

E-MAIL CONTRIBUTIONS

Among the e-mails sent to the debate in the first week is the following, which asks the question "The fossil record-adequate for what?"

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"Very few palaeontologists, if any, adhere to the view that if we wait long enough we will eventually collect sufficient field evidence to 'fill in' all ancestors and thus make phylogenies historical narratives. Siddal's "ancestor worship" is a thing of the past, but that does not mean that fossils have no value in phylogenetics. It is curious that Princeton, where the 1946 bicentennial conference was held, disposed of its fossil collections to Yale and elsewhere, thereby assuredly rendering impossible any attempts to reappraise the importance of fossil evidence in Dobzhansky's home institution!

Equally, it would be naive to conflate all fossil records as equally inadequate. Pearson is quite right to point out that the record of planktonic foraminifera present practical evidence of completeness. Not only that, putative phylogenies are testable and re-testable in different locations. The foraminifera have a fossil record different in kind from that of most large animals and plants. Quantitative treatments revealing stratigraphy based 'lineages' in microfaunas will not go away. Intelligent and assiduous workers continue to find that near-continuous lineages exist^{1,2}, which include putative ancestors, that would be unrecognisable from cladistic treatment of the same species, for the purely methodological reasons already explained in an earlier contribution.

In short, the question of this debate might be rephrased: how can we tell what the fossil record adequately describes?

At the other extreme of the spectrum there are cases where an historical narrative based almost entirely on fossils can be challenged as a possible artefact of a poor record. The rapid, 'explosive' origin of 'modern' bird clades in the Tertiary³ was questioned on the basis of molecular divergence time estimates by Cooper and Penny⁴ - who claimed a divergence of major groups within the Cretaceous. This in turn suggests that effort be redoubled to find early evidence of the clade from real fossils. Just two weeks ago, *Nature* reported the discovery of a fully fledged (if the pun can be forgiven) parrot from Cretaceous rocks⁵.

In this case, a critique of the fossil record suggested what fossils should be sought, and where. The early phase of diversification of a clade may be at low population density, or in marginal habitats, with a low fossilisation potential, but even a few fragments may overturn an evolutionary scenario.

Similarly, the reality of the Cambrian evolutionary 'explosion' has been questioned from geological and phylogenetic evidence⁶. In the last two years numerous estimates of divergence times using genomic evidence (for example ref. 7) have supported the notion of Precambrian divergence of phyla, although the reliability of the

clock assumptions has invited criticism. Bromham *et al.*⁸ have provided confidence intervals on divergence times which offers a more realistic measure of the uncertainty involved. Reports of Precambrian metazoans are already appearing.

Unfashionable though it may be, it seems that a pluralistic attitude might after all be the right one. To reject *all* historical narratives based on stratigraphy is to take a blinkered view of the potential of the record to test evolutionary mechanism as well as phylogeny (for example, the whole gradualism-punctuated debate would be instantly rendered pointless).

Good case histories can be identified from independent geological evidence - obviously they must never fly in the face of morphology. On the other hand, to treat the record naively as always presenting an accurate historical narrative - particularly at times of major biotic turnover may also be an error. Mismatches between fossil evidence and, for example, genetic divergence evidence, may be telling us something important. Surely the salient point is that the completeness of the fossil record, like phylogenies themselves, is something that should be subject to scientific scrutiny, and neither accepted as axiomatic, nor rejected *a priori*."

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Contributions to this debate from readers are encouraged, by e-mail only, please, to debates@nature.com.

The rules are simple: contributions should be short and to the point. The moderator reserves right to select contributions to be posted on the site, and to normal editing for style, sense, length and, of course, good taste.
