Toppling tetrapod trees at Joggins, Nova Scotia

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First described by J.W. Dawson in the early 1800s, the Upper Carboniferous lycopod tree stumps from Joggins, Nova Scotia are famous for their enclosed terrestrial fauna, including millipedes, gastropods (*Dendropupa*), and tetrapods. Particularly notable is the occurrence of the oldest-known amniote, *Hylonomus*. The taphonomy of the stump assemblage has been a matter of some debate since it was found. Dawson considered several hypotheses, but favoured the "pit-fall trap" model where tetrapods fell into a pit formed as sediment piled around the hollow tree. The persistent association with charcoal has suggested fire played an important role, possibly producing fire scars on the trees that were used as entry points for long-term occupation of the stumps (denning), or perhaps even immolating the inhabitants in their refuges.

Until recently, differentiating these hypotheses and other scenarios has been hindered by the limited amount of Dawson's original material that was preserved in museums, usually only the thin charcoal- and bone-bearing layers. A concerted effort by the authors and by others to recover new tetrapod-bearing trees from Joggins has yielded several new discoveries. Rather than the single horizon recognized by Dawson, tetrapod-bearing trees are now known from much of the Joggins Formation. Thus, the preservation was not a unique taphonomic event. Additionally, a new tree from Dawson's horizon itself was recovered last year, allowing direct comparison of the taphonomy of the "classic" horizon with the new discoveries. The material discovered to date demonstrates fair sedimentological diversity, from mudstone-infilled to sandstone infilled, yet still consistently shows a stratigraphic pattern similar to Dawson's original description: blocky charcoal with rare bones followed by fine-grained, laminated, bone-bearing charcoal, followed by decreasing charcoal abundance and more clastic sediments. A mud-intraclast conglomerate is also present in many stumps, the significance of which is unknown.

Besides detailed microstratigraphy, the newest trees have also shown in-situ tilting of a tree trunk that affected its infill, a new specimen of "scales" originally attributed to tetrapods by Dawson, and a variety of millipede remains. Recovering stumps and managing their analysis in the field and lab is a logistical and technical challenge, but results to date with photogrammetry and computed tomography X-rays show great potential for unraveling their story.

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