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INTO FOCUS

# The Never-Ageing Ager

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One of my favourite books in the field of geology is Derek V. Ager's *The Nature of the Stratigraphical Record.* First published in 1973, with a third edition in 1993, it is a thoughtful book, often provocatively amusing: "... when they [stratigraphers] discovered diachronism, all similarities in lithology tended to be taken as evidence of different ages ... We have seen exactly the same psychological process in palaeontology, where the fashionable fixation for homoeomorphy in many groups brainwashed many of us into thinking: 'if they look alike they cannot be related'!" (p. 90). I assume it to have been widely read, and warmly recommend it to anyone who has not yet read it. By way of a monstrous simplification the book can be said to pursue three principal claims: that the sedimentological record is dominated by gaps, that deposition is rapid when it occurs, and that particular facies are widespread during particular periods of time. As the author was careful to point out, it was never meant as a textbook, but teachers of sedimentology, or Earth history for that matter, would find this a useful assignment to stimulate critical reading in students. And it is short! That some aspects of the book have been taken out of context and misrepresented by young-Earth creationists is a sad example of the insincerity of the latter and has nothing to do with the book contents.

Since the 1940s a distinction has been made, at least in the Anglo-Saxon world, between time-rock units and time units. We have all been taught, often by means of more or less helpful metaphors, the distinction between, on one hand, the strata of a certain age and, on the other, time itself. The distinction has nevertheless been the subject of much discussion including how something that is material (the strata) can have time boundaries. Ager had strong opinions on stratigraphic nomenclature and procedure "We have managed to confuse ourselves for years with the jargon of lithostratigraphy, biostratigraphy, chronostratigraphy and the rest. In fact it can well be argued that basically there are only two concepts—rocks and time—with the rest just an obfuscation of the nomenclature" (p. 98–99). In what may be the most prominently placed attempt yet to address this "obfuscation", Zalasiewicz et al. (2004), suggest or, to be precise, offer for discussion, that it may be time to abolish the distinction between time-rock units (chronostratigraphy) and geological time units (geochronology). Chronostratigraphy would then be referring to time units and geochronology would revert solely to dating and ordering of geological events. Thus, no more "Lower" this or that. A cornerstone in the argumentation of Zalasiewicz et al. (2004) is that the traditional distinction has become unnecessary by the adoption of global stratotype sections and points (GSSPs), of which Ager was a staunch advocate (see the home page of the International Commission on Stratigraphy for a useful online source). The distinction may remain valid on philosophical grounds (spikes cannot be driven into time, etc.) but for all practical purposes I agree with the suggestion of Zalasiewicz et al. (2004). I doubt future generations of students will feel cheated if the distinction fades away. Zalasiewicz (2004) provides further thoughts on the pros and cons of this topic.

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Speaking of time and stratigraphic nomenclature, it is worth to keep in mind Hofmann´s (1990) Geon concept, in which Earth history is divided into blocks of 100 million years. This has considerable didactic value and I find it surprising that it appears to have been rather little used. For example, and by lucky coincidence, the early radiation of bilaterians is arguably confined to Geon 5 (that is 600-500 Ma BP). It gets rather tiring after a while to write something like "the events taking place at the Precambrian–Cambrian boundary" (and purists will remind you that Precambrian is not a formal unit). The Geon concept is compact and informative and in this case also removes attention to the boundary itself, which is after all an arbitrary entity.

Phanerozoic system (period) boundaries have been traditionally established on biostratigraphy. Had the search for the base of the Cambrian been conducted today, chemostratigraphy would have presented a serious alternative to biostratigraphy. This is because of a widely recognized, and rather short-lived (e.g., Amthor et al. 2003), carbon isotope excursion close to the Proterozoic–Cambrian boundary. Arguably this would have been an example of what Ager called "event stratigraphy", though in this case the cause of the event is unclear. The GSSP for the base of the Cambrian is nevertheless unique in that it was defined on trace fossils, reflecting the dramatic increase in diversity and complexity of trace fossils taking place during Geon 5. In relation to terminal Proterozoic–Cambrian trace fossils it is perhaps time to ask some basic questions about what trace fossils are and to remind ourselves about the often episodic nature of sedimentation.

Here, we may once more hark back to one of Ager's cherished topics, that the stratigraphic record is more gaps than record. "The stratigraphic record is a lot of holes tied together with sediment. It is as though one has a newspaper delivered only for the football results on Saturday and assumes that nothing at all happened on the other days of the week" (p. 53). One concern in the analysis of trace fossils in storm-influenced settings is that the time of sedimentation does not represent "normal" conditions. To quote Ager once more "... the history of any part of the Earth, like the life of a soldier, consists of long periods of boredom and short periods of terror" (p. 141). If storms are so rare that they are unlikely to be faced by animals of any given population, there will be no preparedness and no adaptation to these conditions. Storms may in fact displace or otherwise stress animals, so that the traces produced do not represent the animals' "normal" behaviour (see Jensen and Atkinson 2001). Such traces may be uncommon, but I nevertheless think it is prudent not to assume automatically that trace fossils represent business as usual.

A more serious concern is the inevitable taphonomic bias of the trace fossil record. The stratotype section for the base of the Cambrian, located in Newfoundland, is interpreted as largely representing subtidal storm-deposits. In this setting, storm-induced currents will to varying degrees remobilise surficial sediments. The modest depth and intensity of bioturbation in the earliest Cambrian arguably would have made fine-grained sediment less prone to current-induced erosion (see Droser et al. 2002). Proterozoic to earliest Cambrian sediments may therefore have been particularly sensitive in picking up the early record of animal activity. Even so, the preservation potential of truly surficial or very shallow infaunal traces arguably would have remained low (this is a topic much in need of experimental studies), and may have varied locally and between different depositional settings.

The decision to define the base of the Cambrian on trace fossils has not been universally applauded. The consequences of recent modifications of the stratigraphic range of key ichnotaxa in the type section (Gehling et al. 2001) need be further explored, but I suspect they are not fatal. Or, put another way, there were no obviously superior alternatives at the time. In any case, the establishment of a GSSP is not an end in itself but must be followed by attempts at improved precision in the correlation of this point to other sections. I'll let Derek Ager (p. 110) have the final word on the topic "It does not matter whether the golden spike is hammered in somewhere in England or in France or in China, so long as we can make an arbitrary decision, stop arguing about words and get on with the much more difficult (but much more rewarding) task of correlation."

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