

### Insects

#### **1. Segments and parasegments, By Jean S. Deutsch**

The monophyly of the Arthropoda is at present generally admitted. Extant arthropods comprise four main groups, Chelicerata, Crustacea, Hexapoda and Myriapoda. The phylogenetic relationships between these groups have recently been reconsidered, and are still **debated**. Page 1117

The monophyly of the 'Myriapoda' (millipedes and centipedes and their kin) is still **debated**. Page 1119

#### **2. The centipede *Strigamia maritima*, By Wallace Arthur**

The order contains many extant families. The internal phylogeny of the order is poorly understood, but some recent studies have made a start on addressing this problem. Page 654

There has been much **debate** over the evolutionary importance of this phenomenon, but this **debate** has been hindered by a lack of information on the mechanisms underlying apparent instances of constraint/bias. Page 655

#### **3. Development and phylogeny of arthropods, By Pat Simpson**

It addressed ways to resolve the still uncertain relationships between the different groups of arthropods and featured talks discussing phylogeny and comparative developmental biology. There seems to be a general consensus that insects and crustaceans are probably sister groups and there is a suggestion that myriapods (millipedes and centipedes) are related to insects and crustaceans. However, the position of the Chelicerates (spiders, scorpions, horseshoe crabs) is still under **debate**. Page 223

#### **4. Stalk-eyed flies, By Ian Warren**

The phylogenetic subgroups of the Brachycera have been much **debated** but there is general agreement that the Cyclorhaphora, flies that develop from a pupa enclosed in a modified form of the last larval cuticle or puparium form a monophyletic group with its origins in the late Triassic. Page 300, 301

#### **5. Spider models, By Alistair P. McGregor**

Phylogenetic relationships of selected extant arthropod taxa. Note that the higher order relationships of the arthropod classes are **debated**. Page 488

#### **6. Arthropod Evolution, By D. Osorio**

Insect and crustacean lineages diverged over 500 Myr ago, and there are continuing uncertainties about whether they evolved from a common arthropod ancestor or, alternatively, they evolved independently from annelid worms. Page 419

The evolutionary origins and diversification of the Arthropoda are the subject of continued **debate**, recently enlivened by studies of the arthropod radiation during the mid-Cambrian period. Arguments about evolutionary relationships between the main arthropod groups, and whether the Palaeozoic lineages that survived and prospered were fundamentally fitter than those that perished, have not been resolved by palaeontology or by classical comparative anatomy and embryology. Page 419

#### **7. Molecular phylogeny, By Jerome Albre**

In this genus, composed of around 100 mountain species, the *Erebia tyndarus* complex has certainly been a major source of **debate** for more than a century. Page 196

The status of sibling species among the Lepidoptera is actually matter of **debate**, some authors advocating an important reduction of so-called "good species." Page 196

#### **8. Isolation and phylogeny, By Tim Verslycke**

The relative positioning of the ecdysozoans (e.g., insects) and lophotrochozoans (e.g., bivalves) within metazoan phylogeny remains the subject of active **debate**, both based on molecular and morphological approaches (Glennier et al., 2004). Page 769

### **9. Phylogeny of acariform mites, By Mirosława Dabert**

Despite their importance, it is still not clear if this marvellous acarine diversity derives from a single ancestor or if “a mite-style” body plan originated independently from two or more arachnid ancestors (for review see Dunlop and Alberti, 2008). Page 222

The phylogenetic affinities among these lineages and their taxonomic consequences, especially the origin of the vast cohort Astigmata, are a subject of widespread and unfinished **debate**. Page 223

Sparse molecular phylogenetic reconstructions of relationships among main groups of Acariformes have given surprisingly contradictory results. Page 223

### **10. Molecular phylogeny and diversification, By Marco Trizzino**

However, and despite their obvious relevance, our understanding of the phylogeny and biogeography of many of the large groups that could be considered most representative of the evolutionary processes leading to the current diversity is very incomplete. Page 1

### **11. Phylogeny of the Genus *Rhagoletis*, By James J. Smith**

Despite a considerable literature describing the biology of flies in the tephritid genus *Rhagoletis*, the phylogenetic relationships of the more than 60 species classified within the genus are not well resolved. Knowledge of these relationships is important, not only in terms of obtaining information that will be useful for the control of *Rhagoletis* where it is an agricultural pest, but also in determining what role host plant shifts have played in the generation of *Rhagoletis* species diversity, a focal point in **debate** over the role of sympatric speciation in the evolutionary process. Page 33

### **12. The phylogeny of acorn weevils, By Joseph Hughes**

In general, phylogeny reconstruction is faced with the difficulty of how to combine multiple data. Page 612

### **13. Mesozoic-aged Eremoneuran Diptera, By John K. Moulton**

Mesozoic-aged divergences (65–250 mya) are a major hurdle for molecular systematists inferring arthropod relationships because few currently available markers adequately track these events (Friedlander et al., 1992, 1994; Hillis and Dixon, 1991; Wiegmann et al., 2000). This is particularly true if the divergences occurred in rapid succession, i.e., as an explosive radiation (Fishbein et al., 2001). Page 363

### **14. The phylogeny of flies, By John K. Moulton**

The greatest degree of concordance among the competing classifications/phylogenies exists between those of Chvala (1983) and Moulton and Wiegmann (2004). Moulton and Wiegmann (2004) recovered trees largely concordant with Chvala's (1983) empidoidean classification, with the exception being that Chvala inferred Atelestidae to be the sister group to Cyclorrhapha. Page 702

### **15. Earth-boring dung beetles, By Regina L. Cunha**

Phylogenetic relationships within the family are based exclusively on morphology and remain controversial. Page 578

Although earth-boring dung beetles are fairly represented in the fossil record (Krell, 2007) there is no information regarding lineage-splitting events within the family that lead to current species diversity. Page 578

Few studies have focused on Geotrupidae, and phylogenetic relationships among earth-boring dung beetles remain poorly understood. Thus far, phylogenetic studies on Geotrupidae have been mostly based on morphological data, and rendered poorly resolved or even contradictory results. Page 579

Phylogenetic relationships within Geotrupidae have been a long-standing **debate** encouraged by the wealth of conflicting evolutionary proposals based on morphological studies. Page 581

### **16. North American admiral butterflies, By Sean P. Mullen**

Within North America, the Viceroy (*L. archippus*) is the basal lineage while the relationships among the remaining species are not well resolved. Page 747

Unfortunately, the utility of this group of butterflies as a subject of speciation research has been limited by the lack of a well-supported phylogenetic hypothesis. Page 748

However, without knowledge of the phylogenetic relationships between the two continental faunas of these butterflies, it is difficult to assess this hypothesis. Page 749

Given the widespread confusion regarding phylogenetic relationships among species and genera within the subtribe Limenitidini, it is clear that there is a need for further revisionary taxonomic work of the Palearctic members of the genus *Limenitis* and other closely related groups. Page 757

### **17. African *Dacus*, By M. Virgilio**

Regardless these efforts, the phylogenetic relationships among *Dacus* species remained largely unresolved mainly because of the difficulties in assigning homologous character states. Page 531

The comparisons between the molecular phylogeny and the morphological classification revealed a number of discrepancies and, in the vast majority of cases, the molecular data were not compatible with the monophyly of the currently recognised subgenera. Page 531

Conversely, disagreement between molecular phylogeny and morphospecies taxonomy could provide the starting point of a **debate** towards a more consistent classification. Page 532

### **18. A phylogenetic revision of the *Glaucopsyche*, By L. V. Ugelvig**

Despite much research on the socially parasitic large blue butterflies (genus *Maculinea*) in the past 40 years, their relationship to their closest relatives, *Phengaris*, is controversial and the relationships among the remaining genera in the *Glaucopsyche* section are largely unresolved. Page 237

The relationships between these genera are poorly known, and were not well resolved in a previous molecular phylogeny that included representatives of ten of the genera (Als et al., 2004). Page 238

### **19. Hennig's orphans revisited, By Isaac S. Winkler**

The composition of this group and relationships among included families have been controversial. Page 746

Determining phylogenetic relationships among families in this assemblage is arguably the most difficult problem in the systematic of Diptera (McAlpine, 1989), and a consensus classification has not yet been achieved. Page 746

The limits, composition and phylogenetic relationships of the remaining superfamilies have been historically more problematic. Page 746

Relationships among "acalyprate" flies are notably difficult because of their large diversity and the high level of homoplasy observed in most studied character systems. DNA sequence data have proven to be no exception to this latter difficulty. Page 756

Because both molecular and previous morphological hypotheses are subject to this random error and generally poorly supported, it is difficult to evaluate the accuracy of many relationships presented here. Page 757

### **20. Placement of *Conopidae*, By Joel F. Gibson**

The question of how *Conopidae* is related to the remaining schizophoran families, however, has been the source of some **debate**. Page 91

### **21. Gall-forming aphids, By M. Inbar**

One of the most striking characteristics of gall-forming insects is the variability in gall position, morphology, and complexity. Our knowledge of the driving forces behind the evolutionary divergence of gall types is limited. Page 504

Finally, an alternative scenario proposes that gall morphologies radiated with no adaptive value for the insects. Page 505

### **22. Phylogeny of the higher *Libelluloidea*, By Jessica Ware**

Although libelluloid dragonflies are diverse, numerous, and commonly observed and studied, their phylogenetic history is uncertain. Page 289

While it is clear that a well-supported phylogenetic hypothesis is needed in order to reach an understanding of the evolution of these traits, phylogenetic relationships among libelluloid families remain highly contentious, with numerous hypotheses proposed (Fig. 1 and Table 1). Page 290

### **23. Phylogeny of the orchid bees, By Alice Michel-Salzat**

Despite previous phylogenetic studies of on morphological characters, the relationships among the five euglossine genera remain under **debate**. Page 309

Without fossils, this remains speculative. Page 320

### **24. Phylogeny and Bayesian divergence, By Shaun L. Winterton**

The lack of external corroborative evidence from fossils for Cretaceous-aged divergences weakens our hypothesis of relationships and ages for weakly supported nodes at the base of Panopinae and Acrocerinae (partim). For improved estimates of phylogeny and divergence times in acrocerids it is equally important to both increase the taxon sampling for DNA sequence data in these clades, and to discover intermediate aged fossils of Acroceridae to provide corroborative evidence of ages. Page 830

### **25. Ribosomal protein genes, By Stuart J. Longhorn**

The phylogenetic relationships among holometabolan insect orders remain poorly known, despite a wealth of previous studies. In particular, past attempts to clarify the sister-group of the enigmatic order Strepsiptera with rRNA genes have led to intense **debate** about long-branch attraction (the ‘Strepsiptera problem’), without resolving the taxonomic question at hand. Page 846

There is little consensus on the phylogenetic relationships among holometabolan orders from morphological data (Kristensen, 1991, 1999) (Fig. 1A and B). Page 846

Hypothetical relationships of holometabolan insect orders from various types of data. Page 847

### **26. Microgastrine wasp genera, By Jonathan C. Banks**

Uncertainty in phylogenetic estimation at higher taxonomic levels is inevitable, due to the confounding effects of factors that may indicate alternative patterns. Page 690

### **27. Primate sucking lice, By Jessica E. Light**

Oftentimes, host data (e.g., molecular, morphological, or fossil data) are insufficient to resolve certain aspects of host history and in these cases data from a cospeciating parasite may provide vital information that can be used to infer events in host evolutionary history. Page 376

### **28. Molecular phylogenetics of the spider family, By Michael G. Rix**

The spider family Micropholcommatidae is an enigmatic taxon of uncertain limits and uncertain affinities. Various phylogenetic hypotheses have been proposed for the family, but these hypotheses have never been tested with a robust phylogenetic analysis. The existence of similar Australasian and New World taxa, the possibility of morphological convergence associated with extreme ‘smallness’, and the apparent paucity of synapomorphic morphological characters, have all clouded generic relationships in this group. Page 1031

Alternative hypotheses proposed for the phylogenetic position of the Micropholcommatidae. Page 1033

Methodological comparisons are central to systematic biology, and have traditionally generated much **debate** and little consensus. Parsimony, likelihood and Bayesian methods each bring a set of assumptions, benefits and recognised problems to the issue of phylogenetic inference. Page 1045

### **29. Phylogenetic multi-locus codon, By James S. Patterson**

The **debate** over the monophyly of triatomine bugs and the temporal origin of triatomine bugs are linked and could be used to assess the vicariance of Gondwanaland breakup, or test whether the date of the molecular clock is accurate. Page 609

The genetic and morphological similarity between the Reduviinae and Triatominae, around which the monophyly **debate** rests, raises an important evolutionary question: why was haematophagous behaviour unable to evolve prior to the formation of South America in comparison to their immediate ancestors such as *Opisthacidus* spp. and *Zelurus* sp.? Page 620

### **30. Domestication of olive fly, By F. Nardi**

The origin and ancient history of the olive tree is still matter of **debate**, but its basal diversification occurred most likely following the aridification of African midlands at the beginning of the Pliocene. Page 678

Mitochondrial sequences have been exploited extensively to study evolutionary processes at the species level (Avice, 2000; Zink and Barrowclough, 2008 for a recent **debate**). Page 679

### **31. Family level relationships of tarantulas, By Nadia A. Ayoub**

Although gaps have been shown to be phylogenetically informative (e.g., Johnson and Soltis, 1995; Baldwin and Markos, 1998; Giribet and Wheeler, 1999), there is **debate** over the best method for including gaps in phylogenetic inference. Page 398

### **32. Dragonfly Genera Libellula, By Thomas Artiss**

Considerable **debate** exists over several relationships within Libellula, as well over the status of two putative genera often placed as subgenera within Libellula: Ladona and Plathemis. Page 348

### **33. Relationships among the Braconidae, By Kevin M. Pitz**

Phylogenetic relationships among the Braconidae have been a source of contention, **debate**, and uncertainty for many years. This uncertainty has been evident in the conflicting relationships and lack of resolution obtained from various morphological (van Achterberg, 1984; Quicke and van Achterberg, 1990; Wharton et al., 1992) and molecular datasets (Dowton et al., 1998; Belshaw et al., 1998; Dowton et al., 2002). Page 338

### **34. Insect Order Hymenoptera, By James N. Derr**

The parasitoids belong to at least nine currently recognized superfamilies whose relationships and composition are the subject of some **debate** (Konigsmann, 1978a; Rasnitsyn, 1980, 1988; Naumann and Masner, 1985; Gibson, 1986; Gauld and Bolton, 1988). Page 136, 137

### **35. Polyphyly of the Zaprionus, By Amir Yassin**

This issue is still under **debate** among world Drosophila researchers (e.g., McEvey et al., 2008; O'Grady et al., 2008; Prigent, 2008; Yassin, 2008; Dalton, 2009) and consideration of the Commission. Page 338

### **36. Southern Appalachian opilionid, By Steven M. Thomas**

Although the inter-relationships and monophyly of certain opilion subgroups is an area of **debate** and active research, Laniatores monophyly is universally accepted (reviewed in Giribet and Kury, 2007). Page 646

### **37. Relationships among Bactrocera, By Paul T. Smith**

The issue of whether to combine data sets in phylogenetic analysis is a subject of much **debate** (e.g., Bull et al., 1993; De Queiroz, 1993; De Queiroz et al., 1995; Huelsenbeck et al., 1996; Nixon and Carpenter, 1996), and no clear consensus has emerged. Page 13

### **38. Libelluloid dragonflies, By Jessica L. Ware**

The two topologies differ in their placement of Corduliidae and Macromiidae, whose mutual relationships with Libellulidae were unresolved in a previous analysis by Ware et al. (2007) and have been the subject of considerable **debate** (see Ware et al., 2007 for a detailed review). Page 428

### **39. The genus Drosophila, By Amir Yassin**

Deciding where to draw the line in species diagnosis and delimitation is akin to the "lumping and splitting" **debate** that continues to frustrate traditional taxonomists. Page 510

### **40. Rocky Mountain grasshopper, By W. Chapco**

This viewpoint has subsequently led to some heated **debate** concerning the species status of *M. spretus* and the species-defining value of genitalic characters (Cohn, 1994; Lockwood, 1996). Page 810

### **41. The Chagas disease vector, By Fernando A. Monteiro**

However, while contingency table analysis is statistically robust, the accuracy of the conclusions drawn using the inference key is still subject to **debate** (Knowles and Maddison, 2002). Page 54

### **42. Queens of the Little Fire Ant, By Olivier Rey**

However, the short-term advantages of sexual reproduction remain a matter of **debate**, and asexuality appears to emerge easily and independently from sexual lineages (Simon et al. 2003). Page 2591

### **43. Regulatory Regions of Drosophila Genes, By Michael H. Kohn**

The role that natural selection may play in shaping patterns of polymorphism and divergence of protein encoding sequences has been a long-standing issue of **debate** (Kimura 1968; King and Jukes 1969; Ohta 1973; Nei 1987). Page 374

### **44. Support for the Ecdysozoa Hypothesis, By Lars Podsiadlowski**

The ongoing Articulata/Ecdysozoa **debate** is in need of additional ground pattern characters for Panarthropoda (Arthropoda, Tardigrada, and Onychophora). Page 42

Here, we compare the onychophoran mitochondrial gene order with that in other Bilateria and perform a sequence-based phylogenetic analysis, which contributes to the ongoing Articulata/Ecdysozoa **debate**. Page 42

### **45. Genome of the House Centipede, By Enrico Negrisolo**

Although there is almost unanimous consensus on the monophyly of the phylum (Giribet and Ribera 2000), there is also hot **debate** about the phylogenetic relationships among the four main arthropodan lineages: chelicerates, myriapods, crustaceans, and hexapods. Page 770

### **46. History of Drosophila buzzatii, By Hafid Laayouni**

There is, however, little consensus about the extent or importance of genetic interactions in the evolutionary process after more than half a century of **debate** (Whitlock et al. 1995). Page 931

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