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Ediacaran lichens – a reply to Waggoner

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It is pleasing to see Waggoner take seriously my heretical reinterpretation of Ediacaran fossils, even to the extent of agreeing that some Precambrian fossils from Namibia and China may indeed have been lichens. I also agree that more needs to be done. My paper outlined several potential lines of inquiry additional to isotaphonomy, including studies of Vendobiont size, morphology, microstructure, paleoenvironments, and biostratigraphy. For the near future my contributions to this question include reevaluation of the putative Witwatersrand lichens mentioned in my paper, together with new lichenlike fossils from the 2.2 Ga Waterval Onder paleosol of South Africa. There also arose a recent opportunity to restudy the compaction of the Devonian lycopsid *Haplostigma* in quartz sandstone from West Beacon, southern Victoria Land, Antarctica. The lichen hypothesis opens up a variety of new tests for evaluating the biological meaning of Ediacaran fossils.

The limitations of sample size of Vendobionta and the dissimilar matrix of the jellyfish *Essexella* in my study were made painfully obvious in my paper, but are not fatal to my conclusions. I collected the fossil Vendobionta myself, and this made a critical difference because I could see that all but one found in float were *raised impressions*. This form of preservation is unknown in fossil logs and unexplained by Waggoner's ingenious mechanism of compactional deformation of associated shaly beds. I would like to hear more about his idea of lateral injection of clay from slab and thin section studies of specimens preserved in part and counterpart. My Vendobiont specimens appear quite typical compared with those of museum collections, which generally do not have recorded ori-

entations. In recent years many of the Ediacaran localities have had stones systematically upturned in the hope that new specimens would be enhanced by weathering. This procedure makes original orientation uncertain. As to the Pennsylvanian jellyfish preserved in siderite, I collected only the most deeply impressed specimens of these generally indistinct fossils. They are quite common near Essex, Illinois, because collectors leave these blob-nodules behind, disappointed that they did not find something more exciting. Because siderite is less compactible than sandstone or shale, my data indicate *minimal* compaction of fossil jellyfish preserved sideways. Jellyfish in noncalcareous quartz sandstone buried some 5 km would have been preferable, but I know of none, other than supposed medusoid Vendobionta. I support Waggoner in the call for data on the compaction of fossil jellyfish and of Devonian lichens (such as *Spongiophyton* of my article).

Also like Waggoner, I see no problem with the high relief of mold and cast preservation typical for burrows, tracks, and trails, and found in some Ediacaran body fossils, such as *Protoechiuris* and *Ernietta* from Namibia. These trace fossils and hollow or rotted body fossils gained mechanical strength from included sand. Compressions of body fossils on the other hand are flattened during burial according to their thickness and toughness (a combination of strength and density, not necessarily the same as "stiffness" of Waggoner's comment, which involves rheidity). As Waggoner points out, this implies that the body was there for the burial to 5 km, so that carbonized remains should be found, and could be revealing. His report of carbon and pyrite films in Winter Coast Vendobionta is exciting

because paleobotanists have been able to extract much histological detail from fossil plants permineralized by pyrite. Such discoveries are unlikely for Vendobionta in South Australia and Namibia, where Precambrian rocks have been reddened and deeply leached by Cenozoic lateritic weathering. Similarly, *Haplostigma* stems from South Africa and Antarctica have not been found with original carbon remaining. One of the main points of my paper was that the well established preservational terminology of paleobotany is useful for the study of Vendobionta.

My hypothesis that Vendobionta were lichens was the basis for my use of line shading, rather than conventional stipple, in illustrating a variety of Vendobionta. This ar-

tistic decision was made to encourage a new look at these fossils, a view that did not sit well with Waggoner and probably others, because it would require sweeping taxonomic and conceptual revision of much past work. Lichen species for example are more variable in external morphology than animal species, and do not have "heads" or "tentacles." To the variety of morphological reasons that falsify interpretation as animals or protists given by Adolf Seilacher, can now be added my preservational arguments concerning Vendobiont toughness. On the other hand, I was unable to falsify the lichen interpretation of any Vendobionta, and invite all to demonstrate with data why these enigmatic fossils could not have been lichens.