linnean classifications (e.g. membership of tribes or families). Here the disagreement may be 'artefactual' in the sense that many of these traditional classifications were established under an eclectic methodology designed to express adaptive radiations or stamp authority. As the talks, botanical or zoological, in this meeting demonstrated the methodology now used is almost exclusively cladistic. And although it needs to be stressed that there are varieties of cladistics, some of which were on display at this meeting, the parameters could be understood, if not accepted by all.

Amongst the zoological papers within the open session there were those dealing with systematics of sponges, crabs, teleost fishes, snakes, birds and insects (Coleoptera, Hymenoptera Homoptera). Some of these had a sprinkling of palaeontology but, in general, the meeting was thin on fossils. This is a shame (well I would say that!) because there are many general

systematic problems which are either unique or best exemplified by fossils. And fossils, of course, provide the time frame on which molecular biologists nail their clocks. Several of the zoological papers concerned host-parasite relationships and this was understandable considering the subject of one of the thematic sessions to which I now turn.

One of the thematic sessions (Tangled trees: phylogeny, cospeciation and co-evolution) concerned cospeciation and co-evolution and dealt mostly with host-parasite systems. The opening papers outlined the theoretical bases of how we compare trees (of say host and parasite), identifying host-parasite switching events and how we can explain these switching events under different models of evolution. These talks were impressive in the complexity of problems they were trying to solve. Analysing the phylogeny of host-parasite systems is analogous to historical biogeographic analysis with the added complication that both host and parasite may evolve under different tempo and modes. Personally I found them a little unsettling in the free use of evolutionary models driving the analyses. Justification for these models may be hard but no-one pretends this is an easy nut to crack. Later in the day some more empirically-based examples of the comparison of host-parasite trees were presented and reassuringly I was brought back to ground.

The other thematic session (Morphology, shape and phylogenetics) tackled equally complex problems of how phylogeneticists can deal with morphometric data (shape, counts, ratios etc). Morphometricians and phylogenetic systematists have been poles apart for many years yet morphometric data is potentially useful for phylogeneticists and phylogeny, in turn, gives meaning to shape. Topics covered included discussion of the mathematical ways in which we describe shape and which descriptors can or cannot not be used as cladistic characters. The concept of a character also came under review. As with the previous thematic session the later papers became more empirical with examples of how morphometric data (including continuously variable characters) could be used both to build phylogenies in the first place as well as the inferences we may draw when morphometric data are mapped onto existing phylogenies derived from other data. Listening to the talks gave me an overall impression is that there is still some way to go before the concepts of morphometric and phylogenetic homology can be understood in common terms. But this session showed that there is a genuine belief that further dialogue will be mutually beneficial. Earlier, I mentioned the obvious preponderance of botanical papers. Equally obvious was the fact that the more theoretical papers within the thematic sessions were heavily weighted towards zoological subjects.

The standard of the presentation of talks was truly outstanding. I realise that, year by year, the tools of presentation become more and more sophisticated—perhaps to the point where the fear of the technology letting us down exceeds the nervous energy of giving the talk in the first place. But ultimately it is the message—and how effectively we get the message across—which is the measure of presentation. And very few talks left us without a clear take home message. Clearly, many had practised their talks over and over again, honing out peripheral information to



make the most of a mere 15 minutes. Presentation was one of the criteria for the student prizes on offer, along with the breadth, depth and relevance of the science beyond the immediate area of investigation, as well as the way in which the talks were structured and kept to time. This provided the criteria for judging the talks entered as bursary recipients as well as the posters. Many congratulations to all of you for the high standard of presentation. The judges (Bateman, Forey, Humphries, Page, Rudall and Wilkinson) under the chairmanship of Pete Hollingsworth finally agreed that the prizes should be awarded to:

Talks

- 1st Vince Smith (Reconstructing character state trees: an example using head louse shape)
- 2nd Diana Percy (Origins and host specificity of legume-feeding psyllids).

Poster

Jessada Denduang-Boripant (Intra-individual ITS variation in *Aeschynanthus* (Gesneriaceae))

Glasgow University provided an excellent venue. The lecture theatres were modern, close to one another for parallel sessions, comfortable and well equipped with PowerPoint presentation facilities.

Accommodation, at least where I was staying, was excellent, and sufficiently far from the lectures that the intervening hills provided the necessary exercise to offset sitting around all day. Our symposium meal was held in the imposing marbled City Chambers, built on the profits of tea exporters, where we were treated to the good old Scottish custom of 'murdering the haggis'. I believe that the whiskey tasting and ceilidh was also highly successful, participants being easily recognisable the next morning.

In all, I very much enjoyed the meeting and hope that enjoyment was shared by everyone. The size of the meeting, plus the range of taxonomic expertise meant there were many opportunities to make new contacts and share common systematic problems.

The organisation went remarkably smoothly, at least from the participants' points of view. I think part of this was due to the fact that Gordon Curry had used on-site conference organisers to take the strain of most of the tedious work (booking, registrations etc). And this is something for organisers of future Biennials to think about. Even so, there remained a lot of hard preparatory work and I would like to express my thanks on behalf of the participants firstly to Gordon Curry and also to Pete Hollingsworth and Toby Pennington who bore the brunt of organisation. And thanks are also due to the projection team. You all did a splendid job.

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Meeting Reports

A Flat World for Some— Interrelationships of the Platyhelminthes

Hands up all those who work on a phylum where everyone agrees as to the interrelationships of the group. Well unless you work on the Cycliophora (1 species) there should not be a great deal of arm-waving. In contrast we enjoyed a certain amount of arm-waving at the meeting *Interrelationships of the Platyhelminthes* from the 14th–16th July 1999 where over 80 delegates from over 25 countries descended on The Linnean Society meeting rooms to discuss flatworms. Jointly sponsored by The Linnean Society, The Systematics Association, the British Society for Parasitology, and with generous assistance from The Wellcome Trust to bring two of the five Australian speakers across. This was the first meeting ever dedicated to the topic and the first specifically aimed at bringing together the groups working on both free-living and parasitic forms. Speakers and posters covered all manner of topics, techniques and phylogenetic levels but, perhaps surprisingly, there was little animosity or gnashing of teeth as characters and topologies were presented and a modern phylogeny took shape. The most irksome of recent findings has been the claim that acoel flatworms are not members of the Platyhelminthes at all, and in fact occupy a pivotal position as basal members of the bilaterian Metazoa¹. Presently the evidence stems only from molecular systematic data so the old morphology versus molecules tried, if only briefly, to rear its ugly head. Nevertheless, as both the morphologists and the molecular biologists are convinced of the homology among their data sets, both groups are left with having to explain the apparent discrepancies in each other's data sets. Seth Tyler (University of Maine) explained the inconsistencies with the calm and clarity only a man who works on microscopic interstitial worms with little or no morphology (the worms not the man) could do.

Ulrich Ehlers (University of Göttingen) wrote a definitive volume on the subject of the meeting in 1985² and he kindly started the meeting with a review of his findings in the light of evidence accumulated since the book was published. The rise of molecular data and the continued accumulation of ultrastructural data clearly revealed an evolution of thought but many of the original conclusions were more firmly confirmed rather than dismissed. Indeed, such features as the monophyly of the obligate parasitic forms (including the monogeneans, digeneans and cestodes) into the Neodermata is now confirmed by multiple lines of evidence and almost legitimizes the separation of parasitologically minded systematists. However, the non-monophyly of the free-living taxa (the 'turbellaria') and the confusion as to the interrelationships of these groups, and therefore the sister-group of the Neodermata, encourages the phylum-wide approach. Indeed, parasitologists cannot ignore some of the 'turbellarian' groups that live in association with, or indeed parasitize, other animals. The temnocephalans and their ancient association with freshwater crustaceans were discussed by Lester Cannon (Queensland Museum), whilst Boris Joffe (Russian Academy of Sciences) used morphological and molecular data on the 'Revertospermata' to argue



for caution in lending weight to molecular data.

Evidence from sperm morphology presented by Jean-Lou Justine (Museum d'Histoire Naturelle, Paris) and Nikki Watson (University of New England, NSW) shows that characters from this peculiar and difficult-to-determine data set are slowly bearing fruit in the indication of phylogenetic affinities. Klaus Rohde (UNE, NSW) gave a presentation on protonephridia that covered the phylum and highlighted the need for continued funding in basic techniques such as electron microscopy.

We were suitably stunned by the spectacular results of combining immunocytochemistry with phase contrast microscopy to show the neuromusculature of a range of animals (David Halton, Queen's University Belfast) including the dreaded acoels (Olga Raikova, Russian Academy of Sciences, St. Petersburg; Matthew Hooge, University of Maine). Even for the colour-blind among us (a trait peculiar to certain digenean workers) the results gave the impression of seeing a flat worm in three dimensions. Other visual delights were presented by Janine Caira (University of Connecticut) who displayed a spectacular variety of scoleces (attachment organs) from seemingly hundreds of tetraphyllidean tapeworms. At breakneck speed we were treated to a *tour de force* of gut parasites that ably defined the term biodiversity in strictly tapeworm terms. Still more astonishing was the ability to have succeeded in coding such morphological variety into a character matrix of enormous utility. A number of the larger clades of flatworms were presented with a 'molecules plus morphology' approach (Ulf Jondelius, Swedish Museum of Natural History; Rod Bray, Natural History Museum; Marco Curini-Galletti, Università di Sassari; Vasył Tkach, Ukrainian Academy of Sciences; Eric Hoberg, United States Dept. Agriculture, Maryland). It seems only a matter of time before such an integrated approach is adopted or at least attempted by all. Jean Mariaux (Museum d'Histoire Naturelle, Geneva) and Jaume Bagaña (University of Barcelona) showed the leaps we can make even with a fleeting reference to morphology when animals provide few anatomical characters for analysis. Meanwhile, the utility of more complex characters such as life-history and life-cycle features was ably premiered by Tom Cribb (digeneans; University of Queensland) and Ian Beveridge (cestodes; University of Melbourne) who picked at this subject with justifiable caution. Scott Snyder (University of Wisconsin) and David Rollinson (NHM, London) led us on a journey looking at the evolution of schistosomes and incorporated molecules, morphology, biogeography and genomes. Max Telford (NHM, London) introduced the audience to the present and future delights we might expect from developmental genetics and embryology. Finally, Mark Wilkinson (NHM, London) showed the utility of a supertree approach, not only in summarizing existing knowledge on interrelationships but as a means of indicating conflict between existing scenarios.

Interspersed with a conference dinner option that is recommended to all conference organizers and it seems attendees (The Benihana on Sackville Street), we had an excellent time courtesy of the Linnean Society team led by Marquita Baird, and one that would be well suited for workers on each of the animal phyla. Just as the Arthropod Conference of 1997 resulted in a book we too will be amassing

selected manuscripts that should see the light of day in 2000.

Dr Tim Littlewood

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References:

1. Ruiz-Trillo, I. et al. (1999). Acoel flatworms: Earliest extant bilaterian metazoans, not members of Platyhelminthes. *Science*, 283, 1919-1923.
2. Ehlers, U. (1985). *Das Phylogenetische System der Plathelminthes*. Gustav Fischer, Stuttgart.

M

Under the microscope—Plant anatomy and systematics

This conference was held on September 9th and 10th 1999 at the Linnean Society of London, organised by Paula Rudall, Peter Gasson and Mary Gregory (Royal Botanic Gardens, Kew), together with Marquita Baird and John Marsden of the Linnean Society. Funding from the Systematics Association paid for two delegates from South Africa to give papers; these people were well received and would not otherwise have been able to attend. Altogether there were 24 oral presentations, including a mixture of students and established researchers from various countries; also several posters were displayed in the library. Although the underlying theme was systematics, the subject matter ranged from ultrastructure & development, to surface waxes, wood anatomy, flower anatomy, leaf anatomy, fruit and seed anatomy and palaeobotany. The focus was on angiosperms, but there were also papers on cycads and various extinct fossil plant taxa. This conference was timely because the role of plant anatomy in systematics has seen a recent revival, particularly in Flowering Plants, and especially with the new impetus brought about by molecular analyses and the high congruence between phylogenetic signals provided by molecules and micromorphology.

The conference was planned to mark the retirement of David Cutler from his post as Head of the Plant Anatomy Section, Jodrell Laboratory, Royal Botanic Gardens, Kew, in August 1999. Several tributes were paid to David during the conference, and he was awarded a Special Gold Medal of the Linnean Society and honorary life membership of the International Association of Wood Anatomists (IAWA) at the business meeting.

Some of the papers presented at the meeting will be published as a special issue of the Botanical Journal of the Linnean Society planned for next year (2000).

Dr Paula Rudall

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Book Reviews

Life on Earth

Five Kingdoms. An Illustrated Guide to the Phyla of Life on Earth (3rd edition, 1998) L Margulis and KV Schwartz. WH Freeman and Co, 520 pp. £25.95 paperback; ISBN 0-7167-3027-8

Human perspectives on the biological world have always been conditioned by our size. The relatively rare big organisms, the cows and oak trees and mushrooms of our everyday experience, have always attracted disproportionate attention compared to the crawling multitudes of “bugs” under our feet or the legions of even smaller organisms which entirely escaped our notice until the invention of the microscope. Nowhere has this bias been more obvious than in our schemes of classification. As the big organisms appeared to divide naturally into animals (which ran away) and plants (which did not), the living world was for many centuries simply split into these two kingdoms. This arrangement proved astonishingly durable, even in the face of mounting evidence for the diversity and disparity of unicellular organisms, algae, and fungi; despite the efforts of pioneers like Haeckel, Copeland, and Whittaker, popular books continued to shoe-horn ciliates, amoebas, and other motile non-photosynthetic forms into “animals”, while algae, fungi, and lichens were with equally slender justification labelled as “plants”. The first edition of *Five Kingdoms*, published in 1982, was a turning point in the struggle to replace this unnatural taxonomic straitjacket with a more realistic perception of biological diversity. Now, Margulis and Schwartz present the third edition of this seminal work.

The layout of the book is commendably simple and accessible. After a brief introductory section covering the history of taxonomy, the justification for the five-kingdom system (Bacteria, Protoctista, Plantae, Animalia, Fungi) adopted in the book, and a guide to natural history museums and parks with palaeontological dioramas (nationally of world-wide coverage but heavily biased towards the United States), *Five Kingdoms* settles down into a kind of illustrated catalogue of life. Ninety-six phyla are described and illustrated in turn, each accompanied by a list of representative genera and a stylised landscape drawing, showing the environments in which the phylum may be encountered. Each kingdom is prefaced with a short section discussing its unifying characteristics. The book closes with a bibliography, a classification, and an extensive glossary.

The extraordinary diversity presented by *Five Kingdoms* ought to be a revelation even to the most blasé reader. The animals, plants, and fungi get their due, by all means, but the real eye-opener is at the single-celled end of the spectrum. Here, on page after page, are the Euryarchaeota, Saprospirae, Aphragmabacteria, Thermotogae, Dinamastigota, Xanthophyta, slime nets, diatoms, radiolarians, etc., the true core of life on Earth, organisms which never feature in wildlife documentaries or the conservation debate but which form the real underpinnings—and indeed the bulk—of the global ecosystem. It is remarkable, with this sheer volume of material, that the style of the text remains consistently engaging;

the authors project not only interest, but a kind of wry affection for these marvellously weird little organisms.

Does the book have any flaws? Yes, a few. Although phylogenies, particularly molecular phylogenies, are discussed quite frequently, the roots of the book still very obviously lie in an older and less rigorous approach to systematics. It is telling that, while “phylogenetics” has several citations in the index, “cladistics” does not appear at all. Perhaps as a consequence of this, the emphasis on delineating natural monophyletic groups, which characterises modern systematics, is not much in evidence in *Five Kingdoms*. This is a pity because monophyly is not merely some shibboleth of modern “phylogenetic correctness”; monophyletic groups have unique unifying characteristics and therefore carry information about the organisms contained within them. A statement such as “The phaeophytes [brown algae]... are the largest protoctists” (p.160) is meaningless because a group Protoctista, defined to include the phaeophytes, has no phylogenetic coherence and no unique defining characteristics whatsoever. On a smaller scale, the taxonomic subdivision of the vertebrates contains several inaccuracies (the correct group name for the lungfishes is “Dipnoi”, not “Choanichthyes”, and both they and the land vertebrates belong within the Osteichthyes). Among plants, “Psilophyta” is a now obsolete rag-bag term for primitive fossil land plants like *Rhynia* and *Psilophyton*. The living *Psilotum* and *Tmesipteris* form the Psilotales and are not closely related to these fossil taxa.

However, despite these failings, *Five Kingdoms* is a wonderful book. I doubt whether any other text on the market gives such a clear, concise, and comprehensive picture of the diversity of life. It should be compulsory reading for every biology undergraduate and school science teacher and ought to find a home on the bookshelf of anyone with a serious interest in biodiversity.

Dr. Per Erik Ahlberg

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Editor's note: This review appeared in *BioEssays* (1999, 21, 533-534), Copyright © 1999 John Wiley & Sons. It is reprinted here with the kind permission of Wiley-Liss, Inc., a division of John Wiley & Sons, Inc.

Logic & Evolution

Some critical remarks on Colin Patterson's *Evolution*, Second Edition.

Logical faults in Patterson's book were pointed out after the publication of the 1st edition, but his illness and untimely death prevented correction in the 2nd edition. These critical remarks are made in the spirit of “a good thing is always worth trying to improve”.

Section 14.2 contains two arguments which should either be modified or removed.

1. Page 118, line 3, “One answer to the question ‘Which are the fittest?’ might be...”, and Patterson presents a circular argument leading to a tautology. It should be replaced by the linear argument “The fittest



are those organisms which are sufficiently well adapted, or 'fitted' to their environment to reach sexual maturity and reproduce". This linear argument correctly represents Darwin's notion of natural selection, which the circular argument does not. In addition "Survival of the fittest" is Herbert Spencer's formulation of Darwin's notion of natural selection: it is just a slogan, and nowhere does Darwin use it.

2. Page 118, lines 6 to 12, Patterson claims, line 6, that the following argument, lines 7 to 12, is deductive. It is presented as a syllogism, but the structure corresponds with none of the 19 valid syllogisms of Aristotle and the scholastics. In fact it violates several basic rules, two of which are given below.

☞ Rule. A syllogism should consist of 3 propositions, 2 of which are premises and the other the conclusion. Patterson has 3 premises, while the conclusion is another whole argument.

☞ Rule. A syllogism should have 3 terms each of which appears twice, 1 of which is the middle-term which does not occur in the conclusion. Patterson's argument has 2 middle-terms both of which appear in the 'conclusion'.

Violation of just one of these rules is enough to render the argument logically invalid and, therefore, not deductive.

Patterson says "...if statements 1-3 are true, so is statement 4". In fact 4 is logically independent of 1-3, so that all may be true; and 4 might just be contingently true, but not as an implication from the 3 premises.

I have tried to re-cast the argument in the 'if-then' form of the Propositional Calculus, but without success. Neither will it fit into either of the two forms of the Sorites—Aristotelian and Goclenian.

Further objections

1st. proposition "All organisms must reproduce". Some organisms, due to genetic failure, are not fertile and cannot reproduce. There is no "All" or "must" about it, it is entirely contingent.

2nd proposition "All organisms exhibit hereditary variation". I am worried about the word 'hereditary'. Variation stems from the initial combination of genes at fertilisation. How can that combination be inherited from parents? Each 'gene shuffle' produces a new combination.

3rd proposition is too vague and needs recasting, say, "Some variants may not reach sexual maturity and reproduce."

The 'conclusion' "...and organisms will change" does not follow deductively from the previous 2 lines. Natural selection, in a stable and unchanging environment, will select for no change.

Line 22. The introduction of Freudian psychology and astrology is just re-cycled Popperian propaganda without attribution, and it is irrelevant.

The last sentence in section 14.2 is false. Natural selection can, in principle, be experimentally tested and falsified. That it would be extremely difficult is irrelevant to the logic of hypothetico-deductive testing. It is intrinsically possible, so it is not protected from falsification. But, yes, it would be difficult.

Section 14.3 continues at an astonishingly naive level of understanding of science and the philosophy of

science. Surely 'dumbing-down' is not required in a publication with the pretensions displayed in the introduction. And what has the 'Creator' got to do with it?

Recommendations. The minimum modification required is removal of the word 'deductive' in line 6, and replacing it with something like 'cogent' or 'persuasive'. If the main argument stops pretending to be a syllogism, then it can be set out in normal English sentences, which could be very persuasive, even without the full support of deductive process.

Patterson's attempt to 'prove' that evolution must have occurred by natural selection, is valiant; but it does not work, for evolution by natural selection is neither logically necessary *de dicto*, nor physically necessary *de re*. Evolution by inheritance of acquired characteristics is logically possible, but it just happens not to be the case in the real world. The matter is contingent and settled by empirical observation, not by deductive process. My case against Patterson is not with the substance of his argument, with which I agree almost totally, but with his claim that it is deductive and necessary, for I see this as a dangerous attempt to return to metaphysics. For all its short comings, empiricism is the safe and sure route to scientific progress; and that, I suppose, nails my colours to the mast.

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The Encyclopedia Britannica deals effectively with both systems of logic.



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