

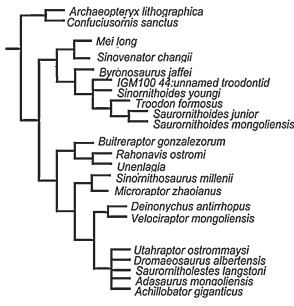
Chapter 1

Introduction

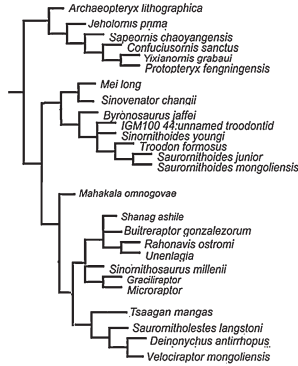
As Chiappe (2009) pointed out, “Deciphering the origin of birds, namely, identifying the closest relatives to the most recent common ancestor of *Archaeopteryx* and modern birds, has been a matter of scientific debate and scrutiny throughout the history of evolutionary biology”. Although consensus exists among authors that birds evolved from coelurosaurian theropods, paleontologists still debate about the identification of the group of coelurosaurians that most closely approaches the common ancestor of birds.

Deinonychosauria, a clade of sickle-clawed predatory dinosaurs including the families Troodontidae and Dromaeosauridae (Gauthier 1986), has been usually considered as the sister group of birds, and consequently are of prime importance to understand avian origins and their early evolution. Sister group relationships between birds and deinonychosaurians have been reported by most authors (e.g., Gauthier 1986; Forster et al. 1998; Rauhut 2003; Turner et al. 2007a, b; Senter et al. 2004; Senter 2007; Xu et al. 2003; Hwang et al. 2002; Makovicky et al. 2005; Novas and Pol 2005; Novas et al. 2009; Xu et al. 2008, 2011a; see Fig. 1.1), and the name Paraves was coined for the group that joins Deinonychosauria and Aves (Sereno 1997).

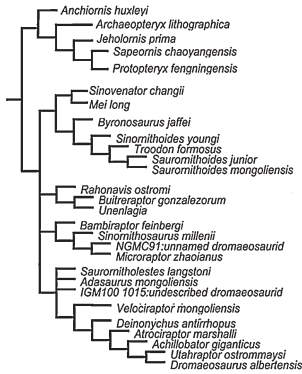
One of the best known examples of deinonychosaurian coelurosaurs is *Deinonychus antirrhopus* (Ostrom 1969), which constituted for long time the principal source of anatomical similarities with the early bird *Archaeopteryx* (Ostrom 1976). However, the last 20 years witnessed the discovery of a wide array of avian-like theropods that has considerably amplified the anatomical disparity among deinonychosaurians, some of which resembling more to *Archaeopteryx* rather than to *Deinonychus* (e.g., Xu et al. 1999, 2000, 2003; Norell et al. 2001; Makovicky et al. 2005; Turner et al. 2007a, b; Senter 2007; Hu et al. 2009; Zheng et al. 2009; Novas et al. 2009). Following this, a recent paper of Xu et al. (2011a) indicate that *Archaeopteryx* was probably more nearly related to deinonychosaurians rather than to birds (see also Paul 2002; see Fig. 1.1). Among these newly discovered theropods that show remarkable bird-like characteristics are the four-winged theropods *Microraptor* (Xu et al. 2000, 2003) and *Anchiornis* (Xu et al. 2008; Hu et al. 2009), and the unenlagiids *Unenlagia*, *Buitreraptor*, and *Rahonavis*. Besides, a bizarre group of minute-sized coelurosaurs, the Scansoriopterygidae, also exhibits some avian similarities that lead some authors (i.e., Zhang et al. 2008; Hu et al. 2009) to interpret them as more closely related to birds than other dinosaurs.



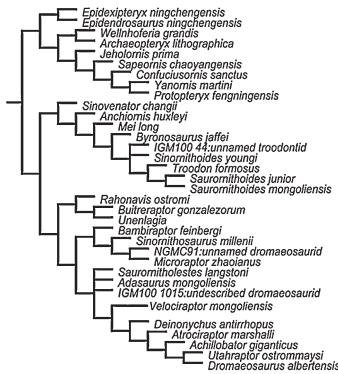
Makovicky et al. 2005



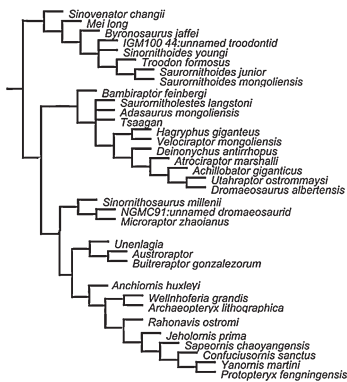
Turner et al. 2007



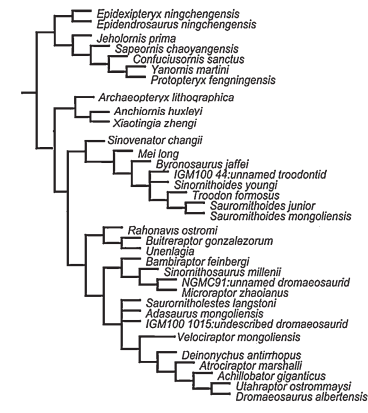
Xu et al. 2008



Hu et al. 2009



Agnolin and Novas 2011



Xu et al. 2011

Fig. 1.1 Diagrams showing phylogenetic hypotheses for Paraves advocated by six previous phylogenetic analyses

Here we present evidence that Microraptorina, Unenlagiidae, and *Anchiornis* form successive sister taxa of Aves, and that the Scansoriopterygidae are basal coelurosaurians not directly related to birds. The implications in the evolutionary sequence of anatomical characters leading to birds, including the origin of flight, are also considered in light of this new phylogenetic hypothesis.

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