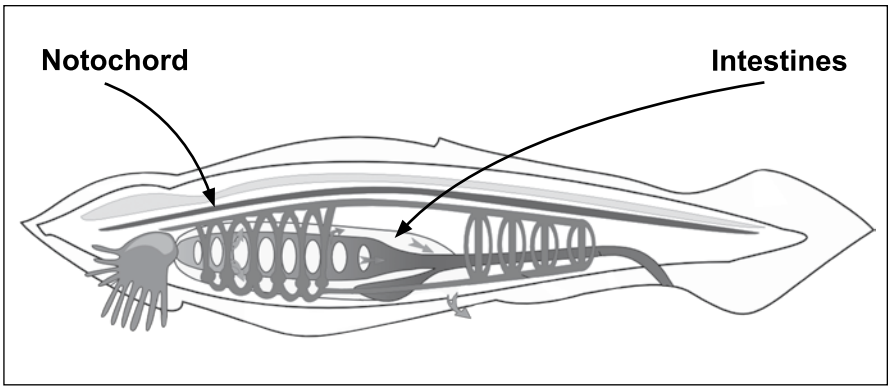
Morphology and molecules in conflict yet again[1]

Reinhard Junker



After Piotr Jaworski, www.wikipedia.org

Figure 1. The roughly 8-cm-long fish-like lancelet *Amphioxus*. The notochord is a flexible supporting rod above the intestine, which is also formed during the embryonic development of vertebrate animals as the first supporting organ and which is replaced to a large extent in the course of ontogenesis by the vertebral column. The transparent lancelet lives in coastal sands.

A frequently used *and* apparently striking argument for the 'fact' of evolution is the supposed harmony between molecular similarity trees, and the 'classical' morphological family trees (based on physical shape and structure) which are commonly featured in the popular media. The technical literature, however, does not reflect such a harmony. In fact the very opposite can be seen, and the molecular data is bringing these established morphological phylogenies/lineages into disarray.

This fate seems recently to have overtaken the relationship between the tunicates (sea-squirts), cephalochordates and vertebrate animals. All three groups together make up the phylum Chordata, characterized by the possession of a flexible supporting rod (the notochord). Salps and sea-squirts belong to the tunicates (saclike animals); a prominent representative of the cephalochordates is the fish-like lancelet or amphioxus (figure 1). Based on morphological similarities, the lancelet was for a long time unrivalled as the closest relative of vertebrate animals.

But this is now being questioned by the extensive molecular studies of Delsuc *et al.*[2] The researchers examined 146 nuclear genes from 14 deuterostomes (to which the chordates, hemichordates and echinoderms belong) and 24 other species as outgroups.

The results placed the tunicates and not the cephalochordates (which include the lancelets) nearest to the chordates (figure 2). So this shifts the lancelets closer to the echinoderms than to the other groups. This also makes chordate monophyly uncertain, i.e. not all the chordates can be traced back to one single common ancestor. This would mean that such a marked key characteristic as the notochord developed independently at least twice. The authors indicate, however, that this result must be verified by additional data. If these findings are confirmed, one more key characteristic could no longer be used as an 'indicator of ancestry'.

Gee points out in a commentary that these results turn this textbook scheme of deuterostome evolution on its head.

'Rather than the steady acquisition of progressively more chordate-like (and, by implication, human like) features from an ancestor with nothing to recommend it, the story becomes one of persistent loss ... The ancestor would have looked like a cross between an amphioxus and a larger, brainier, tunicate tadpole larva. Crazy? Possibly. But possibly not.'[3]

In any case, it is clear that studies being driven by evolutionary assumptions are overturning current concepts of evolution. 'From complex to simple'—this is not the way we learnt evolution.

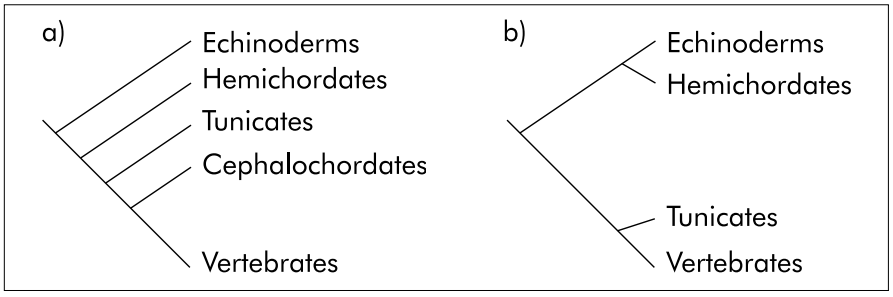


Figure 2. Contradictory lines of descent. a) Classical textbook view, showing a gradual increase in complexity; b) Topology after the data of Delsuc *et al.* (After Gee[3]).

References

1. This article was originally published in German in *Studium Integrale Journal* **13**(2):101–102, October 2006.
2. Delsuc, F., Brinkmann, H., Chouurrout, D. and Philippe, H., Tunicates and not cephalochordates are the closest living relatives to vertebrates, *Nature* **439**:965–968, 2006.
3. Gee, H., Careful with that *Amphioxus*, *Nature* **439**:923–924, 2006; p. 924.