NOTES ON SOME FOSSIL PHRYGANIDEAN LARVAL TUBES FROM THE TERTIARY OF DENMARK AND GREENLAND

by

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Abstract

Larval tubes similar to those produced by certain species of the insect family Phryganidae are described here from Tertiary deposits of Denmark and Greenland. Specimens of such larval tubes (Plate I) are commonly occurring in a layer of hardened gyttja in the lignite at Silkeborg Vesterskov, central Jutland. A single specimen has been obtained from the ferruginous shales of Igdlokunquaq (Paleogene Tertiary); *Taxodium* needles have served as building material for the larval tubes from the lignite (Neogene Tertiary). The fossils are usually found as fragments; those illustrated in Plate I, A and B (× 2) are only slightly damaged and give an idea of the original size.

Tertiary fossils of the type described here have earlier been mentioned by F. UNGER and C. v. ETTINGSHAUSEN and referred to *Equistetum*. F. UNGER (1847. Pl. 37, Figs. 8 and 9, p. 124) has figured them as *Equisetum bilinicum* with the following description: Caule erecto, simplici, obtuso, levi, 2–3 lineas lato, articulis brevibus, vaginis distinctis multifidis, lasciniis obtusis. C. v. ETTINGSHAUSEN (1867, Pl. 2, Fig. 4) illustrates similar material under the generic name *Equisetitis*. He adds nothing to the description already given by UNGER. The specimens illustrated are about 1 cm wide and 5 cm long; this is probably the original length of the fossils. These authors have obviously regarded their material as compressed tubular fragments of *Equisetum* stems, as such bounded with a wall, which, as in *Equisetum*, exhibits salient longitudinal stripes divided with furrows, alternating at succeeding nodes. Yet, a careful examination of the figures cited fails to show the very regular pattern of an *Equisetum* stem. The individual elements are of a somewhat uneven width and the transverse lines, regarded as nodes, are not perpendicular to the axis of the tube. In the insect family Phryganidae, however, the larva of some species produce tubes very similar to the specimens illustrated by F. UNGER and C. v. ETTINGSHAUSEN; in such tubes the increments are added in a spiral.

The fossil specimens from Silkeborg Vesterskov are to be regarded as flattened tubes. They show a fairly constant width (7–10 mm) and a maximum length of 5–6 cm. The original diameter of the tube is estimated as 5–7 mm. The wall of the tube is composed of carbonised vegetable material consisting of connected pieces of rather constant length (ca. 1 cm) and of only slightly variable width (1–2 mm). These pieces are arranged in transverse ranks slightly oblique to the axis.

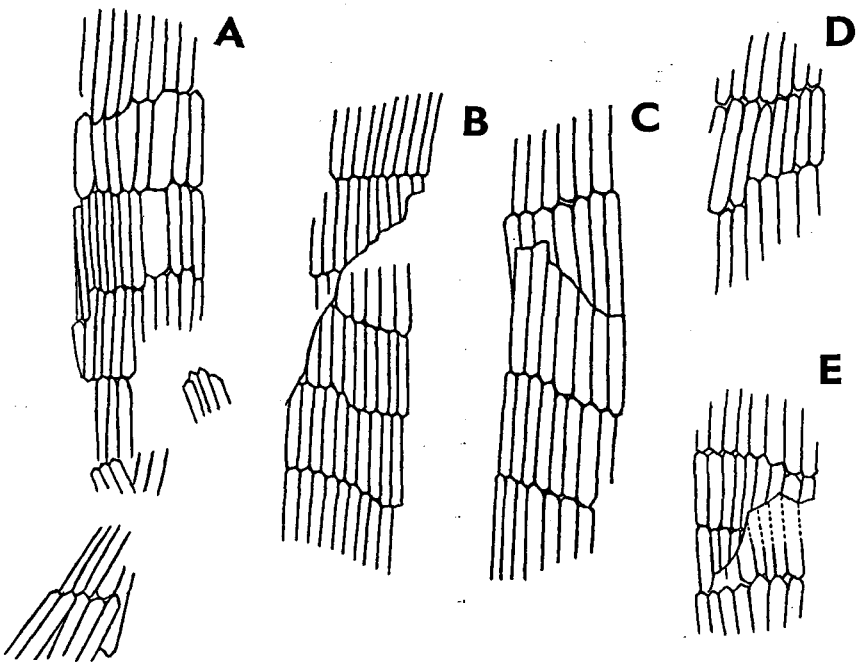

Fig. 1. Fragments of fossil larval tubes of a *Phryganea* sp. Silkeborg Vesterskov. (× 2) (A = Pl. IA. D = Pl. IE. E = Pl. IC).

In the specimens figured in Pl. I, F, the uppermost layer of vegetable substance has been largely removed so that the component parts show their contours as impressions in the surface of the included core of gyttja. Some of the fragments are only exhibiting a single layer of carbonised material, the flattened tube being bisected longitudinally by splitting up the somewhat shaly matrix. In other examples the tube is complete but has been so strongly compressed that it is difficult in transverse section to distinguish the parts of the two walls, particularly in cases where the core of gyttja is lacking. In Pl. I, C, a specimen is figured in which the upper and undermost part of the tubal wall is preserved and the inner side of the former is reproduced as imprints in the core.

Owing to the numerous transverse cracks, formed during drying of the material, it is not always easy to follow the details of the wall structure in the photographs. In order to facilitate this some specimens have been drawn under the camera lucida (Fig. 1). From these drawings it is evident that the pieces forming the wall of the tube have, as a rule, a fairly regular, highly elongated hexagonal shape. The central axial lines of the elements of one row continue as the border lines between the elements of the ranks both below and above, i. e. the elements alternate along the axis of the tube. The transverse rows of the elements slope obliquely in the two layers but in opposite senses, and the transverse lines between

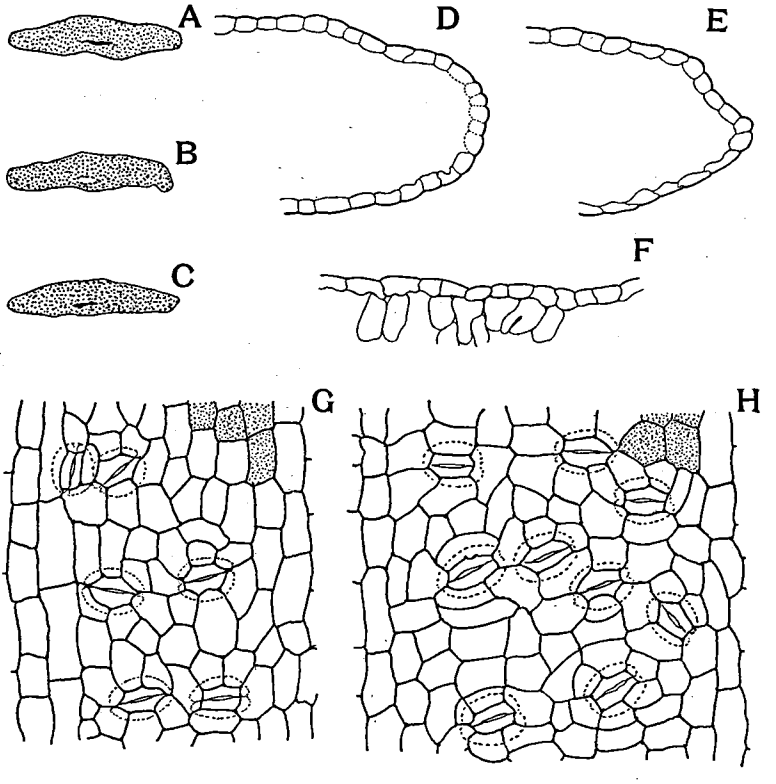

Fig. 2. Anatomical details of the elements (*Taxodium* leaves) composing the fossil *Phryganea* larval tubes. A, B and C transverse sections of elements (× 15). D and E marginal parts and F epidermis of upper side of leaf with some palisades (× 80). G and H surface views of epidermis (× 200). Silkeborg Vesterskov.

the rows are contiguous at the edges of the flattened tube, which can only be explained by the fact that the elements were arranged in a continuous spiral with a uniform rise on the surface of a cylindrical axis. The components are conterminous but not connected and can be easely isolated. Most of them bear a striking resemblance to *Taxodium* leaves, the variations in width do not exceed those occurring in the leaves of both the recent and fossil *Taxodium,* and in each piece a salient midrib was discernable. Remains of the fossil *Taxodium* (*Taxodites,* A. C. SEWARD) are very common in the Danish lignites, the decaying shoots must locally have been abundant in the lakes and ponds of that time, and the leaves have probably prooved a very convenient material to build up a larval tube of the type in question. The base and the apex of the leaves are always lacking, so the elements of the tube walls consist only of the middle part, the basal and distal parts being cut off by two surface cuts forming an angle of about 90° to each other.

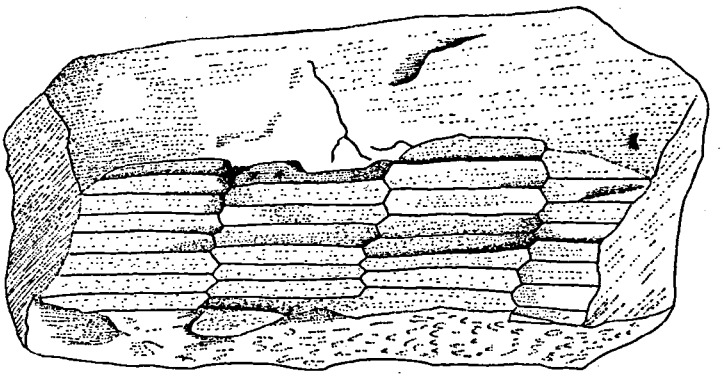

Fig. 3. Fragment of a fossil *Phryganea* larval tube from the brown ferruginous shales of Igdlokunquaq, West Greenland. (× 2).

An anatomical examination of the elements confirmed the views stated above. Transverse sections agree in shape and size with transverse sections of the leaves of recent and fossil *Taxodium*, the epidermis being especially well preserved on the edges of the leaf. Surface views of the epidermis correspond perfectly with those of both recent and fossil *Taxodium* (Fig. 2, G–H), as also does the type of transfusion tissue and the slender sclerenchyma cells of the mesophyll.

It thus appears for certain that the fossil has been originally tubular and composed of pieces of *Taxodium* needles. To explain the nature of tubes of this construction a modern analogy is considered. The larva of certain species belonging to the Phryganidae are the only members of a living genus that builds such a tube by adapting the material to a constant and suitable length and spinning the pieces together. By analogy it is assumed that the fossil tubes were built by larva belonging to insects of the Phryganidae family as an abode during the aquatic stage.

From what I have been told by entomologists it appears that it is only in the Phryganean genus *Phryganea* itself (e. g. *Phr. grandis*) that the larva puts together the elements of their tube in such a regular spiral as in the fossil example, in which the connecting spin, of course, has disappeared.

A specimen very much like the larval tube of a *Phryganea* described above has been found in the Paleogene Tertiary ferruginous shales of Igdlokunquaq, Disco Island, West Greenland (N. HARTZ coll. "in the river bed"); the drawing (Fig. 3) represents the specimen, a fragment of a tube apparantly built up of leaves of a conifer. The material has been too poor for detailed anatomical examination. From the Paleogene Tertiary of West Greenland O. HEER (1862–1883) has figured and described a fragment of a wing referred to a *Phryganea* (*Phr. hyperborea* HEER III p. 136, Pl. 109, Fig. 15) of the type now represented by e. g. *Phr. grandis* L.

My thanks are due to the entomologists of the staff of the Zoological Museum of the University of Copenhagen, the late Dr. phil. V. HEND-

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I am indebted to Mrs. E. NORDMANN for the drawing of the Greenland specimen.

DANSK SAMMENDRAG

I det foregående er beskrevet fossiler af tertiær alder, der stemmer overens med de af visse *Phryganea* arters larver i deres undervandsstadium dannede boligrør. Fundene hidrører dels fra et gytjelag i brunkulslejet i Silkeborg Vesterskov, dels fra Vest Grønland (Igdlokunquaq, den brune lerjernsten).

Rørene er dannet af de af larven tilpassede dele af nåletræsblade, og af elementerne opbygget i en axialt forløbende spiral. For det danske materiales vedkommende har blade af *Taxodium* tjent som bygningsmateriale. Fossilernes overfladiske lighed med dele af *Equisetum* stængler har foranlediget, at lignende objekter tidligere er henført til denne slægt *(Equisetitis)*.

BIBLIOGRAPHY

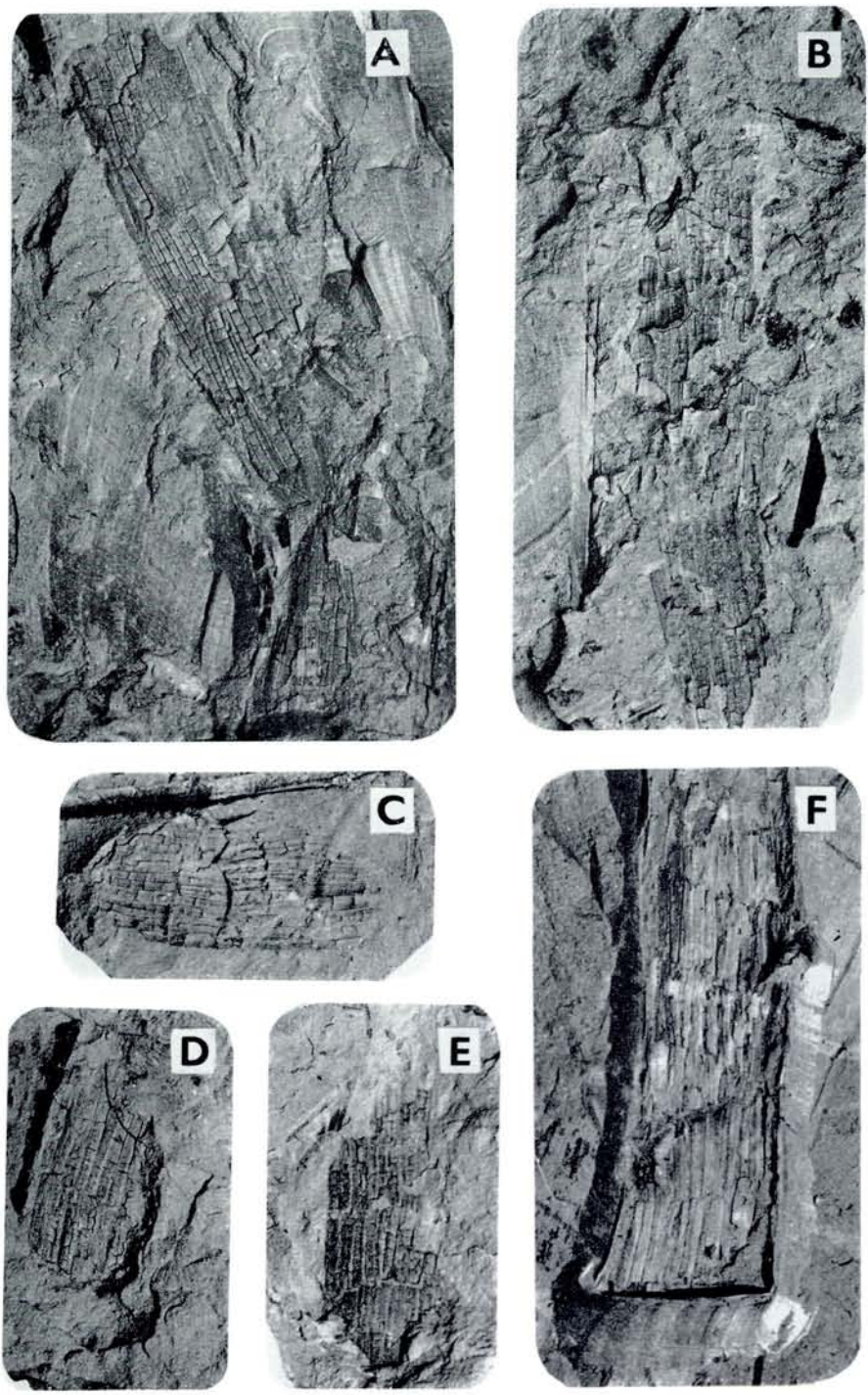
ETTINGSHAUSEN, C. v., 1867. Die fossile Flora des Tertiär-Beckens von Bilin I. Denkschriften der Kaiserl.-Akad. der Wissenschaften. Math.-Naturwiss. Classe. Theil I. Bd. XXVI.

FLORIN, R., 1920. Über Cuticularstructuren der Blätter bei einigen recenten und fossilen Coniferen. – Arkiv för Botanik. K. Svenska Vetenskapsakademien Stockholm. Bd. 16. No. 6.

FLORIN, R., 1931. Untersuchungen zur Stammesgeschichte der Coniferales und Cordailes. I. – Kgl. Svenska Vetenskabsakad. Handlingar. Ser. III. Bd. 10. No. 1.

HEER, O., 1882–1883. Flora fossilis Groenlandica. III. Über die fossilen insekten Grönlands.

UNGER, F., 1847. Chloris protogaea. Beiträge zur Flora der Vorwelt. Leipzig.



Fragments of fossil larval tubes of a *Phryganea* from the gyttja accompanying the brown coal layer (Lower Neogene) at Silkeborg Vesterskov, central Jutland. (× 2).