A NEW TYPE OF CADDIS CASE FROM THE LOWER EOCENE OF TENNESSEE

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The fossil remains of the cases of Caddis larvae are not so common as not to be noteworthy, and an especial interest attaches to the peculiar type described in the following note, which is also the earliest case, so far as I know, to be recorded from North America.

In the preliminary account of the flora of the Wilcox group certain arthropod remains were referred to somewhat incidentally,[1] and, on the authority of Miss Mary J. Rathbun, were tentatively assigned to the isopod genus *Ligyda* Rafinesque (*Ligia* Fabricus). Subsequent field studies have shown that these remains are exceedingly common at certain localities in the Holly Springs sand, the middle formation of the Wilcox group in northern Mississippi, and the basal formation of this group in western Tennessee.

I have never been satisfied with the identification of these fossils as isopods, and having observed a leaf-like venation on the segments in the better preserved specimens, I concluded that they represented some Wilcox species of Caddis case. Recently Prof. J. G. Needham has examined specimens for me and verified my conclusions, and I am also indebted to him for various references to the literature on the recent Trichoptera. Since, as previously remarked, the fossil remains of this interesting order of insects are by no means common, and since none with larval cases of this type of manufacture have been found fossil heretofore, they merit careful description.

As it is altogether impossible, from the cases alone, to be sure of their generic identity, the pseudogeneric term *Folindusia*, meaning wrapped in leaves, has been coined for their designation. This is in conformity with the use of *Indusia* as a similar pseudogeneric term for fossils of the familiar sand grain type of tube. Following the usual taxonomic method the present fossils may be called *Folindusia wilcoxiana* and described as follows:

FOLINDUSIA, new genus

FOLINDUSIA WILCOXIANA, new species

Cases large, flat, two faced, constructed entirely of cut fragments of drift leaves. About 3 times as long as wide, usually decreasing in width posteriorly, but never more than 2/7's, and often scarcely perceptibly. The end pieces are normally nearly semicircular, and

[1] Berry, E. W., U. S. Geol. Survey Prof. Paper 91, p. 33, pl. 111, figs. 7, 8, 1916.

the intervening ones are rough parallelograms, placed side to side, so that the lines of union are almost exactly transverse. The individual pieces appear to be normally fastened edge to edge and not overlapped, although in some cases they show evidence of overlapping as in Figure 5 where the anterior piece is nearly circular and a considerable overlap can be discerned. The lateral edges may be slightly rounded, but are usually rather evenly cut and fitted, so that the lateral margins of the case are approximately straight. Occasionally all of the pieces are roughly semicircular, as in the specimens originally figured, resulting in an angulated margin and heightening the resemblance of the case to the metameres of an arthropod body. (Figs. 1 to 5.) In all instances the leaf pieces appear to have been cut out of large leaves, and none show a leaf margin. In this respect the fossils differ from all recent species of similar habit that I have been able to find.

Occasionally a specimen will have part of one face missing and will show that these envelopes had two opposite faces covered with leaf cuttings as in the comparable existing forms. These leaf pieces are seen to be roughly alternating on the two surfaces. No traces of a central tube can be discerned in the relief of the specimens, so that the internal tube must have been silky, as in modern forms, and of slight bulk or resistance to the pressure developed during fossilization.

No specimens show any trace of the incorporation of any small sticks or other foreign materials, but are built entirely of rather uniformly cut pieces of leaves. These are all dicotyledonous except in two instances where a parallel-veined monocotyledon has been used. The number of pieces per case is 6 to 8 on each face. The cases average about 2.5 centimeters in length and their width varies from 4 to 10 millimeters, and averages nearest to the last figure.

Specimens have been obtained from the following localities: Puryear, 2 miles west of Henry, and Foundry Church Pit in Henry County; 1 mile west of Milan in Gibson County; ¼ mile south of Mandy, $2\frac{1}{10}$ miles northwest of Mercer, and 3¼ miles northeast of Jackson in Madison County; from several outcrops near the town of LaGrange in Fayette County; and from Mill Creek in Hardeman County.

The portable cases of caddis larvae are constructed of almost every material that is to be found in the water and in an almost endless variety of form. The material is cemented by a silk-like salivary secretion. Frequently there is considerable variation in the material used and the form of the cases, not only in a single genus, but even in a single species. Lloyd, however, makes the statement that the trained observer can usually determine the cases.

The Wilcox leaf cases appear to me to be referable to the family Limnophilidae. This is a large and widely distributed group in the existing fauna, especially prominent in ponds and slow streams, but

also fitted for life in almost every aquatic environment, and in the European genus *Enoicyla* the larvae afford the only known instance in the whole order of a terrestrial habitat.

In this family the variety in construction and material of the cases is great, and no general statements can be made. Several of the genera utilize leaf fragments. For example, *Arctoecia consocia* builds a three sided case of leaf pieces: several species of *Limnophilus* utilize leaf fragments: *Glyphotaelius hostilis* makes a case of imbricated leaf pieces, and the allied *Glyphotaelius punctato-lineatus* of Europe constructs a two faced case of leaf pieces much like the fossil. (Fig. 6.) Several of the genera of Limnophilidae change the architecture and material of their cases seasonally (as *Arctoecia*, *Pycnopsyche*, etc.). This is true of *Pycnopsyche scabripennis* as described by Lloyd.[2] In this species the larvae construct flat cases of leaf pieces during the winter and spring months, and these are very similar to those of the fossil. In late spring the tube becomes tougher, bark fragments are added, the broad roof and floor of leaves is discarded, and a heavy "ballast" stick is added on each side. These last prevent the cases from being upset or rolled by currents exactly as did the form of the earlier flat leaf cases.

No traces of such seasonal modifications have been observed in the fossil. The innumerable specimens seen are all built on the same plan and of the same material, and it seems a legitimate deduction that the seasonal change noted above is an acquired habit which was not present in this lower Eocene species. The evidence for this has all the weakness inherent in negative evidence, but the abundance of the leaf cases, the fossilization of all sorts of delicate objects such as flowers in these fine muds, and the large amount of unusually thorough collecting from the Wilcox clays, tends to preclude the absence of modified cases as attributable to accidents of preservation or discovery.

The special construction of the cases of *Folindusia wilcoxiana* to prevent their capsizing indicates that their habitat was a region of some current action. The general environmental picture of this area during the time of deposition of that part of the Holy Springs sand containing these caddis cases, is of a low, abundantly forested, warm temperate coast, with bayou-like stream distributaries emptying into lagoons ponded behind extensive barrier beaches, beyond which the gulf waters were extremely shallow, and not typically marine for a considerable distance.

The somewhat earlier transgressive phase of the Holly Springs sand shows, in the frequent foreset bedding of the sediments, and in the presence of clay conglomerates, as well as in the abundance of drifted fruits and seeds, evidence of stronger stream action than prevailed later when the caddis larvae swarmed in the waters.

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[2] Lloyd, J. T., Bull. Lloyd Library, Ent. series, No. 1, pp. 60–63, 1921.

Regarding the known geologic distribution of the Trichoptera (Phryganoidea) it may be stated that upwards of a score of species from the Mesozoic have been referred to this order. The oldest come from the Lias of Germany and England (*Trichopteridium* Geinitz, *Phryganidium* Westwood, and *Necrotaulius* Handlirsch, the last made the type of an extinct family—the Necrotaulidae). Supposed Trichoptera occur at various other Jurassic horizons, especially in the Purbeck, and these are mostly wing specimens of somewhat uncertain affinities, as is also the Upper Cretaceous occurrence of western Tennessee referred to *Dolophilus* (?).

The oldest larval case that has come to my notice is *Phryganea micacea* Fritsch from the littoral middle Cretaceous (Cenomanian) of Bohemia. There have been about 200 species described from the Tertiary, based upon wings, cases, and sometimes imagos, which last are common at Florissant (Aix, Parschlug, Manebach, Isle of Wight, west Greenland). The oldest previously known American cases are from the middle Eocene Green River Beds of the West (Auversian).

A large variety of Trichoptera have been described from the Baltic amber (Lattorfian). These include the genera *Agrypina*, *Apheilocheira*, *Aspatherium*, *Cyrnus*, *Halesus*, *Hydropsyche*, *Hydroorchestria*, *Hydroptila*, *Limnophilus*, *Neuronis*, *Phryganea*, *Phryganeolitha*, *Polycentropus*, *Psychomyia*, *Rhyacophila*, *Tinodes*, etc. Trichoptera tubes form an indusial limestone in the Auvergne (Aquitanian or lower Miocene) which is in places several feet thick over considerable areas in central France. Their remains are common in the Miocene lake basin of Florissant, Colorado, where a number of genera, several of which are extinct, and about 25 species have been described (*Dorobrochus*, *Leptobrochus*, *Limnophilus*, *Limnopsyche*, *Litobrochus*, *Mesobrochus*, *Neuronia*, *Paladicella*, *Phryganea*, *Polycentropus*, *Tinodes*, etc.).

There are over 1,400 recent species of Trichoptera, segregated in 13 families. They are cosmopolitan, but are said to be most abundant in the north temperate zone. The lavae inhabit all sorts of freshwater environments from torrents to stagnant swamps and temporary pools. All are fresh water except a marine form in New Zealand, and a terrestrial species in Europe.

EXPLANATION OF PLATE

FIGS. 1–5. *Folindusia wilcoxiana* Berry, nat. size. 1 and 5 are from Puryear and 2–4 are from the Grable Pit 2 miles west of Henry, both in Henry County, Tenn.

6. Leaf case of *Glyphotaelius punctato-lineatus*, one of the recent Limnophilidae (after Rousseau) from Europe.

7. Leaf case of *Pycnopsyche scabripennis*, another of the recent Limnophilidae (after Lloyd) from the eastern United States.

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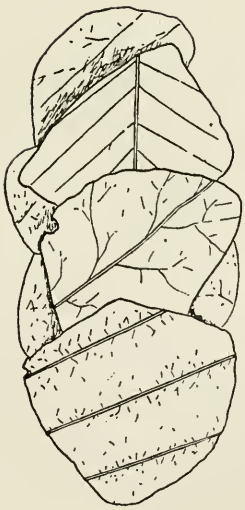
2

3

4

6



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