Palaeontology

Cosesaurus — the last proavian?

from Andrew R. Milner

SYSTEMATIC palaeontology sometimes seems to resemble a scene from Dante's Purgatory. As fast as some palaeontologists tidy fossils into manageable groups, others describe new specimens which cannot possibly fit into any orthodox framework. Some supposedly bizarre or highly significant fossils do maintain their status on investigation but it has been, and still is, the fate of many an oddity to prove on revision to be more mundane than its original author(s) believed. One such fossil, *Cosesaurus aviceps*, now seems to have joined the ranks of the demoted.

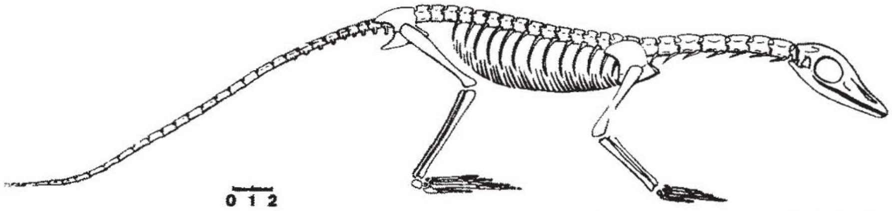
Cosesaurus was first described a decade ago as a proavian from the Middle Triassic of Spain[1]. It is a small fossil reptile, 14 cm long, represented only by a single negative impression of a skeleton having a large-eyed skull with a relatively large brain case and beak-like jaws, a lizard-like body with a long tail and hindlimbs slightly longer than the forelimbs. It was originally described as possessing a furcula (the 'wishbone', or fused clavicles), a bird-like pelvis and traces of feather impressions; this evidence, coupled with the bird-like skull, led one of its discoverers to propose it as a closer relative of true birds than *Archaeopteryx*[2]. *Cosesaurus* was even used to support the hypothesis of a Palaeozoic origin for the birds, quite distinct from dinosaurs or even archosaurs[3]. It seemed in many respects to be the much-sought arboreal 'proavis' rendered tangible at last. But *Cosesaurus* never gained many adherents as a protobird and, in recent years, the relationship of *Archaeopteryx* and the birds to the dinosaurs has been thoroughly supported by cladistic analyses[4,5]. This has left *Cosesaurus* in an increasingly anomalous position.

A recent reassessment by Sanz and López-Martínez seems to have found a more modest position for *Cosesaurus* in the phylogenetic framework of the sauropsid reptiles[6]. They dismiss the supposed furcula and feathers as overinterpretation of a poor specimen, and argue that the remaining suite of derived characters support a position within the Prolacertiformes, a group of Permo-Triassic diapsid reptiles, once thought to be early lepidosaurs, but more recently argued to be primitive relatives of the archosaurs[7,8]. Sanz and López-Martínez also note *Cosesaurus's* specific resemblance to the much larger *Macrocnemus*, a prolacertiform from the contemporary and ecologically equivalent Monte San Giorgio in Switzerland site (see figure). They suggest that other characteristics, including the superficially bird-like head, are juvenile: if *Cosesaurus* is related to *Macrocnemus*, it must be either a hatchling or a dwarf species, the former being more likely in the absence of other evidence.

This identification agrees well with the presence of the nothosaur genera *Lariosaurus* and *Nothosaurus* in the same beds at both localities and implies that the Spanish site has simply produced a small sample of the Monte San Giorgio-Muschelkalk vertebrate association — a typical Middle Triassic Tethys coastal fauna. The general resemblance between the skull of *Cosesaurus*, a juvenile archosauromorph, and that of a bird is an interesting reminder of how progenetic dwarfing may have reshaped the typical archosaur skull to result in the avian skull.

Another strange reptile recently and more cautiously described from the Upper Triassic of Italy[9] is less likely to suffer such a reduction in status. *Megalancosaurus preonensis* is also tiny and has a superficially bird-like head, long cervical vertebrae, a very long forelimb with five short digits, each bearing a deep blade-like claw, slender ribs and an archosaur-type pelvis. Only a preliminary description has yet been published and only a tentative position within the thecodont-grade archosaurs has been proposed.

Some recent analyses of archosaur relationships place the pterosaurs and dinosaurs close together within the archosaurs[10] and, judging by such characteristics as are visible, *Megalancosaurus* seems to belong close to, or within, the pterosaur-dinosaur clade. Its small size, peculiar claws and slender forelimbs suggested to its describers that it was arboreal and, indeed, its forelimb is distinctly reminiscent of that of the Colugo or flying lemur, the patagial gliding mammal of south-east Asian forests. Could it be that this fossil represents a conservative patagial gliding relative of the pterosaurs?



Reconstruction of *Macrocnemus bassanii* from two specimens from the Monte San Giorgio site, Switzerland, studied by B. Pryer. The limb bones are shown in their longest view, without an anatomical perspective. Scale in cm. Drawing by N. López-Martínez (from ref. 6).

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Geochemistry

Uses for synthetic fluid inclusions in quartz crystals

from Edwin Roedder

FLUID inclusions are small droplets of the fluids from which crystals grew and are found in many minerals, both natural and synthetic. In natural gem minerals, fluid inclusions diminish their clarity, and hence their value; in synthetic crystals they detract from the useful mechanical, electrical or optical properties for which the crystals are grown. Why then should anyone want purposely to form microscopic inclusions of fluid in otherwise optically clear quartz crystals? Yet S.M. Sterner and R.J. Bodnar[1] have recently developed a procedure to do just that, and have shown that the resulting inclusions are valuable in a surprisingly wide range of geochemical and mineralogical studies that may help us to understand better the natural processes that may have taken place millions of years ago.

Sterner and Bodnar start with solid cylinders of clear quartz, cut from a fluid-inclusion-free natural crystal. These are heated and then cracked by quenching in water. The cracked but still intact cylinders are dried and sealed into thin-walled noble-metal capsules with the starting materials appropriate to generate the desired fluid composition under the experimental conditions. The collapsible capsules are then subjected to external pressures of 0.5-7 kbar, while being heated to 200-850°C, for periods of between 3 hours and 87 days, before being quenched.

During the time at elevated temperature and pressure, the fractures in the quartz crystal are healed by dissolution and recrystallization of the crack surfaces, thereby decreasing the total surface energy