A. D. SIVETER/REF. 2; B. J. CHEN

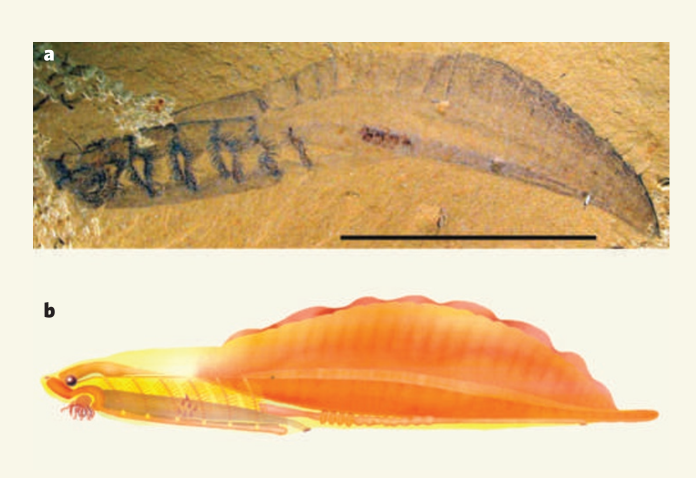


Figure 2 | Early Cambrian yunnanozoan. a, This specimen is well preserved, but, like others from the Chengjiang biota, it is flattened in shale. The orientation of the animal in the rock and the amount of decay before fossilization vary between examples. Scale bar, 10 mm. **b**, A reconstruction of the animal in life.

lost before those of the trunk, including the notochord and muscle blocks.

Even more strikingly, the appearance of the carcass is transformed by decay until it resembles the much simpler morphology of an ancestral (stem) chordate. Attributes tend to disappear in the opposite order to that in which they evolved, so that only the more ancestral morphology remains. As a result, the corresponding fossil falls in a misleadingly low position on the chordate evolutionary tree. This process of 'stem-ward slippage', as Sansom *et al.*[1] call it, clearly compromises the usefulness of such fossils in revealing the pattern of early chordate evolution (Fig. 1).

The fossil record of early chordates poses a challenge to palaeontologists because they predate the evolution of the vertebrate skeleton and are consequently soft-bodied. Their lack of hard parts means that they fossilize only in extraordinary circumstances; early chordates have been discovered in some of the most famous Cambrian fossil deposits such as Chengjiang[2], and the Burgess Shale near Field in British Columbia[3]. Such fossils are flattened on the surface of the shale and are consequently difficult to interpret (Fig. 2). They have also undergone some decay — the details that survive depend on just how much decomposition occurred before fossilization.

Ironically, however, microbial decay is often an essential driver of the preservation process, particularly where fossilization involves the rapid precipitation of minerals[4]. Morphological details of Chengjiang specimens, for example, are often preserved as a thin layer of pyrite (iron sulphide, often later replaced by iron oxide), which forms as a result of the activity of sulphate-reducing bacteria[5]. The information available depends on a race between decay and fossilization. Effects created during decay and preservation may account for some of the controversy surrounding the placement of the Chengjiang chordates[6]. For example, as depicted by the red shading in Figure 1a of Sansom and colleagues' paper[1] on page 798, the bizarre yunnanozoans have been interpreted variously as stem deuterostomes, stem hemichordates, stem chordates, stem cephalochordates and stem vertebrates.

Decay is the norm, and researchers must take it into account when interpreting soft-bodied fossils, even when the original morphology is unknown. There is a long history of palaeontologists making observations of decay in living organisms in the laboratory or the field in order to understand what is preserved in similar fossils[7]. Ranking tissues according to how easily they degrade may allow an estimate of how much decay has preceded fossilization. Recognizing levels of susceptibility to decay may serve to separate features that have been lost through decomposition from those that were absent in the first place, a distinction that may be crucial in constraining the place of a fossil on the chordate tree.

The unfamiliar appearance of Cambrian creatures may also generate another uncertainty — what is the most appropriate living organism for comparison, and how do we equate the different features of the fossil with those in living animals to determine the place of the extinct form[6]? This may boil down to questions as fundamental as whether a linear structure is the gut or the notochord. Sansom and colleagues' analysis[1] offers a cautionary tale for those who would interpret soft-bodied fossils, but the result provides no panacea for the problem of placing these extinct forms on the tree of life. We still need to rely on selecting the most informative fossils and avoiding preconceived ideas about the nature of the animal and the features of its anatomy.

Is stem-ward slippage just an isolated palaeontological example of Murphy's law — in this case, that the most useful evidence is least likely to be preserved — relevant only to

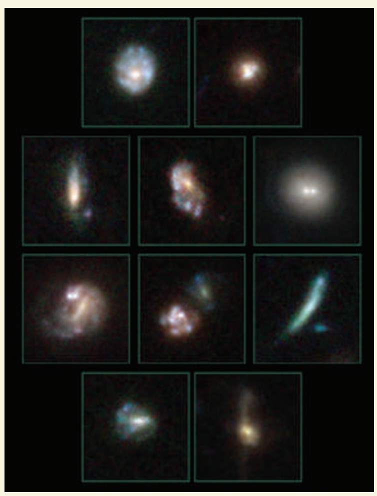
COSMOLOGY

Census at a distance

Cosmologists have long been occupied with trying to understand how galaxies formed and evolved into their intricate shapes and forms. With François Hammer and colleagues' results of a comparative census of galaxy types at two different epochs in the Universe's history, they will become even busier (R. Delgado-Serrano *et al. Astron. Astrophys.* **509,** A78; 2010).

In his early-twentieth-century classification scheme, Edwin Hubble categorized the galaxies seen in today's Universe into three groups according to their visual appearance: ellipticals, spirals and lenticulars (the last being an intermediate type between the first two). Odd-shaped assemblies of gas, stars and dust that don't fall into any of these categories are termed peculiars.

But is the census of today's Hubble galaxies similar to that of moderately distant galaxies? The conventional view has been that it is. Surprisingly, Hammer and colleagues' scrutiny of two samples — 148 galaxies selected from the Great Observatories Origins Deep Survey, seen as they were 6 billion years ago, and 116 local galaxies from the Sloan Digital Sky Survey — finds that it isn't.



NASA/ESA/SDSS/F. HAMMER & R. DELGADO-SERRANO (OBS. PARIS)

The authors demonstrate that, in the distant sample, the fraction of peculiar galaxies (pictured) is about five times higher than that of their present-day counterparts, and that spirals were about 2.3 times less abundant. In striking contrast, the number of ellipticals and lenticulars is essentially the same.

But there's much more to Hammer and colleagues' study than counting galaxies and sorting them into classes. Their investigation suggests that many of the distant peculiar galaxies evolve to become today's spiral galaxies through gas-rich galactic collisions — a conclusion that is at odds with the belief that galaxy collisions lead to the formation of ellipticals. Such evidence needs to be taken into account in testing theories of galaxy formation and evolution.

Ana Lopes