

Actuopaleontology: The strength of its limitations

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It is very easy to be blinded to the essential uselessness of [actualistic projects] by the sense of achievement you get from getting them to work at all. In other words, their fundamental design flaws are completely hidden by their superficial design flaws. [paraphrased from Douglas Adams, *So Long and Thanks for all the Fish*, 1985, p. 177]

Actuopaleontology (actualistic approach) aims to improve our understanding of the Past entombed in the fossil record by studying the patterns and processes observed in the Present. In other words, the present is used as the key to the past. A significant proportion of actualistic studies deals with '...life and death of organisms in their Recent habitats, including the post-mortem history of their remains, ichnology and the study of facies...' (Cadée 1991: pp. 11–12). Such studies, referred to by the German term 'Actuopalaontologie' (Richter 1928), are an essential ingredient of paleontology because they can, and often do, greatly improve the reliability and detail of paleoenvironmental and paleobiological interpretations. Following many seminal contributions (Weigelt 1927; Hantzschel 1956; Schafer 1962), the actuopaleontologic approach has been widely accepted and constitutes a major research direction of modern paleontology (e.g., Schopf 1978; Bosence 1979; Behrensmeier & Hill 1980; Staff *et al.* 1986; Flessa 1987; Davies *et al.* 1989; Kidwell & Baumiller 1990; Fiirsich & Flessa 1991; Parsons & Brett 1991; Flessa *et al.* 1993; Kidwell & Flessa 1995). However, despite its obvious successes, the actuopaleontological approach is undermined by variety of limitations and assumptions. This brief note aims to demonstrate that the weaknesses that arise from such limitations are not necessarily fundamental methodological flaws. Indeed, quite often, these weaknesses can be exploited fruitfully to accomplish our research goals.

The single, most common complain against actuopaleontology is the practical inapplicability of the present-day observations. Such observations may not be applicable, or may be only partly (or indirectly) applicable, to the fossil record because they exist only in the Recent. They are not recorded in the fossil record either because they cannot be preserved or because they are inherently contemporary phenomena. The trivial corollary is that an actualistic researcher must always ask explicitly whether her/his present-day observations are relevant to the fossil record. There is, however, a higher-order corollary here as well: The present-day observations that are irrelevant or not applicable directly to the fossil record should not be discarded because they may be useful indirectly.

A good example is offered by the research on taphonomic facies (taphofacies) that can be distinguished among beach ridges (cheniers), which have formed during the Holocene on the tidal flats of the Lower Colorado Delta (Kowalewski *et al.* 1994). Taphonomic features of shells that are the most informative indicators of taphofacies (the shell luster features) are rarely preserved in the fossil record. Therefore, they can be applied to the fossil record only exceptionally. Because of that limitation, it is appropriate to analyze the data excluding the luster features. The

more preservable features provide less useful data and thus the study is not fully applicable to the fossil record. Moreover, even if the shell luster were preservable, the study would not be directly applicable. This is because cheniers themselves are unlikely to be preserved and/or identified in the fossil record. Although, Pleistocene cheniers can still be identified in Baja California (Meldahl 1995), the pre-Pleistocene cheniers are not documented in older parts of the geological record (Augustinus 1989). The chenier plains are regressive or low-stand features, and consequently, the cheniers are typically smeared into the ravinement horizons during subsequent transgressions (the Pleistocene cheniers still await the doom that will come with the next major transgression). Therefore, a literal application of the actualistic study of cheniers is not appropriate. However, the study can be helpful indirectly because it can aid geologists in identifying those transgressive ravinements that were generated from the reworking of cheniers (Kowalewski *et al.* 1994). Shells composing cheniers may be expected to be typically dominated by single species. This is because extreme tidal habitats and the long-term time averaging typical to residual shell-rich beach ridges both bias resulting accumulations in favor of r-selective, opportunistic taxa. Thus, unless cheniers of different ages are thoroughly mixed during a transgression, the chenier-derived ravinements should retain the close-to-monospecific composition. This characteristic can be helpful in identifying the type and origin of a ravinement. Also, chenier shells are only exceptionally affected by bioerosion and encrustation. This again may help to identify chenier-derived ravinements. Of course, bioerosion and encrustation may occur during the time of ravinement formation, but secondary nature of this bioerosion may often be identifiable (e.g., bioerosion that post-dates fragmentation). In sum, although some actualistic observations may not be applicable to the fossil record directly, they can still be helpful indirectly.

Another common complain against actuopaleontologic observations is that they often contradict or fail to explain paleontological data. But, paradoxically, an actualistic approach can be especially productive when the predictions formulated on its basis are incongruent with the fossil record. This is because the failure of actualistic predictions can indicate important differences between the Present and the Past. For example, the taphonomic study on a lingulid brachiopod *Glottidia palmeri* (Kowalewski 1996) offers quantitative estimates of the rate of shell destruction in lingulid brachiopods, and consequently, provides predictions on potential levels of time-averaging, susceptibility to post-mortem transport, and expected modes of preservation in fossil lingulids. The fact that these actualistic predictions agree with the Cenozoic and Mesozoic fossil record but fail to explain the Paleozoic fossil record suggests that the rate of destruction did change. This, in turn, implies that the taphonomic characteristics of lingulids varied throughout the Phanerozoic. Thus, it was the failure of the uniformitarian predictions that was most valuable by indicating the possibility that a taphonomic megabias affected the lingulid fossil record. This prediction has been confirmed subsequently by a taphonomic survey of paleontological literature (Kowalewski & Flessa 1996). Actualistic research is, thus, not only the key to the past but also a cognitive stimulant that can suggest new hypotheses to test and offer insights that cannot be possibly derived from the fossil record alone.

In sum, the limitations of the actualistic approach should not necessarily be viewed as fundamental design flaws. These limitations can be exploited or treated as testable assumptions.

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