

ADAPTATIONS TO ARID CONDITIONS IN CERCOPIDÆ AND MEMBRACIDÆ.

By E. D. BALL.

The frog-hoppers are distinguished from other Homoptera by the fact that the larvæ envelope themselves in a mass of froth, using this no doubt as a means of protection from their enemies. Only a few species occur in the arid regions, but these are distributed through all but one of the genera occurring in the United States.

The representatives of one of these genera, the *Clastoptera*, appear to have the same froth making habits in the arid region that they have in the humid. The larvæ usually occur early in the season, however, before the air has become very dry or are restricted in distribution to the higher mountains or to exceptionally humid situations in the lower valleys. The other representatives of this group in the more arid regions apparently do not attempt to maintain froth masses exposed to the air, as none have ever been found.

In a former paper* the writer showed the unique method employed by *Aphrophora permutata* Uhl. a western relative of the pine inhabiting species of the Appalachian region. This species was found on the roots and crowns of a Composite and a Legume, where they were protected from the sun and dry air.

Since that writing the larvæ of *A. annulata* Ball has been found around the crown of *Artemisia ludoviciana* in Utah and the larvæ of *Philaronia abjecta* Uhl. on the roots and crowns of *Lupine* and *Geranium* in the mountains of Colorado. The larvæ of the other species of *Philaronia* (*P. bilineata*) occurring in the mountains of Colorado has never been found, although the adults are among the commonest of the family.

During several seasons collecting in California another species of *Aphrophora*, *A. angulata* Ball has been taken quite commonly in certain restricted areas along the coast. This species is closely related to the common *A. binotata*, common on grass and low vegetation east of the Rocky Mountains and whose spittle masses are often so abundant in the meadows as to be a nuisance. The California species was collected on

*Ohio Naturalist, I, p. 122, 1901.

willows and in low situations where grasses occur if at all in California, but no spittle masses were ever seen, although careful search was made.

Last season while collecting another rare species of Homoptera occurring in grassy places, the writer accidentally broke a leaf off from the giant Umbellifera—*Heracleum lanatum* and discovered that the enlarged sheath was full of froth and that nearly a dozen *Aphrophora* larvæ were hidden in the mass.

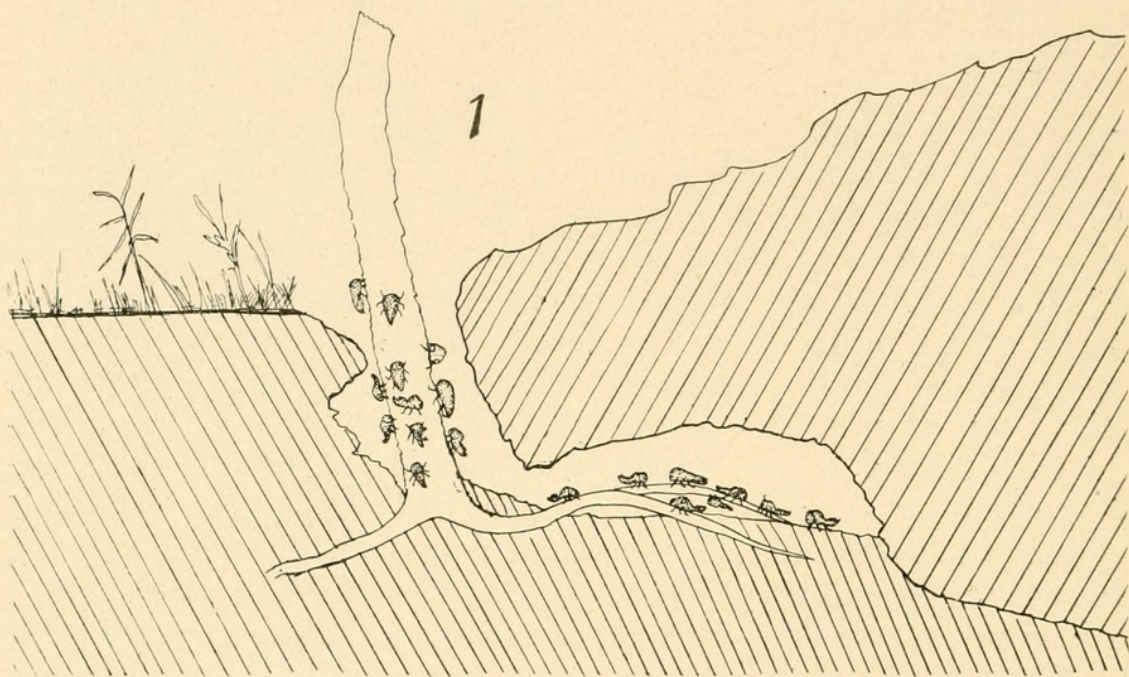


Fig. 1. An *Amorpha* stalk with membracids on roots and stalk below the ground line.

An examination of other sheathes revealed other froth masses ranging from a single larvæ up to over twenty in one case. The larvæ were of various sizes from one-third to full grown when found and a few fresh males nearby completed the identification.

The weed extends across the continent from coast to coast, but this species of *Aphrophora* has only been taken along the California coast from Los Angeles to San Francisco.

Like the other frog-hoppers, it appears to be single brooded, the larvæ appearing in March and April and the adults transforming from late April through May and living until into July and August.

The *Membracidæ* are few in number in the arid regions, especially of the more strictly tree and shrub inhabiting genera contrasted with the weed and miscellaneous feeders like the *Stictocephalinæ*. This may partly be accounted for by the scarcity of trees in these regions, but probably the climatic factor is also of importance. The fact that certain forms

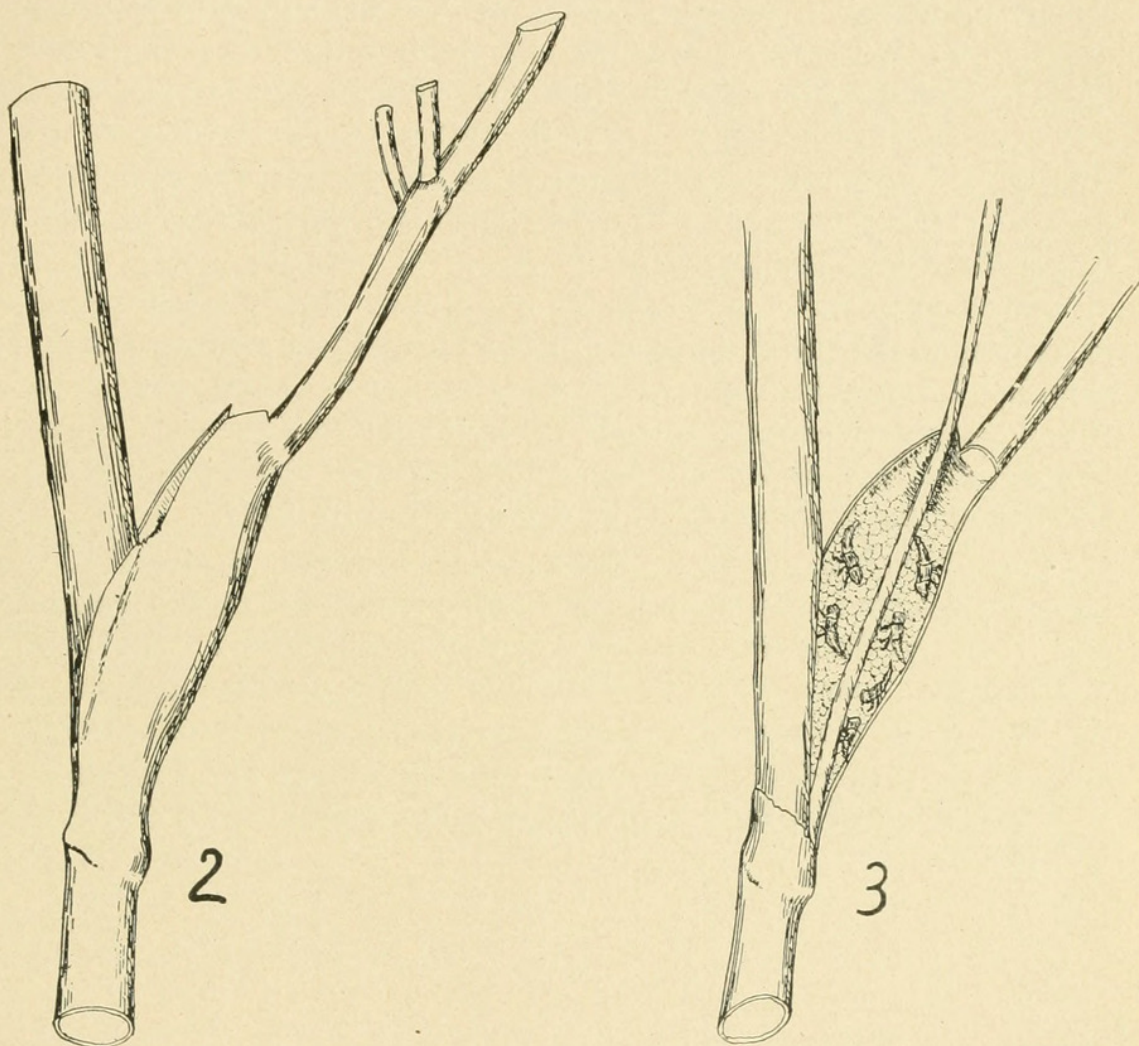


Fig. 2. A stalk of *Heracleum* showing the leaf sheath.

Fig. 3. Section of leaf sheath with larvæ of *Aphrophora* and their froth.

do not follow their respective trees into the arid region and more especially the peculiar change in habit of two eastern species mentioned below, indicate that the aridity is a limiting factor.

The larvæ and adults of *Vanduzea vestita* Godg live together in colonies on the lead plant *Amorpha canescens* Pursh in the Mississippi Valley and are often seen congregated on the

most exposed part of the plant, and are always found on the upper parts of the plants in that region. This plant also extends into the arid region, but in less numbers.

While collecting a wingless ground inhabiting Capsid on a sunny mountain slope in Colorado, the writer found a colony of *Vanduzea vestita* feeding upon the stem and roots of an *Amorpha* beneath a stone. They were as usual attended by ants, so the excavation beneath the stone and around the stem of the plant may have been made for them by the ants or may have existed previously. At any rate, there they were in numbers, larvæ and adults, in the hollow beneath the rock and in a circle around the stem beneath the ground, a very few being above the ground line.

Since that time a number of colonies have been found extending down into the ground for an inch or two and occasionally having lateral galleries. Frequently they would be found gathered around the stem for an inch above and below the ground line under clumps of *Psoralia* or *Amorpha*, where the branching clump served as a protection in itself.

Campylenchia curvata Fabr and *Publilia modesta* Uhl have both been found occupying similar situations under clumps and in excavations around stems of their food plants. All these observations were made in very dry hot situations, desert or dry mountain slopes for the most part. In damper situations, such as river bottoms, thickets, mountain valleys and especially in irrigated alfalfa fields *curvata* will be found on all parts of the plants.



Ball, E. D. 1915. "Adaptations to Arid Conditions in Cercopidae and Membracidae." *Annals of the Entomological Society of America* 8, 365–368.
<https://doi.org/10.1093/aesa/8.4.365>.

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