P A L A 4 6 4 B
Journal Name Manuscript No.
Dispatch: 21.1.05 Journal: PALA CE: Blackwell
Author Received: No. of pages: 15 PE: Karps
[Special Papers in Palaeontology, 73, 2005, pp. 1–15]

THE LIKELIHOOD OF STRATOPHENETIC-BASED HYPOTHESES OF GENEALOGICAL SUCCESSION

by PETER D. ROOPNARINE

Department of Invertebrate Zoology and Geology, California Academy of Sciences, 875 Howard St., San Francisco, CA 94103, USA;
e-mail: proopnarine@calacademy.org

Typescript received XX XXX 2003; revised typescript received XX XXX 2003

Abstract: Understanding the microevolutionary processes underlying patterns of morphological and systematic relationships in the fossil record often requires information derived from stratigraphically ordered samples of fossils. This stratophenetic inference has formed the historical basis of the study of microevolutionary processes. The use of stratigraphic succession as a means to order sequences of events, and in the process identify samples comprising individuals ancestral to individuals in later samples, however, is an implict and generally untested assumption of stratophenetic methods. The failure to evaluate the relative and independent contributions of stratigraphy, morphology and palaeoenvironments/palaeoecology to hypotheses of microevolutionary genealogy, and in fact the hypothesizing of genealogies themselves, is often viewed as problematic to the traditional evolutionary and stratophenetic approaches to phylogeny reconstruction. This paper argues that the use of various types of information is in fact a strength and necessity of genealogical reconstruction. The independence of these data must be recognized, however, thereby allowing probabilistic evaluation of stratigraphic and morphological data, and the relative ranking of multiple genealogical hypotheses. A simple likelihood ratio-based approach to microevolutionary resolution is used to illustrate the complexity underlying stratophenetic assumptions. An example is presented using the Early Devonian ozarkodinidid conodont *Wurmiella wurmi*. Use of stratigraphic data only results in the unbranching and uninterrupted genealogical chain expected of stratophenetic studies of a single species. Morphometric data, by contrast, produce a more complicated, branching pattern of relationships among samples. The two hypotheses may be combined to produce a single stratogenealogy, which although conforming largely to stratigraphic order, does incorporate some of the complexities resulting from morphological comparisons. The conclusion is that stratophenetic patterns do not necessarily reflect the most supportable hypotheses of genealogical descent; those hypotheses must be formulated independently of stratigraphic order, and may be evaluated in the contexts of stratigraphic, morphological and palaeoenvironmental data.

Key words: stratophenetics, genealogy, ancestors, likelihood, microevolution.

DARWIN (1859) suggested that the evolutionary history of lineages would be preserved as the geological succession of fossil groups related by ancestry and descent. This view was adopted as the framework within which to document the results of descent with modification, whether between stratigraphically ordered members of the same (presumed) species, or between higher taxa (e.g. Trueman 1922). The historical palaeontological literature is replete with such examples of stratigraphically ordered genealogical representations (refered to here as 'stratogenealogies'). This historical database formed the basis of Eldredge and Gould's (1972) hypothesis of punctuated equilibrium, which uses the recurrent pattern of within-lineage morphological stability, or stasis, followed by abrupt morphological evolution, as one of its central arguments. Gingerich (1974, 1976, 1979) subsequently formalized the construction and purpose of stratogenealogies, termed stratophenetics, arguing that lineages could be established on the basis of stratigraphic occurrence and phenetic similarity, and evolutionary hypotheses subsequently constructed on the basis of morphometric variation within and among lineages. Gingerich intended stratophenetics to be a tool both to examine patterns of microevolution and to serve as an alternative to cladistics in the discovery of phylogenetic relationships.

There are consequently two avenues of macroevolutionary thought that depend on the implicit assumption of stratogenealogical continuity. First, stratophenetics asserts that stratogenealogies represent primary data for the construction and testing of phylogenetic hypotheses, and implicitly accepts the primacy of stratigraphic order in the derivation of stratogenealogies. Second, macroevolutionary theory depends on the examination of stratogenealogies for the establishment of patterns of stasis and punctuated speciation. Beneath these phylogenetic and macroevolutionary levels, however, lies the implicit

© The Palaeontological Association