education. As a textbook, however, it now leaves much to be desired. It presumes acquaintance with atomic spectroscopy at a level posessed by lamentably few new graduate students. The detailed tabulations are less useful than they once were, since photoionization codes with better atomic data are now widely diffused through the astronomical community (though knowledge of their limitations is unfortunately not so widespread). We can hope that the next edition will include a floppy disk with such a code and a discussion of numerical techniques and sources of data.

Most seriously, the new title is misleading in its generality. Astronomy has grown enormously in the two decades since the structure of the book was laid down. Optical spectroscopy is now only a small, though still important, branch of a much broader endeavor, with equal opportunities for employment at all wavelengths. The reader will find here no mention of x-ray spectroscopy, molecular gas, or even the infrared lines so important to the study of embedded HII regions and the center of our Galaxy. There is no discussion of cooling curves, radiative shocks, multiphase media, stability of photoionization equilibria, or any of the physics of active galactic nuclei other than the state of their peripheral emission line regions. A course on (AGN)^2 in which this was the only source used would be quite imbalanced. The field urgently needs a companion volume addressing the omitted topics. Students should still read Osterbrock's book; they will just have to read it faster than did their predecessors.

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Marsupials Right Side Up

Possums and Opossums. Studies in Evolution. MICHAEL ARCHER, Ed. Published in Association with the Royal Zoological Society of New South Wales by Surrey Beatty, Chipping Norton, NSW, 1987. In two volumes. lxxxiv, 788 pp., illus., + plates. $112.

Mammals are divided into about 30 orders, among which the marsupials are usually assigned only one. In our biased way we tend to think of marsupials as inferior pouched mimics of more familiar "placental" mammals; thus we refer to Tasmanian "wolves," "rat" kangaroos, koala "bears," and marsupial "cats" and "mice." Those of us who don't hang upside down from the bottom of the earth often downgrade living marsupials to the status of primitive "living fossils" from lost worlds. But now that era is ending.

Living marsupials are exclusively American and Australasian, but they were distributed widely in the past. Only the reinvading opossums represent them now in North America, but they were present here from well back in the Cretaceous until the Miocene, and again at the end of the Cenozoic. Marsupials have been in Australasia since the Miocene or earlier. They were in Antarctica in at least the Eocene, South America in the whole Cenozoic, Europe in the early and mid-Cenozoic, and westernmost Asia and northernmost Africa in the mid-Cenozoic. They are not known from the eastern Asian mainland, where their placental sister-group has long held sway.

Some researchers think of Australasia as the marsupial center of origin, probably because familiar koalas, kangaroos, and other living Australasian marsupials are viewed as odd products of long evolution on a moving continental fragment of ancient Gondwanaland. But South America, too, was long an isolated Gondwana fragment and the site of much extinct and some living but less familiar marsupial diversity. Some claim South America to be the original marsupial turf, but marsupials are absent from the Late Cretaceous Los Alamitos mammalian assemblage from Argentina. Negative evidence can be fickle, but on that basis I doubt if marsupials were cryptic South American residents in much if any of the Late Cretaceous. Arrival there in the earliest Paleocene from a source outside of South America makes more sense.

For *Possums and Opossums*, Michael Archer assembled a who's who of researchers to write two idea-filled volumes. The work is an intellectual feat that will convince anyone reading it that marsupials are amazingly diverse. It is a massive update of our knowledge of many groups of marsupials, not just possums (phalangeroids) and opossums (didelphids) as implied. The pace of reported discovery of extinct groups has accelerated greatly, sometimes in spectacular spurts as at the now famous Riversleigh Station sites in northwestern Queensland. Obviously, marsupials deserve to be assigned more than one mammalian order (eight are advocated in *Possums and Opossums*) and constitute fertile ground for new comparative analysis. Archer's volumes are a celebration of that. Their major thrust is toward unscrambling the phylogenetic history behind the diversity. Most of the authors have employed cladistic methods to hypothesize relationships, teasing apart raw similarity into what they take to be shared-primitive, shared-derived, and convergently similar characters.

Volume 1 deals with non-Australasian marsupials, begins coverage of Australasian ones, and contains several weighty but partially conflicting general reviews. The conflicts reveal much about how science works, warts and all. Three superb papers on sperm structure add to the fascination. Volume 2 is primarily a collection of descriptions of newfound Australasian diversity, primarily based on fossils. Seldom has so much genuinely new information appeared in a single work.

To express all this marsupial diversity in words, more than 50 new taxa and about 20 changes in rank are proposed. The proposals are of two main kinds: low-ranking taxa, up to family rank, based on new finds, and somewhat higher-ranking ones based on either cladistic or phenetic interpretation.

In a synthetic chapter, Aplin and Archer wrestle with the problem of how to express nested monophyletic levels without overburdening the Linnaean system with intermediate categories. Ironically, they themselves create two new ones. They adopt "sequencing" in about two-thirds of their classification. "Sequencing" in this context is an attempt to depict nested monophyly within a given taxon by the use of a list of subtaxa such that the first subtaxon is the sister of those listed below it, the second is the sister of those below, and so on to the end of the list. The system is equivalent to a pectinate cladogram showing the same information but can be compressed into less space and does not create a spate of new names or raise what are often single species to dizzyingly high ranks. However, it has the disadvantage that one must be able to see or remember the whole list in sequence in order to understand the hierarchical pattern. One cannot refer precisely to a particular monophyletic group without circumlocution. Aplin and Archer evidently couldn't stomach "sequencing" throughout their whole classification. Most of the other authors get along fine without needing to create new levels.

I kept track of the many introduced phylogenetic changes by constructing a cladogram, using such taxa as seemed required. I think the authors made a convincing (but not explicit) case for a primary bifurcation of marsupials into Szalay's Ameridelphia and Simpson's Eometatheria (Australasian marsupials). Ameridelphia is characterized by sperm pairing and Eometatheria by a reduction of lower incisor count (convergent with some ameridelphians). Other characters need to be supplied before these taxa (particularly Eometatheria) can be considered well supported. South American microbiotheres may or may not be the unique sister-group of the Australasian eometatheres; it remains to be shown that the eometatheres, micro-

biotheres, Ameridelphia, and various Mesozoic marsupials are not equal sisters in an unresolved multiple split. I am thus still reluctant to accept Szalay's other term, Australidelphia (for microbiotheres plus Eometatheria), as an antonym for Ameridelphia. Within ameridelphians, I see a case for recognition of a fourfold split into Sparassodonta (=Borhyaenimorphia), sparassocynids, didelphids, and a diverse caenolestid-like group that is often called Paucituberculata. Within the Eometatheria, Dasyuromorphia are the sister-group of all other eometatherians. Within the latter, *Notoryctes typhlops*, sole present member of the taxonomically lofty Notoryctemorphia, may be the sister-group of what is usually called Syndactyla. Together, Notoryctemorphia and Syndactyla would then form an unnamed eometatherian taxon, but the evidence is weak. Until it is stronger, perhaps we should waffle and simply consider *N. typhlops* as Syndactyla, *incertae sedis*. Undoubted Syndactyla divide into Paramelemorphia (bandicoots) and Diprotodontia. The latter split into Vombatiformes (wombat-like animals) and Phalangerida (=Phalangeriformes; possums and allies). The Vombatiformes resubdivide into koala-like Phascolarctomorphia and wombat-like Vombatomorphia and the Phalangerida break up into perhaps 11 families, of which several are new. However, in such a scheme a number of Cretaceous and Paleocene fossil groups are left dangling, *incertae sedis*. Moreover, even more fossil marsupials discovered since the book went to press (for example, the Yalkaparidontia, a whole order for *Yalkaparidon coheni*) are already beginning to require changes in the various classifications put forth in it. Temporal calibration of the marsupial fossil record is also undergoing growing pains.

Possums and Opossums is a handsome and exciting pair of volumes. It ends with a useful index and is very well illustrated, including several memorable color photographs by Debbie Andrew and Tim Flannery. Interest is added by Peter Murray's colored reconstructions of what various fossil taxa might have looked like.

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