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TREPTICHNUS-LIKE TRACES MADE BY INSECT LARVAE (DIPTERA: CHIRONOMIDAE, TIPULIDAE)

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ABSTRACT: It is shown that the abundant traces of *Treptichnus* found at the Union Chapel Mine closely resemble those made by dipteran larvae collected from temporary ponds on recent flood plains and from point bars of muddy sand exposed along rivers.

Tracemakers of most ichnotaxa remain unknown. This is ichnology's Achilles tendon, despite great effort made in this matter (e.g., Bromley, 1996). Even in terrestrial environments, where neoichnologic research is relatively easy, and some research has been done (e.g., Chamberlain, 1975; Ratcliffe and Fagerstrom, 1980; Metz 1987a, 1987b; Mángano et al., 1996), large gaps in our knowledge of tracemakers still exist. One solution is simple experimentation with animals, an example of which is illustrated in this article.

A few taxa of dipteran larvae were collected from temporary ponds on recent flood plains and from point bars of muddy sand exposed along rivers in southern Poland. The larvae were kept in tanks filled with fresh, plastic mud that was allowed to dry out. They produced several kinds of traces, which show morphologic changes according to the changing consistency of the mud.

One of the most characteristic traces is made by chironomid (midge) larvae collected from sandy mud along a river bank. They produce shallow tunnels whose roof protrudes over the mud surface. Periodically, a characteristic "knot" is produced that marks where the larva communicated directly to the surface. The knots subdivide the trace into straight to somewhat curved segments (Fig. 1). Short side branches protrude from some of the knots. The trace locally displays loops and coils (Fig. 2). This trace is no more than 1 mm wide. The morphology of the trace is very similar to the trace fossil *Treptichnus* (Rindsberg and Kopaska-Merkel, 2005). The chironomid larvae are detritus or algae feeders or carnivores. More information about their life habits is available in Oliver (1971).

The *Treptichnus*-like pattern can also be seen in larger traces produced by larvae of crane flies (Tipulidae). These are also subsurface tunnels and show the characteristic side protrusions (Fig. 3). The larvae produce mostly different furrows and subsurface tunnels, which are 2-3 mm wide. Within a certain range of mud consistency, fine, longitudinal striae can be seen in the furrows. Striae are produced by dragging the lobes and papillae around the posterior spiracle (Fig. 4). Longitudinal striation is also seen in fossil material. Tipulid larvae are efficient deposit feeders, responsible for bioturbation of mud and sandy mud along rivers as observed by the author.

Treptichnus has already been considered the product of dipteran larvae. *Treptichnus bifurcus* Miller has been compared with tabanid larvae traces (Buatois et al., 1998), based on modern subsurface tunnels illustrated by Bajard (1966, fig. 36). Taking into account the similarities outlined above, it can be hypothesized that insect larvae produced *Treptichnus* from the Union Chapel Mine. According to body fossil data, the *Diptera* range from the Permian onward (Labandeira, 1999), but the Union Chapel Mine trace fossils are dated as Late Carboniferous. It is not out of the question either that dipteran insects already existed in the Carboniferous, or that the trace fossils were produced by insect larvae of similar behavior but belonging to some other, maybe related, systematic group. The first possibility is strengthened by the fact that trace fossils have larger preservational potential than body fossils.

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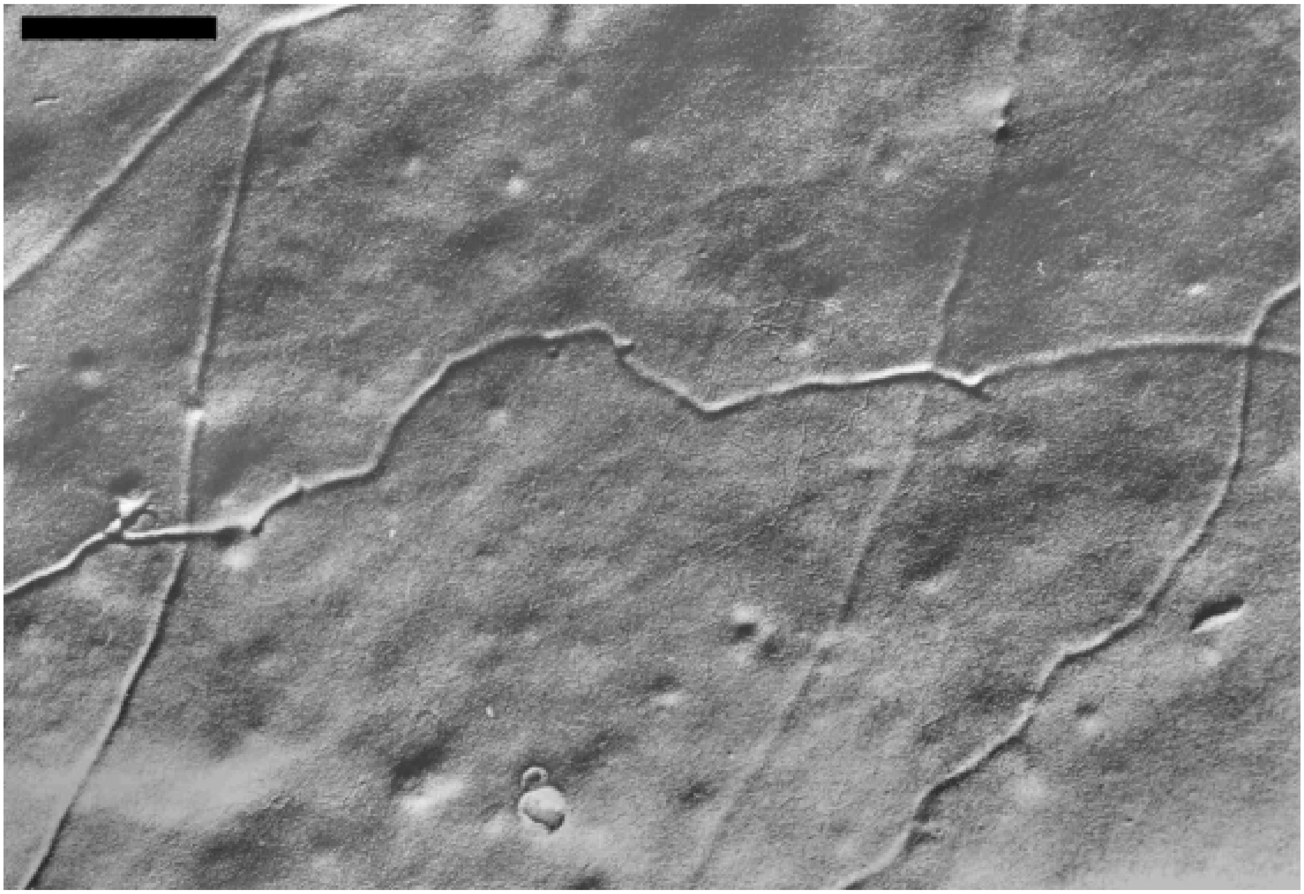

FIGURE 1. Traces produced by Chironomidae larvae in a plastic mud. The traces are subsurface tunnels. Scale bar is 1 cm long.

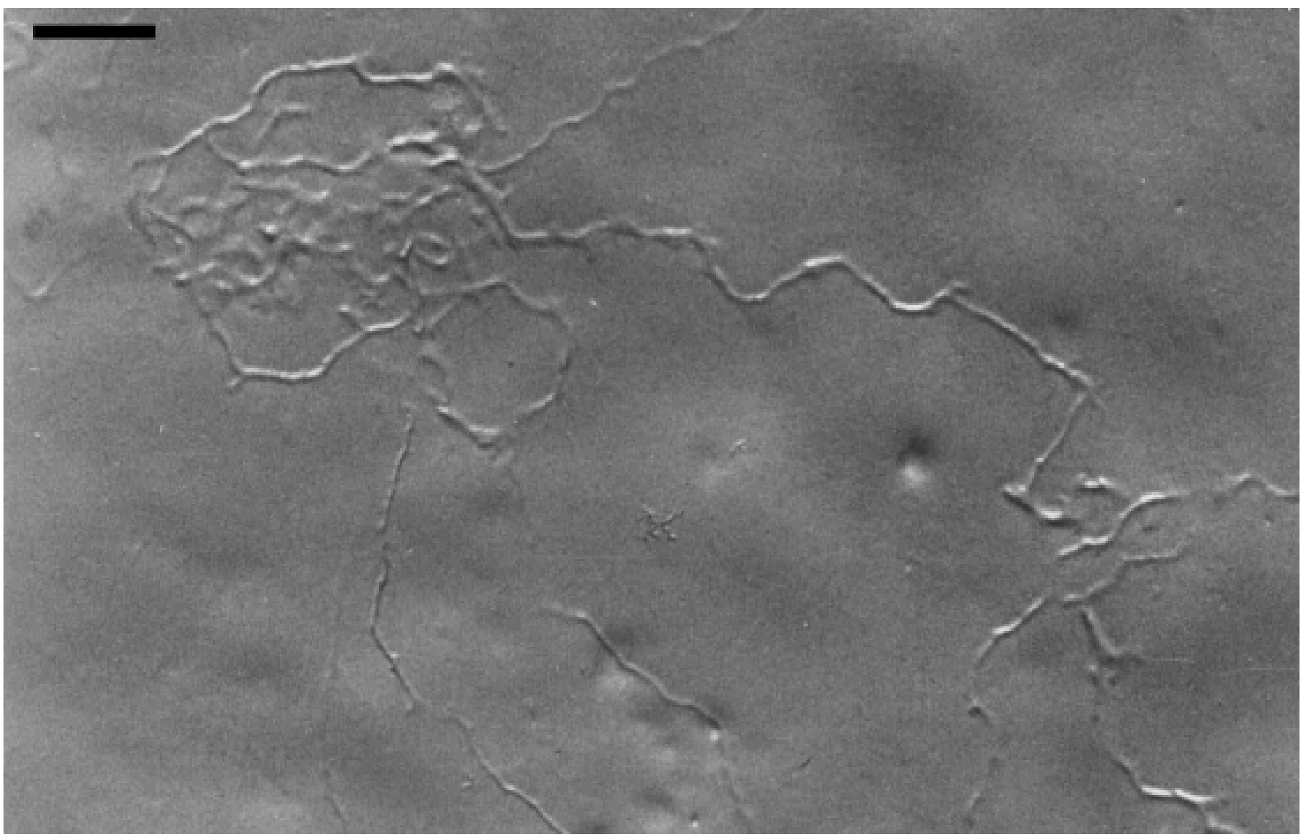

FIGURE 2. Traces produced by a chironomid larva in a plastic mud as in Fig. 1. Scale bar is 1 cm long. Note the characteristic side protrusions and coiling typical of *Treptichnus* from the Union Chapel Mine.

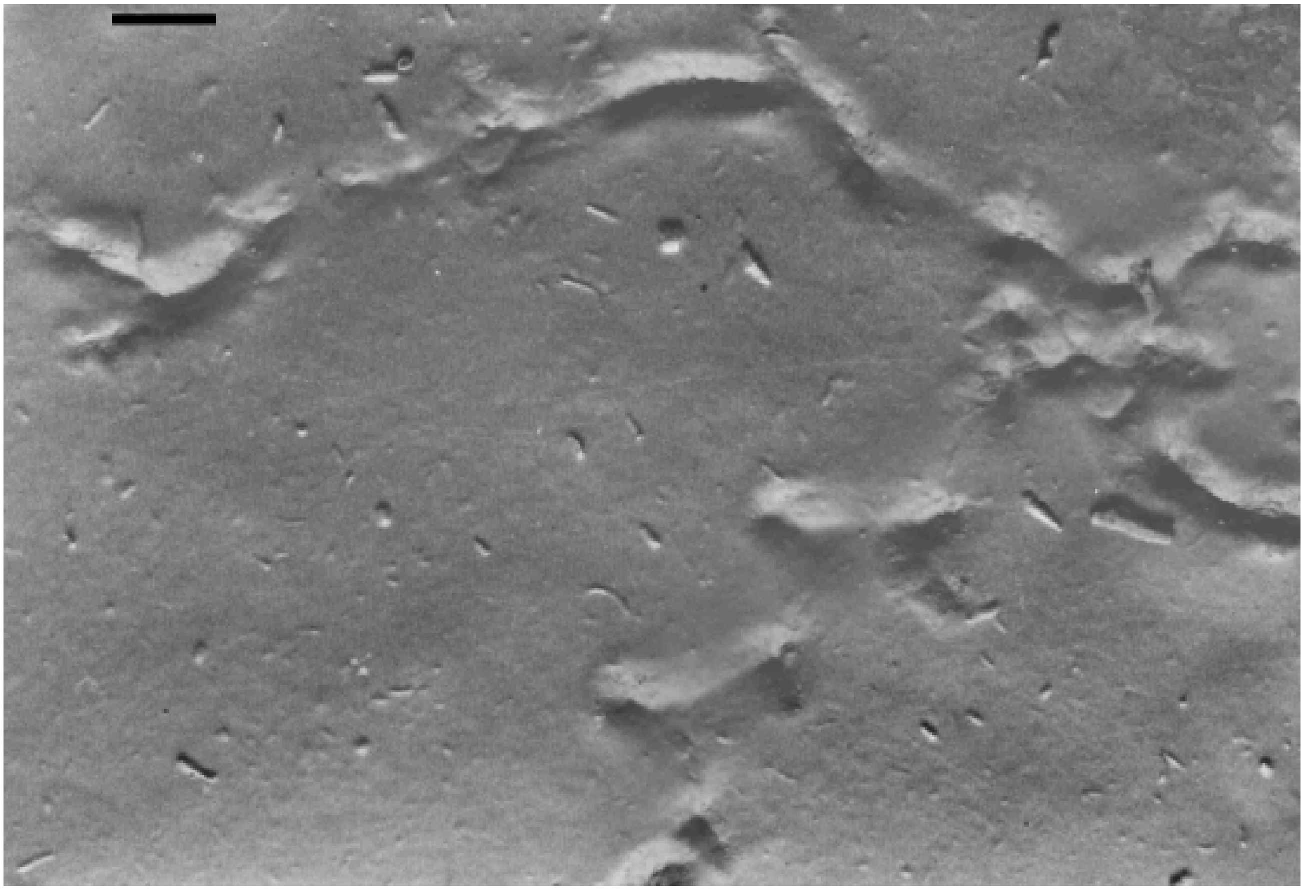

FIGURE 3. Traces produced by a tipulid larva in a plastic, low-cohesive mud. The traces are subsurface tunnels. Scale bar is 1 cm long.

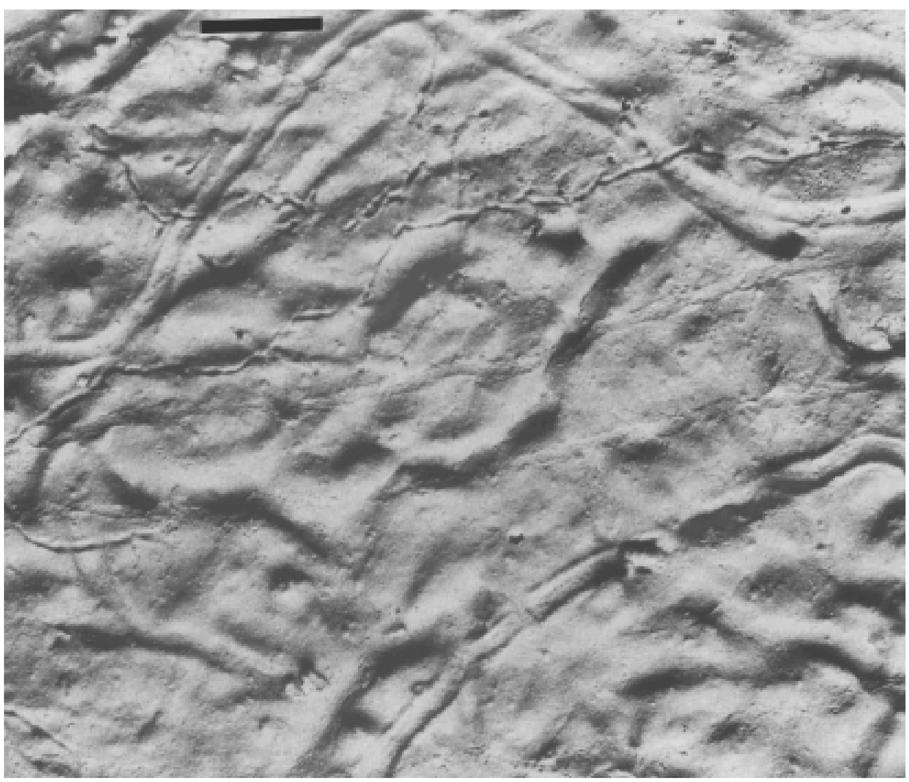

FIGURE 4. Smaller traces produced by chironomid larvae and larger traces produced by tipulid larvae. Note longitudinal striation along some of the Tipulidae traces, produced by dragging of the lobes and papillae around the posterior spiracle in relatively cohesive mud. Scale bar is 1 cm long.

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