LIFE HISTORY NOTES ON CRANBERRY LAKE HOMOPTERA

By Herbert Osborn

In connection with studies of the ecology of the Homoptera of the Cranberry Lake region it was possible to secure a number of records on the development of some of the species and, while these do not cover as long a period of the year as would be desirable for all purposes, the fact that for many species the summer months include the main events in the life cycle seems to warrant the publication of the records even if less complete than would be desired. From the author's standpoint this appears the more desirable because there is little probability that circumstances will permit him to work at periods necessary to complete the annual life cycles and the facts given here may serve as a basis to facilitate further studies. Also it is believed that the facts gained may serve for such appreciation of the injurious phases of the insect as to encourage working out practical measures for control. In some instances, if not all, the determination of certain fragments of the life history appears to supply a biological basis for the development of preventive or remedial measures which may be of service in the protection or conservation of the forest resources.

BIRCH TREE-HOPPER

Carynota stupida Walker

This species (Plate III) often occurs in large numbers on yellow birch, but its presence would scarcely be suspected since the insect is so perfectly protected by form and color that it is hardly possible to see them even when their position has been noted.

The nymphs occur almost invariably in the axils of small twigs, mostly on branches of one year's growth, the head pressed closely against the base of the twig, the body lying flat and lengthwise on the branch, the tail usually toward the tip of the branch (Fig. *k*, Plate III). Here they remain apparently immovable for long periods of time, the food supply being drawn doubtless from the cambium of the growing twig. They are very commonly attended by ants, so far as observed all of one species (*Formica sanguinea* Latr. sub. sp. *rubicunda* Emery*) ; and by far the easiest way to locate the nymphs is to look for the ants and note the nymphs which they are attending. The nymphs appear absolutely oblivious to the movements of the ants, although the frequent rubbing and " caressing " which they receive would seem to be sufficient to disturb them. The nymphs, however, appear to be very difficult to disturb, seeming to be glued to the twig, and only

* Identified by Dr. M. W. Wheeler, Harvard University.

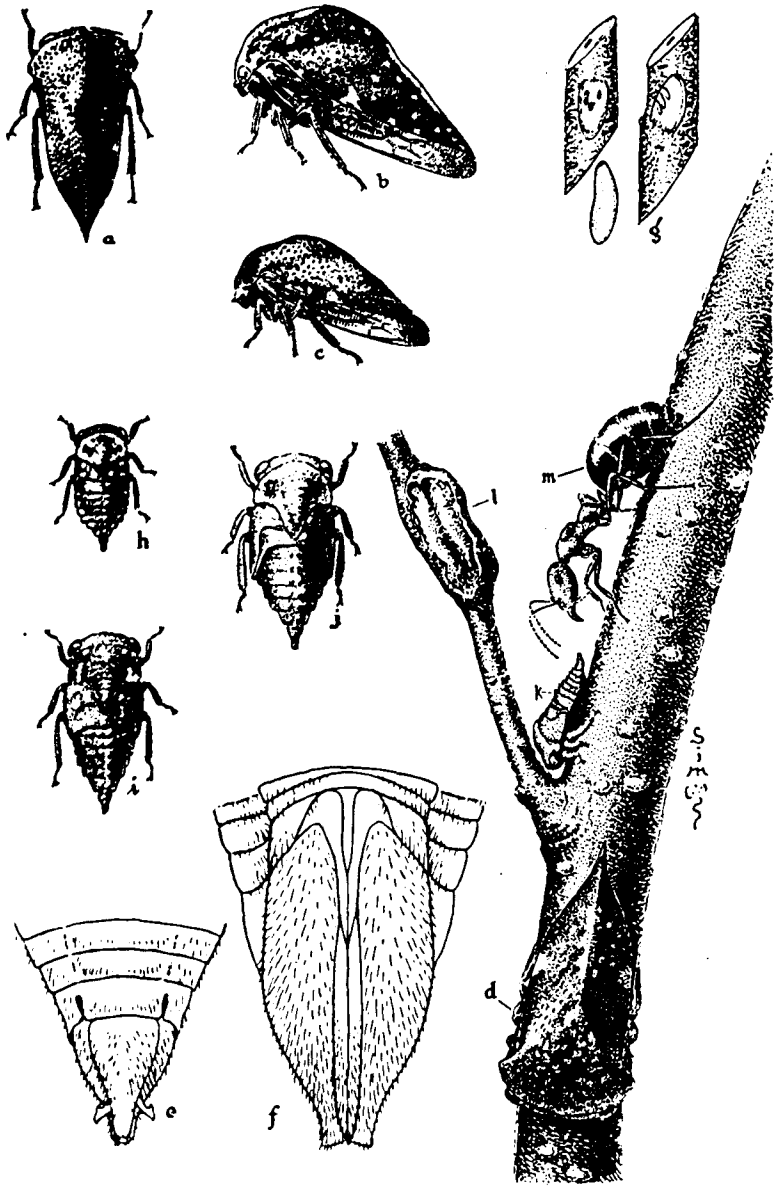

PLATE III

Birch Tree-hopper, *Carynota stupida* Walk.

a, dorsal view of adult.
b, lateral view of adult.
c, female.
d, adult on twig.
e, male genitalia.
f, female genitalia.
g, egg puncture scars showing eggs and an egg greatly enlarged.
h, *i* and *j*, nymphal stages.
k, nymph feeding upon twig.

forcible action will ordinarily dislodge them. The adults are almost equally difficult to move (possibly the basis for Walker's name *stupida*), no doubt having become fully adapted to dependence on their protective features to escape enemies. The human enemy is, of course, an entirely negligible factor in the immense solitudes of the great birch forests and especially in the tree tops, but the prying eyes of insectivorous birds may well be deceived by the perfection of the resemblance displayed.

The attraction for the ants lies in the liquid discharge from the anus, no doubt comparable to the " honey dew " of aphids, and the constancy of the association would indicate that the ants make a large use of this food supply during the period of life of the tree-hoppers. When aphids are also present the same ants appear to visit either aphid or tree-hopper.

The species was first described by Walker from specimens received from Canada (?) but with no description of early stages. Later descriptions by Butler, Provancher and Goding, none of

Fig. 37.— Yellow birch twigs showing egg-punctures (two, three and four years old) of *Carynota stupida* Walk. Photo by Fivaz.

which go into details of the life history or habits, have evidently been based on limited material appearing in collections.

It is not at all strange that specimens have been rare since the species is adapted to life in a manner which precludes its frequent collection. In the primitive forest or on all larger trees the insect occurs probably only on the outer part of branches in the upper part of the tree, or at least far from easy capture by the entomologist. Only the fortunate occurrence of numerous young yellow birch trees in a cut-over and burned tract at the State Forest Camp has furnished the opportunity to note the mode of life and stages of growth which apparently have escaped the attention of entomologists up to the present.

Life History

While field observations have been limited to the summer months and we are, of course, without ocular evidence concerning conditions during the winter months, the fact that the active part of its life cycle is practically completed between June 1 and September 1 makes it possible to detail the life cycle with entire confidence. The remainder of the year from egg deposition in late summer till egg hatching in late May must be passed in the egg stage within the twigs of birch. The earliest date of egg hatching is not known, but Dr. Drake has observed very young nymphs, evidently first instars, as early as May 30 and nymphs of third or fourth instar are found by July 1. The earliest adult female noted in 1920 was July 13 and the first male July 16. So we may conclude that the period of development from egg to adult is close to six or seven weeks. The rate of growth is not entirely uniform or else the eggs of different clusters hatch at different times as nymphs of many sizes and different instars have been noted during the first two weeks of July with stragglers as late as the first week in August and adults have been emerging from July 13 to as late as the 29th. Adult females appeared July 16, but mating activity was not noted until July 23.

Emergence of adults from nymph case appears to come in the early morning, such emergence being noted from the 17th to the 19th and between eight and ten. One individual, a male, which was followed most closely, had split the nymph case along the dorsal line of head and prothorax when observed at a little before eight o'clock in the morning. It was attached to the underside of the petiole of a leaf with the head toward the tip of the leaf and in a position with reference to the twig which would place it nearly head downward, attachment to petiole being entirely by the tarsi of the nymphal case. The head, pronotum and base of abdomen were exposed, as also the forelegs, and the wings were out but scarcely longer than the wing pads, their tips being folded under. The pronotum was no longer than in the last instar nymph and did not expand until after expansion of the wings. In this condition the insect remained fairly quiet for a time, as if resting after the initial effort of exclusion. The color at this period was pinkish, wings and pronotum first appearing colorless, with expansion later darkening to normal dark brown color. At nearly 7:55 the insect became active, grasping the petiole with its forelegs and the nymph case with hind feet, withdrawing the abdomen from the case and turning at right angles to the deserted skin. Meanwhile the elytra and wings were expanding rapidly enlarging at base to full width and unrolling toward tip, the extreme tip being the last to lose its pink color and to acquire the natural symmetry of the adult elytron. At eight the elytra and wings were fully expanded and the pronotal expansion started and five minutes later the wings were fully out in nearly natural position and the pronotum partially expanded at base and tip, with a distinct constriction near the tip. At 8:08 faint indication on spots on head and base of pronotum could be seen, the coloration lying toward the head end but the elytra at this time was entirely transparent. At 8:10 the pronotum was nearly expanded, the base and tip nearly normal, but deeply hollowed at the middle and the tip reaching only to the tip of the abdomen, the following two minutes marking the beginning of coloration of the base of the elytra, the further extension of pronotum which is still constricted somewhat midway and nearly colorless. At 8:15 the constriction of the pronotum was nearly gone and a minute later entirely so, the structure reaching its mature form and reaching nearly to the tip of the elytra. At this time the elytra nearly covered the wings, the latter at first drooping below, the elytra gradually drawing up closer to the body and assuming the normal position at rest. At 8:20 the coloring became more noticeable, the costa darkening and the pronotum becoming a pinkish red, the eyes dark red and all traces of the pronotal constriction are gone and thus the insect is fully normal except in color; and at 8:22 it walked about quite actively with apparently very free use of the legs which a few minutes earlier were flabby, helpless structures. The head has become bluish white; the further change noted in this specimen concerned simply the color, which at about 10 had become dark brown, the nearly normal hue for average specimens.

The first indication of mating was July 23, on a tree in the open with the male clinging to the back of the female but not on center; July 29, male and female were on same twig end to end, but no evident copulation; August 31, many males noted resting on females but none were seen in coition. The prenuptial attentions are apparently quite extended and the males rest uniformly on the side of the pronotum of the female, the feet of one side closed beneath the border of the elytra of the female. Often two males are seen attached to one female but seemingly oblivious of each other. They have no attachment to the twig and the female walks readily up or down the twig. As they are almost invariably accompanied by one or more attendant ants, the moving mass presents a very grotesque appearance. In some instances three

and even four males were seen attached to or clustered around a single female.

Actual egg deposition was not observed but newly laid egg masses, which must quite certainly be connected with this species, were found in twigs sent to me from Cranberry Lake after my return to Columbus. These are laid in two masses diverging from a central line and with the ends of the eggs scarcely below the level of the bark. The position of the egg masses is indicated in the figure (Pl. III, fig. *g*).

Unquestionably the eggs must remain in the twigs over winter for hatching in spring or early summer.

The smallest nymph observed was 3 mm. in length, with the head very short as seen from above; the pronotum was somewhat curved forward between the eyes; the anterior part depressed and the posterior part elevated. The crest was slightly elevated, much less so than later. The apex half way upon the mesonotum; the mesonotum of equal length, forming about a half cylinder. There are no wing pads but the hind quarter of the mesonotum is slightly produced at lateral border. The abdomen is short, roundingly narrowed to terminal segment, which is cylindric, about one-half longer than thick. The legs when contracted do not show from above; the tibia flattened and in natural position at rest are scarcely visible.

The largest nymph is 7.5 mm. long and about one-half as wide; brown-gray, mottled distinctly with white. The head is scarcely visible from above and with the eyes is as wide or a trifle wider than the pronotum. The pronotum is elevated, the central portion rugose, the posterior border produced into an acute process extending over to the meso- and on to the base of the metanotum. The mesonotal wing pads reach the second abdominal segment and overlap the metanotal wing pads which reach about the same point, the hinder border paralleling the mesonotal pads. The abdominal segments 2–7 have a pair of short depressed spurs near the middle line and close to the hind edge. Beneath it is distinctly flattened and the venter is greenish.

The deposition of eggs in the twigs or small branches, mostly in the cambium, results in a distorted growth, the character of which is quite evident from comparison of scars of different ages (Fig. 37) measured by the age of twig or branch. Eggs are mainly, if not entirely, deposited in twigs of the previous year's growth and the result of the first year's growth of new tissue is a deep fissure with protruding lips on the side, the central strip of bark apparently having dried up and broken away. Another year's growth fills in the fissure and still further enlarges the bulb-like swelling of the twig and later years add thickness to the swelling with the growing branch, perhaps ultimately obliterating the scar entirely but in some instances quite evidently causing a weakened spot that may result in the breaking of the branch.

The economic importance of these insects is dependent upon the abundance in which they occur, and from the amount of damage done to a number of the trees at the Summer Camp it is evident that in abundance they will cause very considerable injury. The damage is of two kinds:

The first, that resulting from the sucking of the sap from the trees by the nymphs, a result which may be quite severe, especially if the nymphs occur as has been observed, by several hundred on a single small tree.

The second kind of damage is that due to punctures made by the females in depositing eggs and this damage, as indicated above, depends largely upon the size of the branch or twig which is attacked.

Natural Enemies

We have not observed any natural enemies that could be considered of any special value in reducing the numbers of the insects. The ants, which are constantly in attendance upon the tree-hoppers, are unquestionably seeking the secretion which they use as food and, if having no other relation to the hopper, must be of service to them in keeping other insects away. We have observed no birds feeding upon the insects nor have we found hoppers in the webs of spiders. One female was found with the contents of the abdomen eaten out, but it had the appearance of having been attacked by some species of fungus. However, no general attack of this kind has been observed and it seems evident that the natural enemies are of little account in the matter of control.

It is difficult to suggest any control measures which could be thought of as of service in any large way as applied to the forests, but for individual trees under observation it would be a simple matter to trim the twigs containing egg punctures during the fall, winter or early spring, although the newly formed punctures are too inconspicuous to be found without some careful examination. From the evident inclination of the females to cling closely to the trees on which they develop it would seem quite possible to beat them from small trees but in that case they would no doubt seek other trees in the same locality, and the plan cannot be recommended as of any value except for individual small trees in parks or private grounds.

ASPEN TELAMONA

Telamona barbata Van Duzee

This Telamona is a fairly common species on aspen, but less abundant than the birch tree-hopper. Nymphs were taken July 3 and adults (males and females) first noted July 19th. While not agreeing in all details this seems best placed in *barbata,* though resembling *reclivata,* which according to Funkhouser occurs on basswood. In this form the crest of pronotum has a short elevation at apex of crest, drops a little and runs in straight descending

line to posterior concavity, while *reclivata* is figued as straight from tip to concavity.

Twig scars, which from association are quite certainly to be referred to this species, show two adjacent curved scars of the usual membracid type. Previous years' punctures on one or two year old twigs are uniform, almost circular, with the surface of healed part deeply blackened and with a narrow fissure at center. Older deformities show much swelling and distortion. A group of these scarred and deformed twigs or branches all apparently to be referred to this species are shown in Fig. 15, photographed by Fivaz from twigs collected at the Forest Camp.

Aspen is of too little commercial value to make this an important species and unless it is found to attack other forest trees of the locality it may be considered for this particular region as of little consequence. With other trees involved or with commercial use of the aspen wood the species would at once assume economic importance.

WILLOW LEAF-HOPPER

Idiocerus suturalis Fitch

This insect was frequently observed on willows near the camp site, Barber Point, during the summer. Immature forms, collected on willow and reared in the insectary, emerged as adults July 12. The species also occurred in considerable numbers on aspen (camp site) during the first week of July and for several days later. The nymphs, mostly of the final instar, present considerable variation in markings, usually showing from two to four black spots on the margin of the vertex between the eyes, the inner ones round or slightly angular, the outer ones near the eye elongate — triangular or squarish. In some individuals, otherwise apparently identical, there were two rows of quadrate black dots running the length of the body.

The nymphs live on the leaves, move about quite actively, occasionally jumping if disturbed. The leaves show numerous blackened or browned spots which are apparently due to the feeding punctures. A few badly infested leaves were entirely brown.

ASPEN LEAF-HOPPER

Idiocerus lachrymalis Fitch

Adults and nymphs (Fig. 38) were collected on aspen July 2, 1920, the latter with head markings resembling mature forms with two large black spots, borders next eye, two small round spots near hind border and spots in hind border, two large transverse spots on pronotum, a large black spot rounded behind, divided by narrow line, on mesothorax; base of metathorax between wing pads black; margin of abdomen dark, leaving ovate central disk greenish; below black margined, disk of abdomen greenish, segments five

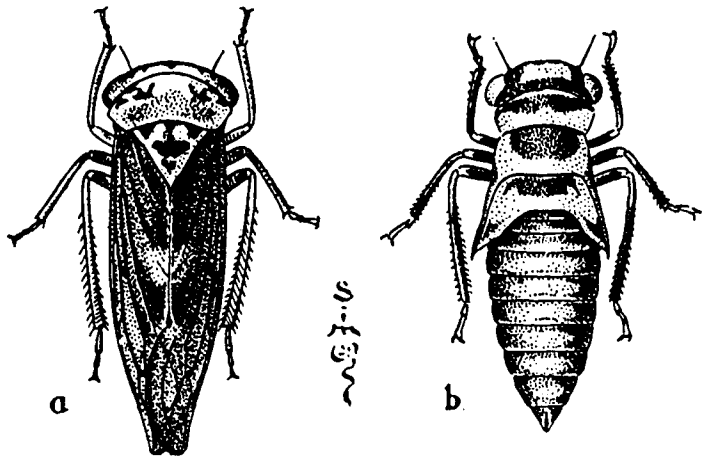

Fig. 38.—*Idiocerus lachrymalis* Fh: *a*, adult female; *b*, nymph.

Specimens of last instars were caged on July 2 and issued as adult during the night of July 4th or the morning of July 5th. (See Fig. 38.)

SCARLET LEAF-HOPPER OF PINE

Empoasca coccinea (Fitch)*

In the very brief description given by Fitch which reads "Scarlet Empoa, *E. coccinea*. Scarlet red, immaculate, pectus and venter orange, elytra brownish-pellucid. Length 0.10. Taken on pines No. 829, male." there is no mention of economic importance nor hint as to the abundance of the species. Since Fitch's time it would seem that the species has been very rarely taken so that it is a matter of some interest to find the species occurring in great numbers on white pines in the Cranberry Lake region. As both adults and nymphs have been secured from this host plant and nymphs from no other it is safe to conclude that it has close restriction to the white pine or at most may occur on closely related species. Collections of the adults were made by Drake in 1917 and during the present season we have taken them in large numbers both by beating and sweeping, especially in late July, at which time the nymphs were noted in greatest numbers.

The nymphs which were mainly in the last instar have the general appearance of the *Empoasca* nymphs are dark green in color closely resembling the pine leaves in tint and have a length of 2.75 mm. to 3 mm. The head is short, broad, subtruncate in front, the vertex depressed with two oblique furrows forming a

* The species is included in Gillette's monograph under the genus *Typhlocyba* and he copies Fitch's description and states that he had not seen specimens and did not know of a determined specimen in existence.

broad V. The wing pads extend to the third abdominal segment and are paler than the body, the scutellum is tinged with yellow and the abdominal segments 1–5 are bordered on the hind margins with brownish. The coxae and base of the abdomen beneath are tinged with blue.

KENNICOTT'S LEAF-HOPPER

Thamnotettix kennicotti Uhler

The nymphs of this species (Fig. 39) were taken frequently during July and early August usually from sweeping hard maple undergrowth or seedlings, and the first adult observed for the season emerged from a nymph in cage August 8.

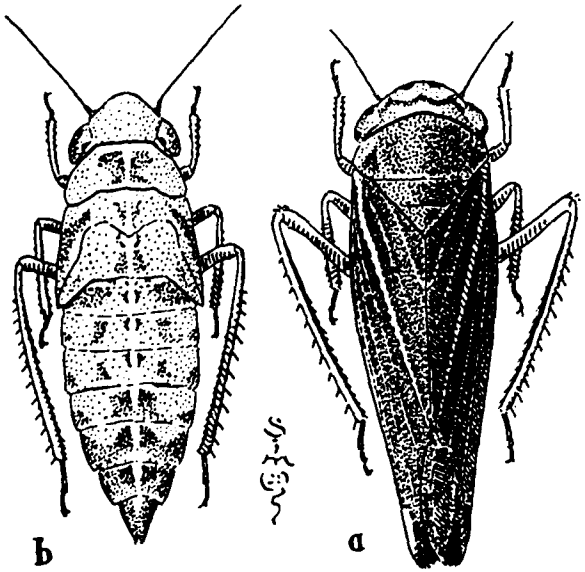

Fig. 39.— *Thamnotettix kennicotti* Uhl: *a*, adult female; *b*, last last instar nymph.

The nymphs were supposed at first to be *Mesamia vitellina*, adults of this species occurring frequently in the same association. Moreover, these nymphs agree very closely with Ball's brief description of the nymph of *M. vitellina*.

Nymphs in confinement survived well on leaves of maple, feeding perhaps most frequently from the petiole, one specimen being kept alive from July 19 to August 8 with occasional supply of fresh leaves.

The nymph of the last instar is about 4 mm. long. The head is distinctly angular and nearly at right angles with front, somewhat flattened and without depressed areas — a little longer than the prothorax and the angle to the front obtuse. The wing pads reach

to the second abdominal segment and are wider than the abdomen. The abdomen narrows from the second segment and in full fed individuals is quite long, tapering gradually to the rather acute tip.

The color is white or yellowish white, minutely dotted with brown or blackish in a definite pattern for the abdomen but with rather scattered spots on the thorax. There are lateral patches on the pronotum, a median patch on the line opening on the meso-thorax and meta-thorax and converging stripes on the abdomen starting from the sides at the base and meeting on the third segment continuing as median stripes to the sixth, which is entirely dark. The seventh segment is paler than the sixth and the apex with bristles. The body beneath is all white, the cheeks are partially dotted with blackish, the legs are entirely white. The beak extends to the second pair of coxae.

SLOSSON'S ELIDIPTERA

Elidiptera slossoni Van Duzee

This species (Fig. 40) presents some very interesting features and furnishes a hint as to the habits and life history of other members of the genus which should make it possible to add much of interest in their study.

Hitherto the genus has been represented quite sparingly in collections and so far as known to the writer nothing has been published as to their life history or habitats.

In 1917 a number of adults and nymphs were taken by Professor Drake and sent to me for identification. Additional specimens have been secured the past season and the data now

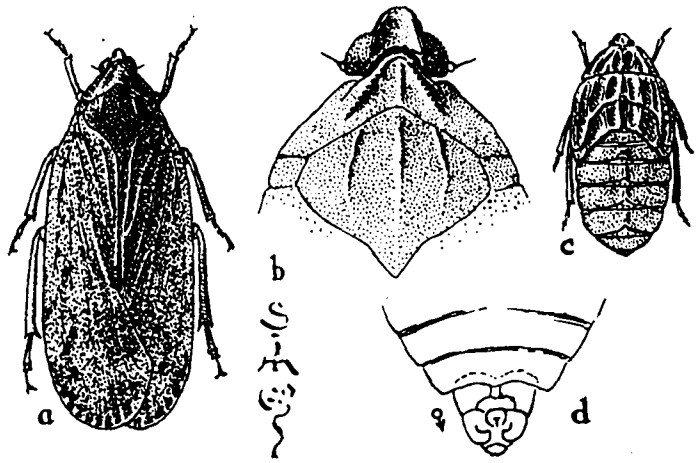

Fig. 40.— *Elidiptera slossoni* Van D.: *a*, adult; *b*, head, pronotum and scutellum dorsal view — much enlarged; *c*, male genitalia; *d*, nymph of last instar.

available warrants a record of parts of the observed cycle and quite certain inferences as to other phases.

The adults (Fig. 40) appear in July or early August (one taken July 19, 1920, by Mr. Fivaz) and evidently while recently emerged are found in crevices of rotten wood or under bark of spruce stumps. At time of mating they probably take wing and the females no doubt seek out new and favorable dead trees for egg deposition. Drake reports that a number of the nymphs and adults were found in a spruce stub, 18 or 20 feet high and about 10 inches in diameter, and which had been dead several years. The eggs must certainly be laid on or under the bark, doubtless on trees or stumps in process of decay and where the nymphs develop.

The nymphs occur in the soft decaying tissue of dead trees between bark and wood or in crevices of rotten wood. Their food is presumably derived from the juices of the decaying wood tissue or fungi and this probably at a favorable stage of decomposition during the second, third or fourth year after the cutting of a tree or under natural conditions during the same period after death or injury of a tree from accident or natural causes. Many large nymphs and adults have been taken in quite rotten pine and spruce, Barber Point, 1917.

The nymph shown in the figure (Fig. 40), the only stage yet found, was taken in early August along with fresh adults and reared individuals show that nymphs mature and adults emerge about August 1.

The nymphs show the head characters of the adult with the vertex proportionately a little wider, slightly wider than long; the pronotal carinae are prominent, the median one disappearing anteriorly; the inner ones curved outward behind, and the lateral ones nearly paralleling the margin. On the mesonotum the five carinae diverge slightly from before backward and the median one is forked posteriorly. The metanotum has three carinae within the bases of the wing pads, corresponding with primary venation. The abdomen is nearly as wide at base as the thorax, broadly ovate behind the segments rather short, six segments being visible.

The body is decidedly flattened, similar to many other insects living under bark. The color is gray-brown with a darker median stripe and border. Length, 5 mm.; width, 2.4 mm.

It may be noted that all recorded American species of the genus are from localities where conifers are found and association with this food supply seems possible. It seems reasonable to expect, therefore, that many other species will be found to have a similar habit, perhaps associated with particular species of *Coniferae* such as larch, fir, southern pine, cedar, etc., and special attention to collecting where such opportunity presents may result in some interesting material and a great enrichment of collections. Aside from the biologic or ecologic interest attached to the species, there is perhaps little of importance to the species as there is no evidence that it can cause injury to growing trees and the effect of its feeding upon the decaying tissue of fallen timber is entirely negligible.

PINE CHERMES

Chermes pinicorticis Fitch

Many years ago Dr. Fitch recognized this species (Fig. 42) as injurious to pine and indicated its potential possibilities as a forest pest. Since the time of his publication the species has shown itself at many localities and frequent intervals to be capable of serious injury to pine trees and it deserved attention in any discussion of insects connected with forest problems. The species was observed on a number of small trees in the vicinity of the summer camp and in some instances in sufficient numbers to be counted injurious. If in large numbers on older and larger trees they were too far from observation to be recognized. In nurseries at the Ranger School it is frequently a very serious pest.

Fig. 41.— Pine blight (*Chermes pinicorticis* Fh.) showing aphids clustered on twig. Photo by Fivaz.

The infested trees are readily recognized by the appearance of numerous small flecks of white cottony material covering the bodies of the insects and adhering to the bark especially around the bases of the branches or in the axil of the twigs. They do not occur on the leaves but the twigs, branches and even the trunk

may be thickly dotted with little thin white tufts. The white cottony secretion consists of wax filaments secreted from glands on the upper surface of the abdomen and may be readily separated from the insect by touching with a needle or brush or dissolved away by application of creosote.

Since the description by Fitch the species has been studied in Iowa by Osborn ('80) in Illinois by Storment and in Maine by Patch and referred to by other writers. The more essential points in the life cycle with reference to control may be stated briefly as follows:

The winter is passed in egg stage and in part by adult wingless-asexual females. The progeny of early spring broods developing first from stem mother are wingless oviparious but about May there is a generation of winged individuals that by a general fight serve to scatter the species in all directions. The later summer generations are wingless and wingless oviparous females provide the eggs which are destined to survive the succeeding winter and produce the stem mothers for the succeeding season. The cottony covering protects them fairly well against sprays unless driven with such force as to dislodge them and this may be done for lawn trees where water pressure is available by drenching the trees with a stream of water as well as with a contact spray,

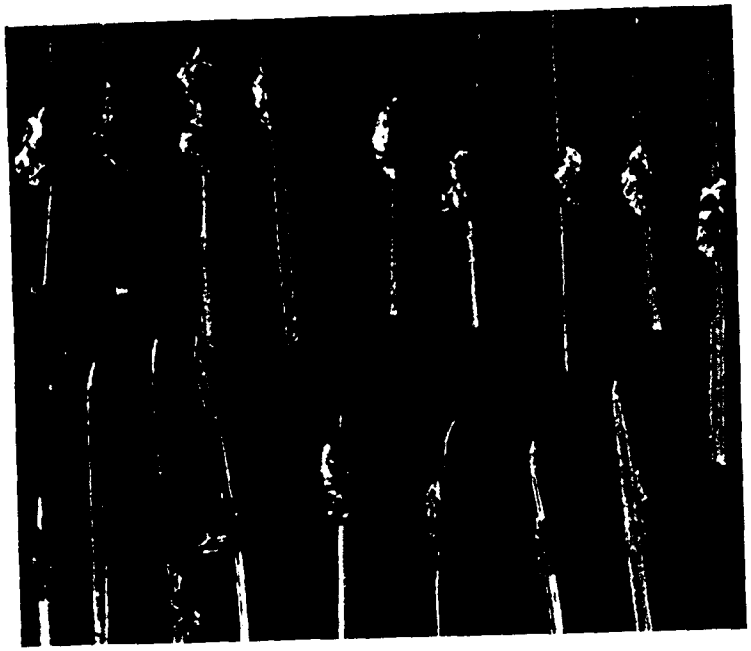

Fig. 42.— Pine leaf Chermes (*Chermes pinifoliae*) showing position in egg deposition. Note egg masses in front of insect at several points. Photo by Fivaz. (See note, p. 104.)

although the latter if under equal pressure might have added advantage of killing the insects and preventing a return of pests by development of new generations from chance individuals surviving the spray.

In extensive forest areas or in large parks where direct applications are impracticable or impossible it may be advisable to cut the badly infested trees and burn the infested branches and twigs to prevent them from serving as centers for the multiplication of the insect and their distribution to healthy trees. This has the further advantage of directing the natural enemies which on the whole are the main factor in preventing wholesale damage by the pest to those trees that are less infested and thereby reducing the numbers of the pest. Care in freeing nursery stock by spraying or fumigating before planting should serve to prevent some of the damage in newly planted forest areas.

Natural enemies that have been noted are chrysopas, syrphids and mites; and these play an important role in reducing the numbers of the pest.

THREE-SPOTTED PSYLLIA

Psyllia trimaculata Crawford

Psyllia astigmata Crawford

This species (Fig. 43) is a very conspicuous feature of the locality, both nymphs and adults appearing in such numbers and distributions as to attract attention.

The nymphs were first noted as abundant on the Fire cherry (*Prunus pennsylvanica*) where the white cottony or woolly masses covering the bodies of the insect and occurring on the under surface of the leaves formed a very conspicuous object. (See Fig. 44.)

Nymphs observed July 3 were in final instar and adults were observed emerging July 7. All adults noted July 7 and 8 were males, and agreed closely with descriptions and figures of *astigmata* Crawford, for which no larval history has been recorded. The woolly nymphs bear close resemblance to *P. floccosa* Patch described from alder, but adult characters appear to be sufficient to separate the two species. While a very few scattered nymphs have been well restricted to the fire cherry so this may be counted the preferred if not the only host plant. Early nymphs have not been observed but undoubtedly occur and develop during June, probably hatching from eggs which have wintered in buds or bark.

Nymphs of the last instar are light green, the wing pads whitish, broadly ovate, the head short, wider than long, as wide as prothorax. Antennae with terminal segment and apex of preceding segments, 5–6–7, black, 3–4 tinged at tip, 1–2 pale. Ocelli close to eye, dark; eyes blackish; pronotum short, beak light yellowish, dark at tip; wing pads of meso- and meta-thorax expanded, wider than abdomen; abdomen as wide as long and sub-truncate

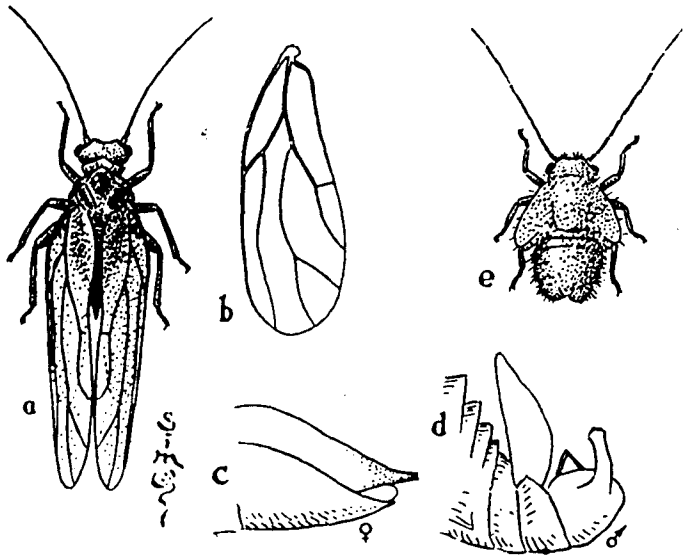

Fig. 43.— *Psyllia trimaculata* Crawford: *a*, adult female dorsal view; *b*, fore wing; *c*, female; *d*, male genitalia; *e*, nymph of last instar with flocculent mass removed.

behind, bearing a large mass of flocculent waxy filaments, easily detached but when the insect is moving giving the appearance of animated bits of fluffy cotton. The appearance of these cottony masses is well shown in the photo plate (Fig. 43). There are long whitish bars on the margin of wing pads and abdomen; the legs with few hairs.

Adult males were appearing fairly common July 7 and 8 and females on the 8th and 9th. Nymphs were still present on fire cherry July 20 but practically all have emerged as adult and very few of the cottony masses remain as compared with a week earlier. Many of the adults collected on fire cherry as well as from other vegetation have the orange red or red markings given as characteristic of 3-*maculata*, later appearing adults seeming to furnish a greater proportion of the red marked individuals. Extended search for nymphs has failed to show any on alder or other plants on which adults are common. On August 1 no nymphs were to be found but occasional tufts of the cottony secretions and molted skins were still hanging to the leaves.

Adults taken July 28 from cherry — agreeing in every detail, except color, with earlier specimens — are nearly all deep blood red on the dorsal lobes of pro- and meso-thorax. As earlier collections and reared specimens for the early part of the month were less distinctly marked it appears probable that the different coloration is a seasonal feature due possibly to later maturity in nymphal stage, or to difference in temperature or other conditions

at time of emergence. No evidence that there is change in color after individuals are once fully mature was found as uncolored specimens kept in confinement either if bred or collected from trees showed no decided change of color when kept several days with food supply.

Adults both with and without the bright red marks have been taken in large numbers from a great variety of trees, including

Fig. 44.— *Psyllia trimaculata* Crawford: leaves (taken from fire cherry in field) show nymphs covered with flocculent masses. Photo by Drake and Fivaz.

birch, willow, aspen, maple, and on none of which have the flocculent nymphs been seen alive. Those taken on *Prunus* have the thorax of yellowish white or light greenish with three prominent orange or red spots on the three lobes; the abdomen is green; tip of upper genital valve, tarsal spurs, claws and antennae, except at base, are black; eyes black. The evidence given in brief above seems to warrant the conclusion that *P. astigmata,* as suspected by Crawford, is only an uncolored form of *P. maculata* and as *P. maculata* has priority, the former species becomes a synonym.

It seems also fair to infer from the seasonal history and the habits of related species that eggs are deposited in fall, probably in or around the buds of fire cherry, where they remain till the following summer when they hatch, and develop as the cottony covered nymphs of June and July.

NOTE REFERRING TO FIGURE 42

Chermes pinifoliae Fitch. This species, illustrated in Fig. 42, page 100, is not discussed in detail, our observations being quite fragmentary, but it may be mentioned that females ovipositing on pine leaves were seen to extrude eggs and, after laying a mass of 35 to 40 eggs, to turn around and deposit another mass, proving very definitely that Fitch's conclusion that eggs were not extruded but held within abdominal walls, the dead insect adhering to the leaf, is not the rule for the species.