

and throats of all possible wild ruminant hosts are greatly to be desired. Such hosts are the various deer, wapiti, various caribou, moose, all belonging to the family Cervidæ; and pronghorn, various mountain sheep, Rocky Mountain goat, musk-ox, belonging to other families of ruminants. The bots should be sent alive, packed in loose dry earth in tin receptacles.

NOTES ON LEPTOBYRSA RHODODENDRI HORV.

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The writer has been interested in observing this insect in New Jersey during the past few years and presented a brief paper on its development and habits at the fifth annual meeting of the Entomological Society of America in December, 1910. Recently the synonymy of this species has been noted in the Entomologist's Monthly Magazine and it seems opportune therefore to bring this to the attention of American entomologists and to record some additional notes on this insect.

The species, which was redescribed by Heidemann under the name *Leptobyrsa explanata* (Proc. Ent. Soc. Wash., X, p. 105-108, 1908) and which has been considered under the latter name by American collectors, was first described by Horvath as *Stephanitis rhododendri* in 1905 (Tingitidæ Novæ et Minus Cognitæ e Regionæ Palearctica in Ann. Mus. Hung., Vol. III, p. 556). As this description may not be available to some of our American students I include it herewith: "Pronoto elytrisque hyalinis, pallido-reticulatis et pilis brevibus erectis griseis sat dense obectis: capite nigro, buccubis albidis, fere ubique æque altis et antice ultra apicem tyli prominulis; antennis albido testaceis, brevissime pilosulis, articulo ultimo apicem versus nigro, pronoto disco brunneo, utrinque prope vesiculam anticam nigro, lateribus foliaciis late explanatis, irregulariter quadriseriatim areolatis, vesicula antica oblongo-elongata, sat humili, carina mediana quam vesicula antica haud vel parum altiore, carinis duabus lateralibus antice vesiculam anticam attingentibus: elytris abdomine multo longi-

oribus et latioribus, apice divaricatis, membrana costæ latissima, basin versus triseriatim, dein quadriseriatim et nox pone medium quinquaseriatim areolata, ante medium macula transversa subtriangulari nigricante notata, vesicula discoidali parum elevata; corpore subtus nigro, lobo postico prostethii maculisque pectoris ad coxas pallidis; pedibus albido-testaceis, tibiis apice et tarsis levissime infuscatis. ♂ ♀ Long. $3\frac{1}{2}$ – $3\frac{3}{4}$ mm. Hollandia: Boskoop in *Rhododendris*."

In his paper Heidemann states: "This new species seems to be most correctly placed in the genus *Leptobyrsa* which was founded by Stål on a single species (*Tingis stenii*) from Rio Janeiro, Brazil. It also has much affinity with the genus *Stephanitis* Stål, but the hood is comparatively smaller and the lateral carinæ extend over the whole length of the pronotum, not abbreviated in front."

Heidemann describes the first two nymphal stages briefly and the last one in detail, the egg and its position, the time of oviposition and emergence. *Kalmia* and *Rhododendron* are given as food plants, a number of localities are noted and Rock Creek, D. C., given as the type locality. It is interesting to note that among the records is one from the Uhler collection, Lehigh Gap, Pa., 1877. The distribution recorded is from Boston to Florida and as far west as Ohio. A nymph and adult are figured.

In the Zoologist, 4th Series, 14, 1910, p. 395, W. L. Distant states that he has received specimens of this species from a grower of rhododendrons at Fulham and that Dr. Horvath suggests it has been imported into Europe. He, Distant, erroneously concludes "that it has been introduced from India, it being well known that the headquarters of the genus *Rhododendron* is in the Himalayan region and four species of *Stephanitis* are already recorded from British India." He figures the adult and the last nymphal stage.

In the Entomologist, September, 1916, E. Ernest Green, Way's End, Camberley, records this species, recently introduced into England infesting rhododendrons. G. C. Champion adds a further note, citing the above references and stating that *S. rhododendri* Horv. and *Leptobyrsa explanata* Heidemann are without doubt the same species. He suggests that the "Eastern States of North America and not India are the home of this insect," and states that this insect would be better placed under *Leptobyrsa*.

In the *Journal of Economic Entomology*, Vol. 8, No. 4, pp. 409-414, C. R. Crosby and C. H. Hadley, Jr., give an account of this species, mentioning distribution, food plants, injury, and control measures and describing the eggs and their location, and the various nymphal stages. The various stages of the insect, injury and eggs in position are illustrated.

As noted in this paper and also by Heidemann this species inhabits the undersides of the leaves and by feeding causes a light mottled spotting on the upper surface. In addition the under surface of the leaves are more or less disfigured with numerous minute dark spots of a dark varnish-like excreted material.

The egg is somewhat irregular, cylindrical and flask-shaped, or in general outline oval, with a rather broad, neck-like elongation at the outer end turned to one side as shown in the figure. It measures about .4 mm. long and is pale yellowish white. These eggs are inserted in the lower surface of the leaf obliquely toward the midrib with the truncated end of the neck-like portion extending slightly above the surrounding surface (Plate VIII, fig. 6). The egg is capped with a varnish-like material which later becomes dry and hard and sometimes drops off before the egg hatches. This cap has a lighter outer rim and an inner darker portion which is very slightly more protruding. "The tissues surrounding the egg becomes hardened and corky but this hardening is entirely internal and makes no noticeable change on the surface of the leaf." The eggs are usually placed along the midrib and where several of them occur in a row, as is often the case, they are easily seen due to the varnish-like material that covers them. Occasionally they are placed along the side veins a short distance from the midrib and in a few instances I have observed them 5.5 mm. distant from any vein. The number of eggs counted in one badly infested leaf totaled 176, about equally distributed on either side of the midrib, and several other leaves examined appeared to contain fully as many. The number laid by a single female was not ascertained. In ovipositing, the female rests with the body parallel to the surface and with the ovipositor extended from the sheath, extending posteriorly and ventrally into the leaf tissue.

The various stages of the insect have been previously described, as already noted, and need not be redescribed here. The interesting point is that there are only 4 nymphal instars, the insect thus differ-

ing from some of our common species, which have 5 nymphal stages, Crosby and Hadley give the duration of the nymphal stages under insectary conditions as follows:

“First stage 6 to 7 days,
Second stage 4 to 6 days,
Third stage 3 to 6 days,
Fourth stage 12 to 15 days.”

This would give a minimum time of 25 days and an average of 30 days. In New Jersey development appears to be even shorter, at least in some cases, and more rapid on those plants exposed to full sunlight than on those in the shade. In one case some insects emerging May 10 reached maturity by May 30. The day's durations for the various nymphal stages were 5, 4, 3, and 7, giving a nymphal period of 20 days, other individuals requiring a longer period. During the first three nymphal stages the insects appear to move very little, remaining grouped close together, feeding on the undersides of the leaves. I have observed the insects feeding on the opposite side of the midrib from the cast skins. In the fourth or last nymphal stage there seems to be decidedly more movement. In feeding, it might be noted, the lancets are extended from the sheath of the beak, the latter doubled on itself with the tip helping to guide the lancets. The winter is passed in the egg stage. “At Ithaca, N. Y., the eggs hatch in late May or early June. . . . They have been observed hatching out of doors on June 6 and had apparently all hatched by June 17.” At Rochester, N. Y., young nymphs have been observed May 25. In New Jersey development begins somewhat earlier. In 1911 in the vicinity of Newark nymphs began hatching May 10, while in other seasons emergence begins nearer the first of that month and in the southern part of the state undoubtedly in the latter part of April. Near Washington, D. C., Heidemann records finding young nymphs and unhatched eggs April 20.

The number of broods seems to vary. Usually I believe there are two broods in New Jersey. The nymphs begin emerging early in May and reach maturity early in June and by the middle of that month or shortly after all the insects of this brood have matured. After feeding and copulating oviposition occurs and may continue through June and part of July. Insects of this as well as other species

of Tingids have been observed in copulation. These individuals rest side by side, the bodies forming an angle of about 95 degrees and the abdomen of the female dorsal to that of the male. From these eggs a second brood of adults emerges in August. Nymphs of this brood have been observed at Springfield, N. J., August 23, nymphs in all stages and adults at Somerville, N. J., August 21, and in Cumberland County, N. J., September 2. Adults in small numbers were still present on badly infested plants in the northern part of the state on September 29. Adults of this brood oviposit the hibernating eggs.

On the other hand I have observed near Newark, N. J., infested plants where there was only one brood. Adults began to mature in early June and continued to appear until shortly after the middle of that month and continued in evidence through July; no hatching of eggs occurred in August and hence there was only one complete brood.

In this connection it is interesting to note what Mr. Van den Broek and P. J. Schenk say concerning the insect in Holland (Zeitken en Beschadigingen der Tuimbouwgewassen, p. 170), *Stephanitis (Tingis) rhododendri*. Insects pass the winter in egg stage. In May or later the eggs hatch and it takes about three weeks to complete its development. Not all the eggs hatch at one time apparently, as nymphs are still found at the end of July and in the beginning of August. The insects disappear at the end of summer.

An examination of the adults reveals some interesting structures including those associated with the reproductive system.

In the male the extremity of the body appears somewhat elongate due to the character of the apical segment. This is narrower and longer than the other abdominal segments and normally rests with its base somewhat retracted within the penultimate one. It may also be designated as the genital segment since it bears the reproductive organs. On the dorsal side (Plate VIII, fig. 1) there is a concave posterior margin just before which, laterally, is noted a slight covering of short hairs. From beneath this margin there projects a pair—one on each side—of comparatively large falcate claspers which are sparingly covered with hair at center, especially on the inner side. Between these claspers and also projecting from beneath the central part of the margin is the penis, resting within a thin chitinous sheath, which is elongate and truncate with parallel sides and bears

a number of short hairs near the apical end. Just beyond the extremity of the lateral margins of the penis sheath there is on each side a pair of small openings or pores on the dorsal surface. The posterior one on each side is slightly interior to the anterior one and is oval in outline, while the anterior one is circular. Between these two pairs of pores a small number of minute hairs can be distinguished. Viewed from the ventral side (Plate VIII, fig. 2), the posterior margin of this apical segment is observed to be broadly rounded and slightly sinuate and to extend beyond the dorsal posterior margin so that only a small portion of the claspers is visible when the latter are in their normal resting position. Before this posterior margin, laterally are small areas of anteriorly directed short hairs.

In several common species of Tingidæ that I have examined I find that claspers similar to those here noted are borne on the genital segments of the males.

In the female, the apical end of the abdomen is broadly rounded. On the ventral side is situated the ovipositor (Plate VIII, fig. 3). This originates with its base below or within the antepenultimate segment and extends posteriorly with the tip resting in the apical segment and the whole inclosed in a groove closely fitted to it and open along the center line. One pair of membrane-like edges meeting along the center cover and enclose the ovipositor from the base of penultimate segment to the apex of the abdomen, while a second and similar covering overlays this one in the penultimate segment. This second covering may be considered as a paired outfolding of the chitinous membrane of this segment which has been pressed over so as to meet in a line extending over the ovipositor. The position of the ovipositor in its groove and the covering membranes may be better understood by noting the cross-section view.

The ovipositor as seen in cross-section (Plate VIII, fig. 4) consists of two parts, an upper u-shaped piece and a lower paired piece. The upper piece is thin at the top with its side parts broadening out and having each on their ventral surfaces an acute ridge. The paired parts of the lower piece are somewhat triangular in outline with a groove in the dorsal side of each which fits the acute ridge of the side piece of the upper part of the ovipositor. The two parts of the organ are thus able to move on one another. The paired pieces of the lower part, moreover, are united by a thin membrane which ex-

tends upward between the two sides of the upper piece. Thus there is formed by the upper piece and the lower side pieces and their connecting parts an oviduct which extends from the base for two thirds the length of the ovipositor beyond which point the membranes connecting the side pieces are divided.

Viewed from the side (Plate VIII, fig. 5) it is observed that the ovipositor gradually tapers from the base to the apex. The upper part is smooth save toward the apical end where it becomes somewhat serrate with an acute apex. The two lower side pieces are strongly transversely ridged from base to apex. The possession of an ovipositor by the female is related of course with the habit of this species of ovipositing in the leaf tissue.

As noted in Heidemann's description of the adult "the entire lateral margins of the pronotum, crest of hood, carinae, and most of the nervures are beset with long very fine hairs." In this respect this species is quite different from some of the commoner species of the Tingididae which I have examined. In these latter the hairs on the nervures, etc., are variable but spine-like and very few in number. In this species they are comparatively fine and long approximating in length the width of the medium-sized areoles and on the upper surface are more or less erect (Plate VIII, fig. 7). They also occur in somewhat smaller numbers on the undersurface of the elytra where they are distinctly inclined.

Another interesting structure noted in cleared and mounted specimens is a mass of small papillae-like structures. There are two such masses, one on each side, within the first abdominal segment.

This species infests the rhododendron and mountain laurel (*Kalmia latifolia*). Heidemann records it from both of these plants and I have found it infesting them in New Jersey. In the nurseries it occurs mostly on the rhododendron, especially *Rhododendron maximum*, and while some varieties seem to be freer from infestation than others this exemption may be more apparent than real. Van den Broek and P. J. Schenk (*e. c.*) state: "This species has been found in 120 varieties of rhododendron, azaleas, and *Kalmia latifolia*."

While Heidemann gives the distribution from Massachusetts to Florida and westward into Ohio, the insect will undoubtedly be found even outside this area where rhododendrons have been planted, owing

to its liability of being distributed on nursery stock. It is a native American species and evidently introduced into Europe on rhododendrons exported from America. It is reported from Holland and England and may occur in adjacent countries where rhododendrons are grown. The eggs have been found on rhododendrons received in this country from Holland and England.

EXPLANATION OF PLATE VIII.

- Fig. 1. Apical segment of male showing claspers, and dorsal surface.
- Fig. 2. Same, ventral surface.
- Fig. 3. Ventral surface of female showing ovipositor in position.
- Fig. 4. Cross section (at *A-B*, fig. 5) of ovipositor.
- Fig. 5. Lateral view of ovipositor.
- Fig. 6. Egg in situ.
- Fig. 7. Portion of hemielytra showing hairs on dorsal surface.

LIFE HISTORY OF A BOATMAN.

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The rearing of aquatic Hemiptera appears to have been attended with unusual difficulty, and, for this reason, little has been known regarding the life histories of some of them.

However, the fact that our information concerning some of the aquatic bugs has been meager, has not been due to a neglect on the part of our best known workers in this group. For Dr. Kirkaldy, Dr. Abbott, and Mr. de la Torre Bueno have endeavored to provide the much needed information.

The late Dr. Kirkaldy, though a taxonomist primarily, experimented with this phase of the problem. Mr. de la Torre Bueno,¹ who has added more to our knowledge of the life histories of American water bugs than any other, has called attention to the obstacles involved.

Among the most difficult of the aquatic insects to rear have been the water boatmen. Dr. Abbott,² our authority in this group, suc-

¹ Can. Ent., X, 1912: p. 113.

² *Ramphocorixa balanodis* Abbott, Can. Ent. XXXI, p. 113.



Dickerson, Edgar L. 1917. "Notes on Leptobyrza Rhododendri Horv." *Journal of the New York Entomological Society* 25, 105–112.

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