

PLANT-ARTHROPOD INTERACTIONS FROM EARLY TERRESTRIAL ECOSYSTEMS: TWO DEVONIAN EXAMPLES

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Although terrestrial plant-arthropod interactions during the Devonian and earlier are poorly understood when compared to the later Paleozoic, intriguing new discoveries from the Rhynie Chert of Scotland, the Welsh borderlands, and elsewhere are beginning to shed light on this aspect of early terrestrial ecosystems. We report two Canadian additions to our knowledge: the first is coprolites containing plant tissues from the Lower Devonian of Gaspé, Quebec; the second is mycophagy in the fungus *Prototaxites* from the Upper Devonian Kettle Point Formation of Lambton County, Ontario.

The coprolites are from the lower Emsian Cap-aus-Os Member of the fluvio-deltaic Battery Point Formation, exposed on the northern shore of Gaspé Bay, Québec. They occur in a light gray siltstone on one bedding plane within a series of horizons bearing dense mats of plant axes attributable to a new species of *Stockmansella* (Rhyniopsida sensu Kenrick and Crane), characterized by narrow, leafless, rarely branched axes probably no more than 10 cm high and 0.5 cm wide. The coprolites are barrel- to ellipsoidal in shape, with bluntly rounded or tapered ends, and measure approximately 5 to 12 mm long and 3 to 5 mm wide. Internal structure consists of subparallel sheets of cuticle in a spongy, brown matrix that probably represents degraded to partly digested cell wall material. A high percentage of the recognizable cuticle fragments closely resemble *Stockmansella* sp. nov. since they often display the same type of longitudinal folding or thickening that characterize the megafossils. Indurated tissues such as tracheids or spores are extremely rare in these coprolites, suggesting preferential feeding on soft tissues. Notably, *Stockmansella* lacked hard tissues except for a central narrow vascular strand, and thus would have served as an attractive food source. The coprolites were probably produced by a millipede, extant members of which are almost exclusively detritivorous.

Prototaxites is a large, log-shaped, terrestrial Devonian organism variously attributed to marine algae or to an extinct terrestrial group of unknown relationships. One of us (FMH) has amassed several lines of evidence strongly supporting its interpretation as a septate member of the Eumycota, analogous to modern bracket fungi. The internal structure of *Prototaxites* consists of two types of large (30–50 μm diameter) hyphae oriented with their long axes parallel to the organism's long axis and entwined by a mass of smaller (5 μm diameter), highly branched, septate hyphae. Specimens of *Prototaxites southworthi*, first described by C.A. Arnold in 1952, are extensively penetrated by linear to gently meandering tunnels that average 0.69 cm in maximum diameter. These tunnels occasionally enlarge into galleries that are 2 to 3 times the tunnel width and contain hemispheroidal embayments into host tissue. Excavation of tunnels and galleries clearly occurred when the host was alive, since tunnels exhibit infilling hyphae of secondary reaction tissue. These tunnels also contain coprolites of degraded fungal hyphae and angular, macerated, but apparently undigested tissue fragments. The culprit was a relatively large arthropod boring into a hard, wood-like substrate. However these borings are an anomalous occurrence since there is no known, appropriate, Late Devonian candidate for this life habit. Oribatid mites construct tunnels an order of magnitude smaller. Millipedes, although known to consume live root tissues, are not endophytic in live fungal or plant tissues. The most plausible candidate—holometabolous insects—are frequent borers of bracket fungi, but do not appear until the Late Pennsylvanian. Notably, *Prototaxites* becomes extinct during the end-Devonian, suggesting its arthropod borer may have suffered the same fate.

Emerging evidence now indicates that trophic diversity (plant-based detritivory, mycophagy, and herbivory) and strategies of tissue consumption (external feeding, boring, and piercing-and-sucking) were established by arthropods by the Late Devonian.