allele dropout[3]. Consequently, this technique requires validation before use in forensic casework. We are currently investigating a robust interpretation strategy for single-cell STR profiling. This work also raises issues about STR profiling low numbers of cells and the need for stringent precautions in collecting and processing to avoid contamination.

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Archaeopteryx-like skull in Enantiornithine bird

The bird *Cathayornis* from the Early Cretaceous period gives the first evidence for a post-Jurassic survival of an *Archaeopteryx*-like skull in birds. This skull combines short, toothed premaxillaries, nasals meeting at the midline and submaxillary fossae in the antorbital fenestra.

During the late Mesozoic era, from the Early Cretaceous to the latest Cretaceous (Maestrichtian), two distinct groups of birds co-existed as separate lineages[1,2]. One of these, the ornithurine birds, survived into the Cenozoic era to give rise to all modern birds[3,4]. The other lineage, the Enantiornithes, became extinct along with dinosaurs at the end of the Cretaceous[3,5].

The structure of Enantiornithine bird skulls is poorly understood. Until now, the best known was *Gobipteryx*, of which there are fragmentary adult and embryonic skulls[6] showing the absence of teeth, a reduced antorbital fenestra and an *Archaeopteryx*-like quadrate.

Cathayornis from the Early Cretaceous of China has the typical elongated outer metacarpal and the characteristic shapes of the scapula, coracoid, and distal tibiotarsus found in later enantiornithine birds[3,7]. Photographs of the skull have been published[8] and a drawing of it as it is preserved[7], but there has been no detailed reconstruction of any enantiornithine skull published to date. Our reconstruction (Fig. 1) is based on the holotype of *Cathayornis* (specimen IVPP, V9769) and skulls from two skeletons referred to that genus (IVPP, V10896 and V10916). The latter two skulls provide information on the maxilla, lacrimal and a lateral view of the quadrate. The premaxilla bears four or five small teeth that are directed downwards or slightly forwards. It is covered externally with large nutrient foramina. The dorsal process of the premaxilla extends posteriorly slightly beyond the edge of the nares (nostrils). It is slightly shorter in *Archaeopteryx* (Fig. 1 c,d). The nares meet on the midline as in *Archaeopteryx* and are overlapped by the premaxillaries on their anterior process.

The premaxillaries are toothed and about one-third the length of the skull compared to about one-quarter in *Archaeopteryx*, and the nasals are shortened. The antorbital fenestra is large and triangular with two distinct anterior maxillary fossae. The maxillary is toothed. Teeth are set in sockets indicating that the individuals are mature. The teeth are not serrated and have the expanded base and waisted crown typical of all known toothed birds (Fig. 1g). The 'T'-shaped lacrimal is inclined posteriorly. The braincase is expanded over that in *Archaeopteryx* (Fig. 1 b,d) and this may reflect an increased brain size coupled with an improved shoulder girdle (keeled sternum) and presumably more sophisticated powers of flight in *Cathayornis*. There is a bone in the posterior corner of the skull that might be a squamosal, but the quadrate articulation and basicranial region is not preserved in our material, nor is the quadratojugal and jugal.

There is a well-preserved quadrate (Fig. 1f) lying disarticulated and behind one skull (IVPP, V10916). It is a long slender bone with a single small proximal head and very little orbital process. It is similar to the quadrate (Fig. 1e) of the London, Eichstätt and seventh *Archaeopteryx* specimens[9] and to that of *Gobipteryx*. In *Archaeopteryx* the dorsal process of the jugal is too far back to contact a postorbital even if one were present[10]. The reduction or loss of the postorbital frees the jugal bar for prokinesis and may have occurred more than once in avian evolution. *Cathayornis* lacks evidence for a postorbital but one is present in *Confuciusornis*. The flattened nature of the nasal and the nasal process of the premaxilla[7] may also indicate the presence of prokinesis in *Cathayornis*.

If *Archaeopteryx* and the Enantiornithes are united into a monophyletic Sauriurae[1], then the presence of a primitive *Archaeopteryx*-like skull in *Cathayornis*, after the derived postcranial differences between enantiornithine and ornithurine birds was established, indicates that the modern ornithurine skull and 'typical avian kinesis' was developed independently by ornithurine birds.

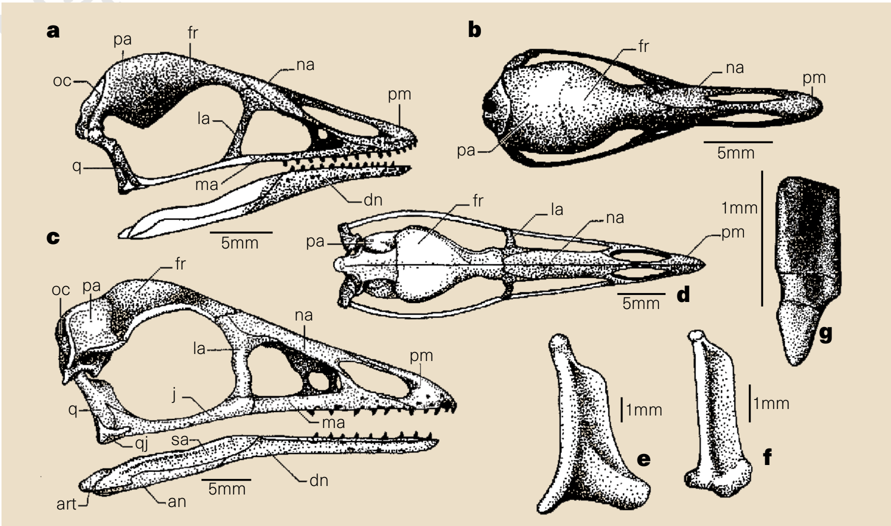

Figure 1 Reconstruction of skull structures of *Cathayornis* and *Archaeopteryx*. **a,** Lateral view of *Cathayornis*. **b,** Dorsal view of *Cathayornis*. **c,** Lateral view of *Archaeopteryx*. **d,** Dorsal view of *Archaeopteryx*. **e,** Quadrate of *Archaeopteryx*. **f,** Quadrate of *Cathayornis*. **g,** Labial view of tooth from the maxillary of *Cathayornis*. Abbreviations: an, angular; art, articular; dn, dentary; fr, frontal; j, jugal; la, lacrimal; ma, maxillary; na, nasal; oc, occipital; pa, parietal; pm, premaxillary; q, quadrate; qj, quadratojugal; sa, surangular.

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