NEW XIPHOSURID TRAILS FROM THE UPPER CARBONIFEROUS OF NORTHERN ENGLAND

by P. G. HARDY

ABSTRACT. Trails from the lower surfaces of sandstone bands in the Upper Haslingden Flags (G Stage, Namurian) of the Rossendale area of Lancashire are attributed to arthropod (xiphosurid) activity. The trails are associated with *Pelecypodichnus* Seilacher which here result from the activity of non-marine bivalves. The xiphosurid trails are therefore considered of non-marine origin. The trails differ from those previously described in that in addition to walking activity, burrowing by the xiphosurid is recorded. For convenience these new trails are referred to *Kouphichnium rossendalensis* sp. nov.

TRAILS of xiphosurid origin have been found in loose blocks from the upper part of the Upper Haslingden Flags (G Stage Namurian) in Rossendale, Lancashire (for details of the stratigraphy see Wright *et al.* 1927). The trails occur on the sharply defined under surfaces of flaggy sandstone bands which generally are interbedded with siltstones. The sandstones associated with the trails exhibit a number of sedimentological structures including large-scale planar cross-bedding, small-scale asymmetrical ripples, interference ripples, micro-cross lamination, and ball and pillow structure. The Upper Haslingden Flags are essentially lens shaped, thinning in all directions from their strongest development in the Whitworth area of Rossendale where they exceed 100 ft. (30 m.) in thickness. The thickness is now known to exceed the figure quoted by Wright (in Wright *et al.* 1927). Together with the sedimentological evidence of clean, well-sorted, ripple-marked sands there seems to be evidence to suggest a sandbank type of environment during deposition of the Flags. Trails of xiphosurid origin are well known from various horizons including the Upper Carboniferous and have been described by many authors. A bibliography up to 1938 is given by Caster (1938). Subsequent papers include those of Caster (1940, 1941, 1944), Linck (1943), Brady (1947), Glaessner (1957), Häntzschel (1962), Malz (1964), King (1965), and Bandel (1967). Limulid trails previously supposed to have been of vertebrate origin have been given various names. Many earlier names are inappropriate and *Kouphichnium* (Nopcsa 1923) is now generally used for these trails (see Häntzschel 1965). Previously described trails have featured mainly evidence of walking activity e.g. appendage marks, genal spine drag marks, and telson marks. In this instance a new species of the genus *Kouphichnium* seems justified as there is clear evidence of burrowing activity which has only been described previously from modern *Limulus* trails (see Caster 1938, pl. 12, fig. 2).

DESCRIPTION

Genus KOUPHICHNIUM Nopcsa 1923

Kouphichnium rossendalensis sp. nov.

Plate 40

[Palaeontology, Vol. 13, Part 2, 1970, pp. 188–90, pl. 40.]

Holotype. Geology Department, Manchester University, SF3.

Diagnosis. Trails comprise lunate casts corresponding in outline to the shape of the xiphosuran prosoma, often in a series, and associated with appendage and telson marks.

Description. The trails are preserved as an irregularly meandering series of lunate casts the width of which is in general 16–17 mm. although some are smaller, 9–11 mm. The casts are deepest at the anterior convex end, where they project 2·5–3·5 mm. below the surface. Posteriorly each cast shallows, and most pass directly into the preceding cast at a distance of between 0·5–2·0 cm. Where the casts are less closely spaced, and in a few more or less isolated casts, they often resolve (see Pl. 40, inset) into 2 rows of appendage marks of circular plan which appear to be in a series *en echelon*. Behind many of the lunate casts there is median telson cast which is strongest 2–3 cm. behind the shallow end of the lunate casts. Groups of *en echelon* marks, each elongated in plan, occur behind some telson casts in Plate 40. Up to 6 clear elongate casts can be seen in one set. In no instance has the pusher impression of the maxillipeds been observed. Very fine wrinkle-like marks occur around the convex end of some of the lunate casts. In a few examples the convex end of the lunate cast is represented by a cloven-hoof-like mark. Similar marks have been produced by modern *Limulus* (Caster 1938; pl. 12, fig. 2) when sinking vertically into the sediment.

Interpretation. The faintness of the trails at the beginning of each series of *Kouphichnium rossendalensis* sp. nov. is interpreted as due to a xiphosurid about to touch down on the sediment surface dragging telson and appendages through the sediment for a brief interval and retracting them again before finally landing to implant the first lunate mark in the sediment. It is conceivable that telson and appendages were used as a brake prior to touch down; further the use of the telson in this way would serve to depress the prosoma towards the sediment surface. It appears that the xiphosurid having landed on the sediment surface burrowed, then moved forward some few millimetres, burrowed again and so on before finally taking off into the overlying water. Although the temporal sequence of burrowing–walking–burrowing is clear the actual time involved is unknown. Associated with *Kouphichnium rossendalensis* sp. nov. is *Pelecypodichnus* Seilacher formed, apparently, by non-marine bivalves. The evidence for this statement is, (1) *Pelecypodichnus* of the Haslingden Flags is identical in form and lithological association with *Pelecypodichnus* in the sandstones above the Lower Mountain Mine at Upholland (Lancashire). Non-marine bivalves occur within the burrows of *Pelecypodichnus* in the sandstones at Upholland, (2) *Pelecypodichnus* of the Haslingden Flags is identical to *Pelecypodichnus* at the base of the Rough Rock at Billinge Hill near Bollington, Cheshire. The base of the Rough Rock at Bollington contains non-marine bivalves, (3) the Upper Haslingden Flags are followed in upward sequence by shales known to contain a non-marine fauna (body fossils) at various localities. The conclusion is reached that *Kouphichnium rossendalensis* sp. nov. is non-marine. Two genera of xiphosurid, *Belinurus* and *Euproops*, are known from the Upper Carboniferous. *Belinurus* is often found in association with non-marine bivalves (Calver 1968) and is thought to have been responsible for the trails. Specimens of *Belinurus* from the Manchester Museum were measured across the prosoma, the width of which was found to correspond closely to the total width of the trails.

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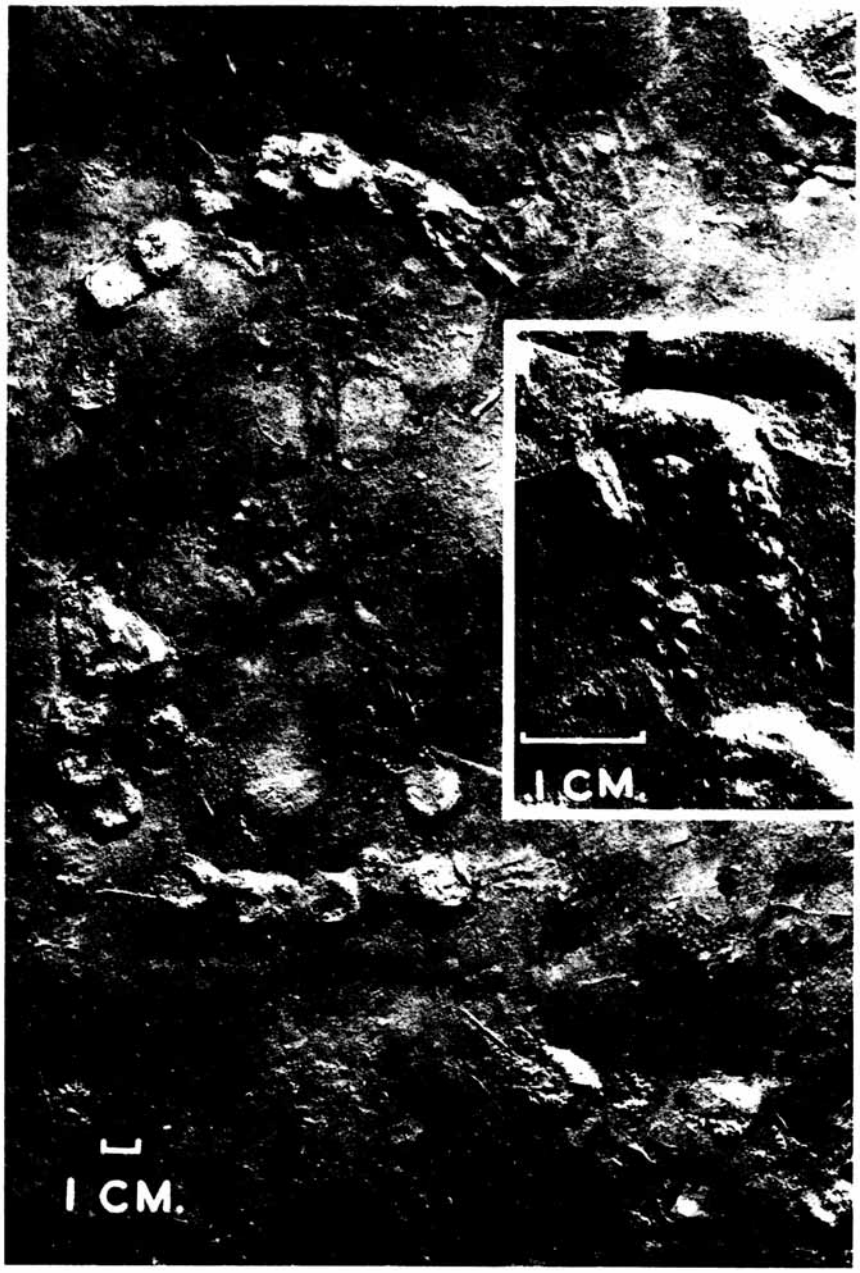
EXPLANATION OF PLATE 40

Kouphichnium rossendalensis sp. nov. holotype (coll. Geology Dept., Manchester University SF3) showing appendage marks, telson marks, and lunate casts, ×2/3. Inset, paratype showing appendage marks arranged *en echelon*, ×2, specimen SF4.



HARDY, *Kouphichnium rossendalensis*