Dinosaur fossils with soft parts

Soft tissues of long-dead organisms are preserved only in very special circumstances, and the study of such materials has caused considerable excitement. Two papers just published in Nature1,2 report small theropod dinosaur that retain a remarkable array of soft-tissue features. Two specimens come from China and have been named Sinosauropteryx3 (and were discussed in TREE with respect to dinosaur-bird relationships4). They are from a famous, probably Lower Cretaceous locality called Jehol in Liaoning that has produced a remarkable array of soft-tissue features. The internal remains in the larger specimen of Sinosauropteryx include证据: a hitherto unknown feather. The smallest content is unusual but not unique finds, because they involve normal preservation of hard bones remains. Other internal structures are more impressive. Low down in the visceral cavity, the larger specimen of Sinosauropteryx also contains two large eggs, complete with shells. These eggs had almost certainly not been eaten – they are far from the stomach (which in any case is full of lizard) and they are unbroken. They lie low in the abdomen, close to the location of the duct in modern birds, where the egg shell is produced before laying. Two is a low number for a reptile: indeed, dinosaur eggs usually contain eight to 30 eggs, more in line with modern crocodiles, lizards and turtles. Perhaps there were two or three eggs at the other side of the abdomen of Sinosauropteryx: Although fossil eggs are not unique in the fossil record, eggs inside a dinosaur are. In the future, it will be interesting to try to determine whether the eggs were fertile, and whether there are any indications of foetal remains within them. Most excitement has been aroused by the external features of the two Sinosauropteryx specimens: they appear to have feathers, or at least barbs. Perhaps, it is an indication of foetal remains within them. The 'feathers' are now more circumspectly termed ‘integumentary structures’5. The

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unique kind of filamentous “hair”, as in the extinct flying pterosaurs, but not yet clear evidence of feathers, or even “proto-feathers”. However, there are now rumours of another dinosaur specimen from China that shows unequivocal feathers.

The second exceptionally preserved dinosaur find is also Early Cretaceous in age but comes from Italy. The newly named Scipionyx is known from a single specimen from the Pietraroia locality in southern Italy, a site well known for a wide fauna of exceptionally well preserved freshwater organisms, shrimps, fishes and crinoids. Scipionyx is tiny, only 25 cm long, and the unique specimen is probably a juvenile. It has no integumentary structures, features or other debatable structures of that kind, but its internal organs are amazingly well preserved. In the throat region is a segment of trachea, with the reinforcing rings, and there are patches of preserved muscle in the shoulder area and at the base of the tail. The most amazing feature is the preserved intestine – a broad but short irregular tube filling the abdominal cavity and showing bands of muscular tissue. The texture and colour look just like the intestine of a recently dissected animal.

Other soft-tissue traces in Scipionyx include a haematitic halo just anterior to the intestine, possibly representing the liver. The putative liver has given rise to a few days after death, before much degradation. Where bacteria grow over the carcass in body is placed in gentle anoxic waters are required for such preservation – the special conditions the body outline is replicated by phosphatised microbial mats. Special conditions are preserved in an iron carbonate, and the small bony scales set in the skin. Some specimens even contain organic material: A specimen from the Early Cretaceous of Spain, Pelecanimimus, has been reported with skin and muscles mineralized in the throat and neck region, the back of the head, the arm and the chest area. These are preserved in an iron carbonate, and the body outline is replicated by phosphatised microbial mats. Special conditions are required for such preservation – the body is placed in gentle anoxic waters where bacteria grow over the carcass in a few days after death, before much degradation can take place. Some of the surviving soft tissues are replaced by bacteria and then mineralized in carbonate or phosphate derived either from the decaying carcass or from surrounding waters. Rapid fossilization seems to be the key, and geochemical studies of the new Chinese and Italian dinosaurs should reveal how they came to be so remarkably well preserved.

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