

Fossil Myriapod Trails in the Permo-Carboniferous Strata of Northern Nova Scotia, Canada

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Several new localities of the trace fossil, *Diplichnites*, have been found in the Permo-Carboniferous strata of northern Nova Scotia. The trails at Cape John, Pictou County, Nova Scotia are the largest and the youngest (Early Permian) record to date of this ichnogenus attributed to myriapods. At the Smith Point locality the trails are numerous, well preserved and have a turning configuration. Poorly preserved trails are also found near Pugwash, Cumberland County, Nova Scotia. The trails at Smith Point and Pugwash are late Westphalian in age. These trails are attributed to the giant Carboniferous myriapod, *Arthropleura*.

Les strates permo-carbonifères du Nord de la Nouvelle-Ecosse ont livré plusieurs nouveaux gisements de la trace fossile *Diplichnites*. Les traces de Cape John, dans le comté de Pictou en Nouvelle-Ecosse, sont les plus larges et les plus jeunes (Eopermien) connues à ce jour pour cet ichnogenre que l'on attribue aux myriapodes. A la localité de Smith Point, les ichnites sont nombreuses, bien préservées et montrent des trajets en virage. On a aussi découvert des traces mal préservées près de Pugwash, dans le comté de Cumberland en Nouvelle-Ecosse. Les pistes de Smith Point et de Pugwash sont d'âge tardilwestphalien. On attribue ces pistes à *Arthropleura*, un myriapode géant du Carbonifère.

INTRODUCTION

The localities of the trace fossils described in this paper are: (1) along the shore, 500 m north of Reef Point near Cape John, Pictou County, Nova Scotia; (2) Smith Point, along the Northumberland Strait shore, 2.1 km west of Smith Point, Cumberland County, Nova Scotia; and (3) Pugwash, along Pugwash Harbour shore, 1.1 km north of the Highway 6 bridge at Pugwash, Cumberland County, Nova Scotia (Fig. 1).

Briggs et al. (1984) described in detail the morphology of a *Diplichnites culthensis* from the Tynemouth Creek Formation of southern New Brunswick and compared it with the trails previously described from Joggins, Nova Scotia (Ferguson, 1966). In addition they attributed these trails to the myriapod, *Arthropleura* (Fig. 2).

The first trails linked to *Arthropleura* were those reported from

Joggins, Nova Scotia, from the Cumberland Group of Westphalian B age (Ferguson 1966, 1975). A Namurian specimen from Arran, Scotland (Briggs et al., 1979) and a Stephanian specimen from Montceau-Les-Mines, France (Langiaux and Scotty, 1977; Rolfe et al., 1982) may also be trails produced by fossil myriapods.

GEOLOGICAL SETTING

The trace fossils occur at two stratigraphic horizons within the Permo-Carboniferous strata of northern Nova Scotia. The older, smaller trace fossils at Smith Point and Pugwash occur within the Cumberland Group of Westphalian B-C age. The larger, younger trails are found in the Pictou Group of Stephanian to Early Permian age (Fig. 3).

Ryan (1984, 1985) established the basic stratigraphy for the Permo-Carboniferous strata of the Tatamagouche Syncline area of Cumberland Basin (Fig. 3).

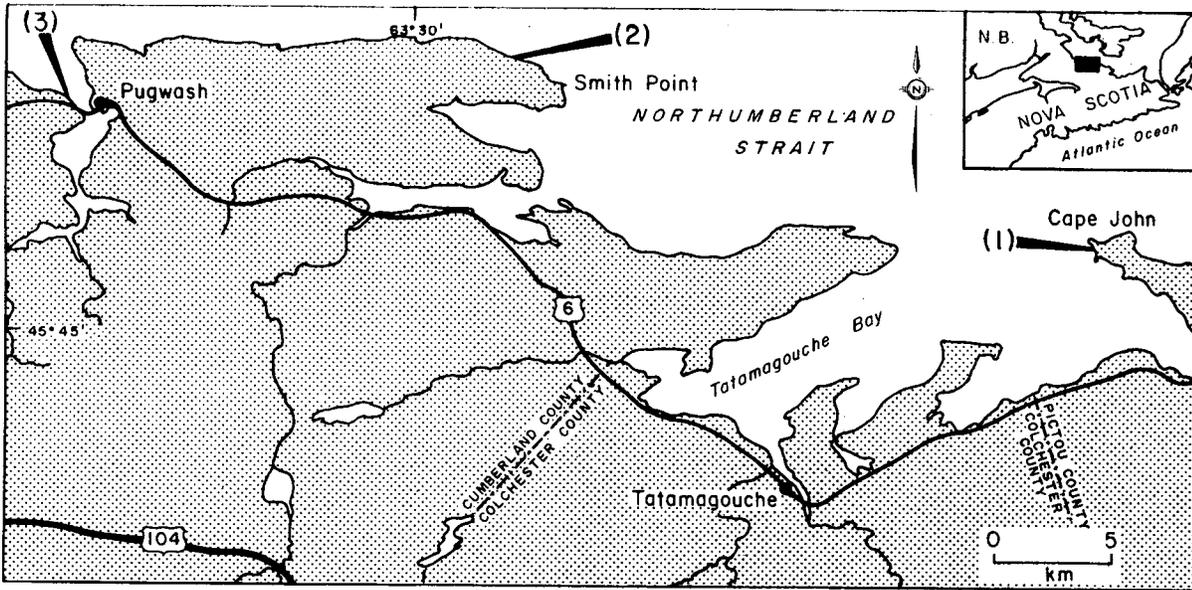


Figure 1. Location map for the *Arthropleura* trails in northern Nova Scotia; 1) Cape John 2) Smith Point 3) Pugwash.

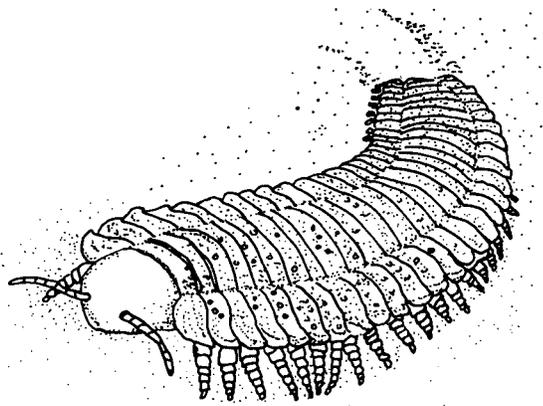


Figure 2. Reconstruction of *Arthropleura* (after Briggs et al., 1984).

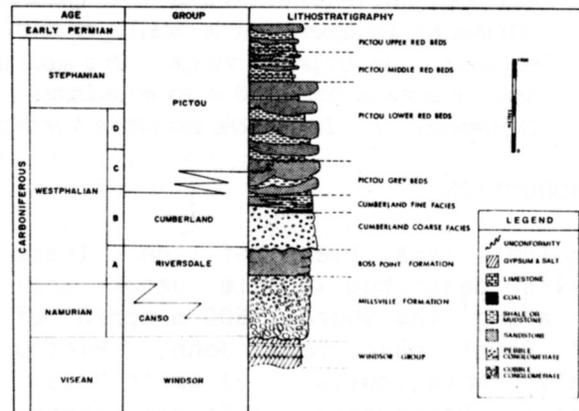


Figure 3. Lithostratigraphy of the Permo-Carboniferous strata in the northeastern Cumberland Basin, Nova Scotia.

The trace fossils at Smith Point and Pugwash occur within the "fine facies" of the Cumberland Group. The Cumberland "fine facies" is made up of continental, grey to red-grey, calcareous mud-chip conglomerate, arkosic coarse grained sandstone, subarkosic medium- to fine-grained sandstone, siltstone and mudstone and minor amounts of coal, limestone and shale. The sandstone and conglomerate are trough cross-stratified and were deposited in low sinuosity streams.

The *Arthropleura* trails at Cape

John occur in the upper redbeds of the Pictou Group (Ryan, 1984) in the Tatamagouche area (Fig. 3). These redbeds are Permian in age. The Pictou Group rocks of the Tatamagouche Syncline are composed of fluvial cycles of red to grey conglomerate, arkosic sandstone, siltstone and mudstone. The upper redbeds are interpreted as being deposited within anastomosing stream systems, with sediment transport and accumulation primarily being the result of dune progradation at the base of the channels (Ryan, 1985).

INTERPRETATION AND DISCUSSION

Description

Cape John Locality

Three trails are found at this locality (Fig. 4). Two of the trails, A and B (Fig. 5), cross each other with a third trail occurring near the top of the exposed outcrop. All three of the trails exhibit similar average widths and are therefore attributed to trails made by a single *Arthropleura* (Fig. 4). The two longer trails, A and B, are 2.75 m and 2.5 m respectively. Trail C is approximately 1.5 m in length. The width of the trails varies from 46.3 cm to 50.25 cm with an average of 47 cm width in the straight sections. All three of the trails exhibit variable degrees of turning with trail C having



Figure 4. *Arthropleura* trails, Cape John, Pictou County, N.S. Scale is 25 cm.

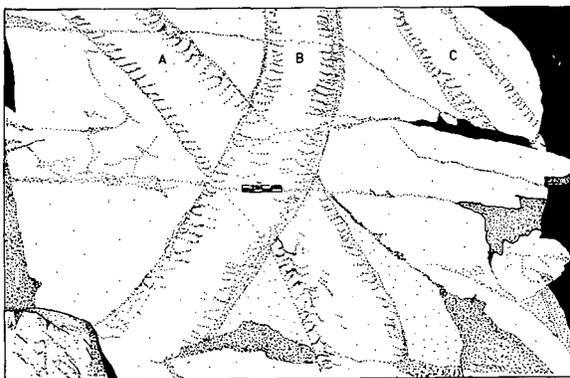


Figure 5. *Arthropleura* trails, Cape John, Pictou County, N.S. Scale is 25 cm.

the most acute turning radius. Briggs et al. (1984) presented a detailed discussion of the turning mechanics of *Arthropleura*.

The trails are simple with two parallel rows of tracks, each up to 13 cm wide. The tracks are elongate and near normal to the trail axis. There are 28 track depressions per metre on each side of the trail, although some coincident footfalls probably occur. The depth of the tracks (up to 1.3 cm) varies, in part due to the differential outcrop weathering, and also due to the sorting, packing and grain size of the host sandstone.

Smith Point Locality

Twenty-five well preserved trails, as well as several poorly preserved trails, are found on two separate surfaces at this locality. The lower surface has nineteen well preserved trails (Fig. 6) and the upper surface has six trails (Fig. 7).

All of the trails on the lower bedding surface exhibit the same average width of 37 cm. The width varies from 35.2 cm to 40.0 cm, with the average width of 37 cm occurring in the straight sections of the trails (Figs. 8, 9). The lower trail bedding surface is 30 m in length and is from 1.2 m to 3.0 m in width. The upper bedding surface is 8 to 9 m long and approximately 1.5 m wide. The two surfaces are separated by 1.3 m of cross-stratified, medium grained arkosic sandstone. At this locality, one of the trails on the upper surface has a preserved turn of about 300 degrees (Fig. 10).

The trails are simple and similar to the trails found at Cape John. They consist of two parallel rows of tracks, each up to 11 cm wide. The trails of the upper surface are up to 40 cm wide and have an average width of 37 cm. The tracks are nearly perpendicular to the trail axis, although they vary more than the Cape John trails. The tracks are closely spaced, 24 per metre per side, and attain a maximum depth of 3 cm. Crossover of trails is common.

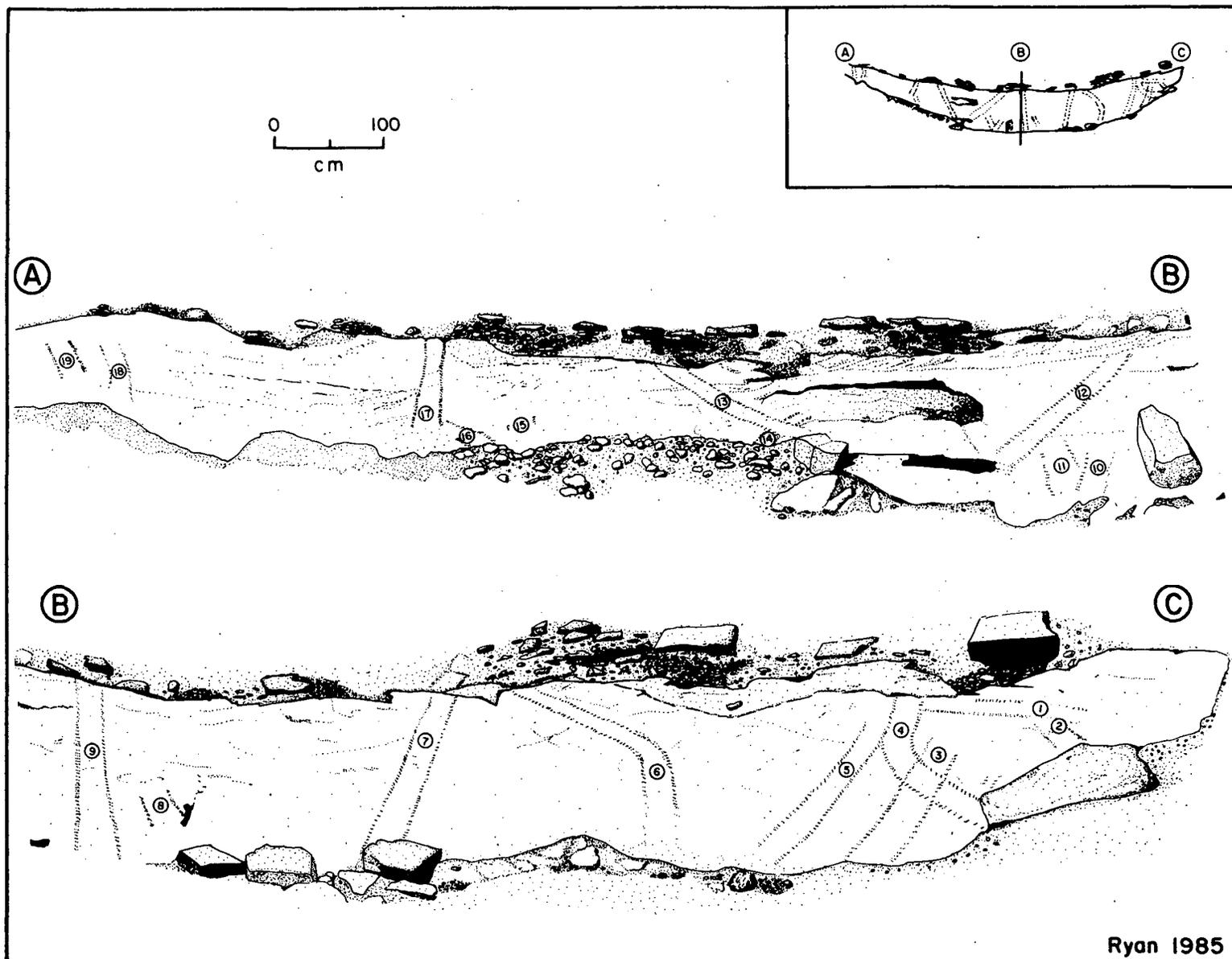


Figure 6. *Arthropleura* trails, Smith Point, Cumberland County, N.S. Scale is 21 cm.

The trails on the upper bedding surface are smaller, with an average width of 32 cm.

Pugwash Locality

Twelve poorly preserved trails (undertracks) are found at this locality. The trails are nearly identical to the trails at Smith Point. The width of the trails is approximately 38 to 41 cm. There are 22 to 24 track depressions per side per metre. The depth of the tracks varies from 2 to 3 cm and the width is 8 to 10 cm. Only slight turning of the trails is evident at this locality and crossovers are absent. The coarse grained nature of the sandstone and the severe coastal weathering has obliterated much of the detailed

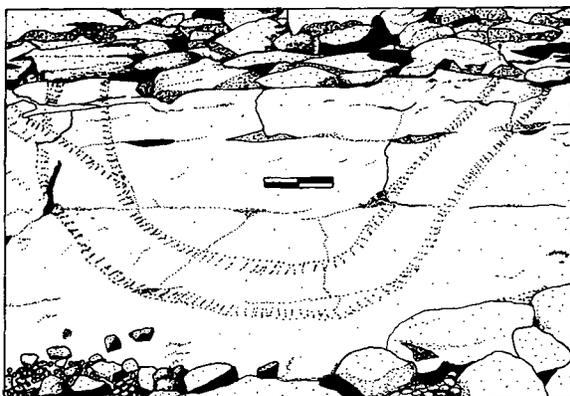


Figure 7. Turning *Arthropleura* trail, upper trail surface, Smith Point, Cumberland County, N.S. Scale is 21 cm.



Figure 8. Trails 13 & 14, Smith Point, Cumberland County, N.S.

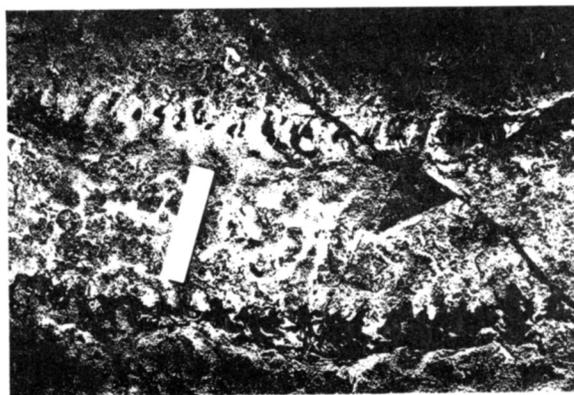


Figure 9. Detail of footfalls in Trail No. 9, Smith Point, Cumberland County, N.S. Scale is 21 cm.

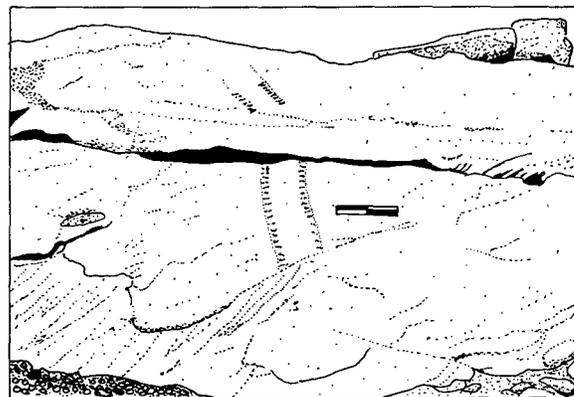


Figure 10. *Arthropleura* trails from Pugwash, Cumberland County, N.S. Scale is 21 cm.

morphology of the trails.

Environmental Setting

The trails are preserved in pebbly arkosic sandstones which are overlain by thin veneers of mudstone, preserved on some of the trail surfaces. In coarser sandstones there is poor preservation of the trails, with only the undertracks preserved.

The sandstones at all of the localities were probably deposited during flood stages as mid-channel prograding dunes which were subsequently subaerially exposed as channel bars during a dry period.

The *Arthropleura* passed over the beds, possibly scavenging for decaying plant material stranded on the emerging

bars (Briggs et al., 1984).

The Trailmaker

The size, regularity in the spacing of the tracks and the depositional environment of the fossil localities suggest that the trails were made by *Arthropleura* (Briggs et al., 1979). The arthropleurids are an extinct group of giant centipede-like myriapods of Carboniferous age. The body length is approximately 3.75 times the width, based on reconstructions by Briggs et al. (1984), which suggests that the *Arthropleura* responsible for the trails at Cape John would be at least 1.70 m in length (Fig. 2).

SYSTEMATIC PALEONTOLOGY

Ichnogenus *DIPLICHNITES* Dawson, 1873 (emended Briggs et al., 1984)

Type Ichnospecies *D. aenigma* Dawson, 1873, by original monotypy.

Emended diagnosis *D. culthensis* (modified after Briggs et al., 1984). Morphologically simple trail, up to 50.25 cm wide, consisting of two parallel rows of tracks, each up to 13 cm wide; width of the exposed rows increasing on curves corresponding to greater lateral separation of individual tracks, each row may divide into two, on acute curves; individual tracks elongate roughly normal to trail axis, spaced closely and regularly at as few as one per cm in large examples.

Horizon: Namurian to Early Permian.

Remarks: The diagnosis is slightly emended by the extension of the trail width from 37 cm to 50.25 cm and the width of the tracks from 11 cm to 13 cm. The trails at Smith Point and Pugwash are very similar to *Diplichnites culthensis* and are therefore assigned to that species. The trails from Cape John are larger and younger than others previously described but are tentatively assigned to the same species. Recovery of casts of the trails is presently being undertaken by the Nova Scotia Museum under the direction of Bob Grantham.

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