

Plants

1. When Clocks Collide, By Christopher A. Brochu

Other conflicts have received less attention but remain no less perplexing, such as the origin of angiosperms (Doyle, 1998; Wikstrom et al., 2001) and gaviatoid crocodylians (Brochu, 1997; Harshman et al., 2003). These have remained robust to improved data sets and techniques—the more we look at fossils, molecules, or algorithms, the stronger the disparity seems to grow. Page 1.

2. Morphologic Evolution, By Michael Knappertsbusch

After splitting events there is a considerable amount of gradual change involved in the evolution of *C. leptoporus* morphotypes, which suggests a more complex phylogenetic model than punctuated equilibrium or phyletic gradualism alone. Page 725

3. Photosynthetic evolution, By Ralph A. Bungard

After all, the chloroplast itself is an ancient remnant of once free living cyano bacteria whose structure, function and genome has been winnowed down and modified to such an extent that its precise phylogenetic origins are still under **debate**. Page 235

4. Classification of *Frullania Raddi*, By Jörn Hentschel

Whereas the general circumscription of *Frullania* is without controversy, the position of a few species with aberrant morphology is subject to **debate**. Page 148

5. Macaronesian endemics, By Ruth Jaén-Molina

Our molecular data allowed us to assess some taxonomic treatments of the Macaronesian taxa based on morphological features alone that have stirred **debate**. Page 979

6. *Eucalyptus* (Myrtaceae), By Dorothy A. Steane

As a result of these factors, reconstructing the phylogenetic history of *Eucalyptus* species has been problematic for systematists, even with the application of molecular techniques. *Eucalypt* researchers have tested a range of molecular techniques (see below), but none has proven to be suitable for resolving relationships among closely related species within sections or between closely related sections. Page 206

There has been considerable **debate** about how well single-gene phylogenies reflect species phylogenies (see Liu et al. (2009) and references therein) and researchers have often lamented the lack of an efficient method of whole-genome phylogeny reconstruction. Page 218

7. Diversification of mangrove fauna, By D. G. Reid

For mangrove littorinids the fossil record is equally old, but there is conflicting phylogenetic evidence for an ancestral habitat on either rocky shores or mangroves. Page 186

8. Fast evolution, By Jin-Hua Ran

However, in recent years, extraordinarily high substitution rates have been documented from mtDNA of several angiosperm genera, such as *Pelargonium* (Palmer et al., 2000; Parkinson et al., 2005; Bakker et al., 2006), *Plantago* (Cho et al., 2004; Bakker et al., 2006), *Silene* (Städler and Delph, 2002; Houliston and Olson, 2006; Barr et al., 2007; Mower et al., 2007; McCauley and Ellis, 2008; Sloan et al., 2008), and *Acorus* (Mower et al., 2007), intensifying the **debate** on the evolution of plant mtDNA. Page 136

However, the monophyly of conifers is still controversial due to the conflicting results among various molecular studies, especially with regard to the relationship between Pinaceae and Gnetales. Page 146

9. Phylogeny of the Polytrichales, By Jaakko Hyvoonen

At the moment it seems that none of the morphological characters is a very good indicator of phylogeny, since all of them show considerable homoplasy. Page 924

10. Major clades of parmelioid lichens, By Oscar Blanco

The phylogeny and classification of parmelioid lichens has been a matter of **debate** for several decades. Page 52

The morphology and physiological effects of these pores have been studied intensely during the last decades (Beltman, 1978; Green et al., 1981, 1985; Hale, 1973, 1981; Lumbsch and Kothe, 1992; Sancho et al., 2000; Yoshimura and Hurutani, 1987), but their evolutionary history is currently poorly understood. Page 52

11. Major clades of the Asteraceae, By Jose L. Panero

Most of the studies listed above have been unable for the most part to clarify the phylogenetic positions of anomalous or transitional genera. Page 758

If the evolutionary histories of the nuclear and chloroplast compartments in Asteraceae truly differ so extensively at the tribal relationships it would be remarkable, and could suggest an even greater role of hybridization in generating Asteraceae diversity. However, this interpretation of the incongruence between these nuclear and plastome topologies is confounded by other factors that can lead to conflicting phylogenetic signal, namely sampling error and homoplasy arising from the assessment of sequence orthology as well as nucleotide substitution saturation. Page 774

However, the position of Stifftioideae is still equivocal and the phylogenetic relationships among the three main lineages of the Cichorioideae are still problematic. Page 775

12. Carnivorous plant genus *Genlisea*, By Andreas Fleischmann

So far, reliable relaxed-clock estimates for the age of Lentibulariaceae have been hampered by both the absence of useful fossil calibration points and the uncertainty with respect to the phylogenetic position of the family within Lamiales. Page 780

13. Origin of Macaronesian *Sideritis*, By Janet C. Barber

Numerous hypotheses of taxonomic relationships in *Sideritis* have been proposed over the years, including a variety of sectional and subgeneric circumscriptions and even the segregation of the Macaronesian taxa as a separate genus, *Leucophaea* (Kunkel, 1973; Webb and Berthelot, 1845). Page 295

Few clear-cut morphological characters delimit subgenera and sections and there has been particular disagreement over sectional circumscription of the relatively few annual species. Page 295

Explanations for the woody nature of oceanic island plants have differed. Page 303

14. Ancient extant seed plant *Cycas*, By Long-Qian Xiao

An important and often **debated** issue is the effect of ITS pseudogenes on phylogenetic inferences. Page 169

Although the evolutionary relationships among these are **debated**, cycads are likely the earliest diverged gymnosperm lineage (e.g. Chaw et al., 2000), because their mature pollen has multi-ciliate sperms and their ovules are borne on the margins of leaf-like megasporophylls (Stevenson, 1990). Page 169

This suggests that the phylogenetic analysis can provide some insights into the evolution in *Cycas*. However, the currently **debated** evolutionary relationships and delimitations of intra-generic taxonomic units cannot be addressed here, because a too small sample size (only 6 out of about 90 species) was sampled. Page 176

15. The sectional level in *Eucalyptus*, By Fiona S. Poke

Understanding evolutionary relationships among eucalypts is difficult because of the diversity of the genus (includes approximately 700 species) and the propensity for inter specific hybridisation (Griffin et al., 1988). As a result, there has been much **debate** about the taxonomy and phylogeny of the genus. Page 160

In conclusion, phylogenetic analysis using a single copy nuclear gene, CCR, was unable to resolve three sections of *Eucalyptus* into monophyletic groups, similar to previous studies using nrDNA. Page 169

16. Origins of vivipary and salt secretion, By Suhua Shi

The most remarkable morphological specializations of mangroves are vivipary, salt secretion, and aerial roots. There has been a long **debate** on whether the complex traits vivipary and secreters have a single origin, the answer to which has profound implications for the mechanism of evolution in mangroves. Page 159

Although we are in favor of the multiple origin hypothesis for both vivipary and salt secretion based on our analysis, we realize the final conclusion will depend much on the knowledge about the rate of loss and gain of these characters, which cannot be resolved by the sequence data presented in this study. Unfortunately such information is scarce either from molecular biology or plant physiology. Page 164

17. Phylogeographic patterns, By Heidi M. Meudt

Despite recent systematic studies, many important questions remain regarding taxonomy, biogeographic patterns, and character evolution within the Hebe complex. Page 320

18. Relationships within Cornales, By Qiu-Yun Xiang

Cornales traditionally represented one of the systematically most problematic groups of flowering plants. The systematic **debate** largely centered on the circumscription and relationships of the core member, Cornaceae (for reviews see Eyde, 1988; Xiang and Soltis, 1998; Xiang et al., 1993). Page 36

This lack of strong support for basal nodes of the phylogenetic trees (or relationships among major lineages) suggests either conflict in characters or insufficient information in the sequence data to solve deep relationships within the Cornales. Page 54

19. Phylogenetic relationships of Ruteae, By Gabriele Salvo

The different types of datasets were partly incongruent with each other. The discordant phylogenetic patterns between the phytochemical and molecular trees might be best explained in terms of convergence in secondary chemical compounds. Page 736

More generally, the choice of characters for phylogenetic analysis has been a crucial and controversial issue in systematics (e.g., Hart et al., 2004; Stace, 2005) and the relative role of molecular and morphological data in reconstructing phylogenies has been extensively **debated** (Hillis, 1987; Patterson, 1988; Sytsma, 1990; Donoghue and Sanderson, 1992; Novacek, 1994; Baker et al., 1998; Wahlberg and Nylin, 2003; Wortley and Scotland, 2006). Directly linked to character choice is the controversy about combined versus separate analyses of different datasets (Bull et al., 1993; de Queiroz et al., 1995). Page 736

20. Sorting wheat from chaff, By M. Virginia Sanchez-Puerta

Studies of molecular data have partially clarified the pattern of plastid acquisition and transfer; complete plastid genomes provide support for some clades, although resolution of other phylogenetic questions is less clear, and different studies have at times reached conflicting conclusions. As with any comparison of phylogenetic analyses, such conflict may represent a biological phenomenon or an analytical artifact. Page 885

In addition, a heated **debate** exists regarding the relative importance of taxon sampling and site sampling in phylogenetic analyses, while limited resources force compromises between the number of genes and taxa included in any analysis (Graybeal, 1998; Rokas and Carroll, 2005; Rosenberg and Kumar, 2001; Soltis et al., 2004). Page 892

21. Diversification in the Andes, By Federico Luebert

However, both the timing of the major stages of the Andean uplift and the onset of aridity in western South America remain controversial. Page 90

Fossil evidence encompassing the relevant periods across the western flank of the Andes is scarce. Estimation of divergence ages onto plant molecular phylogenies (Renner, 2005) has the potential to contribute to this **debate** and to provide feedback in reconstructing the history of the earth and its biota. Page 91

22. The Qinghai-Tibetan Plateau, By Jian-Quan Liu

Senecioneae, the largest tribe in the Asteraceae with 3200 species and 120 genera (Bremer, 1994), has been the subject of much **debate** with regard to its phylogenetic composition. Page 32

23. North American Psoraleaceae, By Ashley N. Egan

However, the relative utility of gap characters has been a matter of **debate**. Page 540

24. Hawaiian Dryopteris, By J. M. O. Geiger

There has been much **debate** and confusion regarding specific and subspecific classifications and in the understanding of the evolutionary relationships among the taxa, especially for the Hawaiian species (Fraser-Jenkins, 1986, 1994; Herat, 1979; Palmer, 2003; Wagner, 1993, 1995; Wagner et al., 1999a). There have also been conflicting views regarding the historical biogeography of these taxa and their origins in the Islands. Page 393

25. The red algal tribe, By Lynne McIvor

All our analyses show *Aglaothamnion* to be paraphyletic. Whether this genus is justifiable has previously caused fierce **debate** amongst algal taxonomists. Page 441

In the light of our phylogenetic analyses, the **debate** concerning whether *Aglaothamnion* and *Callithamnion* should be recognized as separate genera has been shown to be well-founded: there is no simple answer to the question. Page 443

26. Early-diverging eudicots, By Sangtae Kim

There has been considerable **debate** concerning the primitive or ancestral habit in the angiosperms, woody vs. herbaceous. Authors of modern classifications (e.g., Cronquist, 1981; Takhtajan, 1997) favored a woody ancestral condition. Page 17

27. Rates of synonymous substitutions, By Guy Drouin

The later is a significant advantage because estimating the divergence times of seed plant species is complex and still the subject of much **debate** (Soltis et al., 2002; Magallon and Sanderson, 2005). Page 827

28. Pestalotiopsis and allied genera, By Rajesh Jeewon

The taxonomic history and complexity of *Pestalotiopsis* and its allies have been **debated** for over half a century (Arx, 1981; Guba, 1955; Roberts and Swart, 1980; Steyeart, 1949; Sutton, 1969, 1980) and more recently by Nag Rag (1993). Page 379

29. Pestalotiopsis taxonomy, By Ai-Rong Liu

Morphological based classification of *Pestalotiopsis* species has always been a taxonomic **debate** over the last five decades. Page 533

30. Divergence in *Dyosma versipellis*, By Ying-Xiong Qiu

The origin of greater species diversity of vascular plant genera in eastern Asian temperate forests when compared with their sister taxa in eastern North America has been the subject of much recent **debate** (Qian and Ricklefs, 2000, 2001; Harrison et al., 2001). Page 281

31. Polarity of Gene Fusion, By Yoji Nakamura

Determining the state of fusion or fission of the gene pairs identified here in the suspectedly basal angiosperm *Amborella*, for example, where a raging **debate** exists regarding its evolutionary position because large sequence data sets give conflicting results with strong support (Goremykin et al. 2004; Lockhart and Penny 2005), may shed further light on this and other currently difficult phylogenetic issues. Page 120 **Page 65**

32. Grouping of Plant and Animal, By Gayle K. Philip

Another major **debate** concerns the relationships of three eukaryotic Kingdoms (Animalia, Plantae, and Fungi) to each other. Page 1175

33. Differentiated Sunflower Species, By Jared L. Strasburg

Interest in documenting positive selection within species and adaptive divergence between species is motivated not only by the ongoing **debate** about the relative roles of neutral and selective processes in evolution but also by the promise that identifying genes under divergent selection between species can help us to understand both gene function and the nature of adaptive phenotypic differences (Steiner et al. 2007; Barrett et al. 2008). Page 1341

34. Phylogeny of Extant Seed Plants, By Chung-Shien Wu

In the past decade, molecular data have been widely used to reexamine the traditional evolutionary schemes of seed plants but have generated an even more diverse set of phylogenetic hypotheses, especially about relationships among the 4 surviving groups of gymnosperms and the angiosperms (see also review by Burleigh and Mathews 2004). Page 1366

35. Glyceraldehyde-3-Phosphate, By James T. Harper

There are contrasting views as to whether the two green plastid lineages are related (Cavalier-Smith 1999; Archibald and Keeling 2002), and the **debate** over the origin of red plastids is thornier still. Page 1730

36. Evolutionary Innovation of Angiosperms, By Judith Nardmann

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The evolutionary relationship between higher land plants, gymnosperms and angiosperms, jointly seed plants, is still a matter of **debate**. Page 1745

37. Plastid Genome Sequence, By Hameed Khan

Biochemical and molecular data indicate that cryptophyte plastids are derived from red algae, yet the question of whether or not cryptophytes acquired their red algal plastids independent of those in heterokont, haptophyte, and dinoflagellate algae is of long-standing **debate**. Page 1832

38. Alphabets for Phylogenetic Inference, By Edward Susko

Years of controversy have surrounded the identity of the basal-most node in the angiosperm phylogeny. For instance, the placement of Amborella within the radiation of angiosperms has evoked a **debate** about the basal node in angiosperm phylogeny (Goremykin et al. 2003, 2004; Soltis et al. 2004; Lockhart and Penny 2005; Martin et al. 2005). Page 2146

This would usually be considered the correct relationship, although there has been considerable **debate**. Page 2147

39. Distance Method Adjustments, By Jihua Wu

This placement has been the source of considerable **debate** (Goremykin et al. 2003, 2004; Soltis et al. 2004; Lockhart and Penny 2005; Martin et al. 2005; Jansen et al. 2007; Moore et al. 2007). Page 2694

40. Covarion-like Evolution in Protein Sequences, By Huai-Chun Wang

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41. Genomes of the Green Algae, By Monique Turmel

In this context, it is worth mentioning that the nature of the progenitor of all green plants has generated intense **debate** and is still controversial (Melkonian 1984; O'Kelly 1992; Sym and Pienaar 1993). A better understanding of the relationships among prasinophyte lineages will be required before one can infer with confidence evolutionary scenarios of cellular changes. Page 644

42. The Placement of Mesostigma, By Naiara Rodriguez-Ezpeleta

The scaly green flagellate *Mesostigma viride* has an important place in the **debate** on the origin of green plants. Page 723

43. Stability and Oligomycin Resistance, By Marie Lapaille

In Chlorophyta, aside from the well-accepted basal position of Prasinophyceae, the relative branching order of Chlorophyceae, Trebouxiophyceae, and Ulvophyceae is still a matter of **debate**, which led us to consider three different subtrees (Pombert et al. 2004, 2005; Rodriguez-Ezpeleta et al. 2007). Similarly, unresolved relationships within Chlorophyceae (e.g., Lewis and McCourt 2004) entail three variants of each subtree, thus amounting to nine possible evolutionary scenarios. Page 1636

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