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Biological and other notes on *Pseudococcus aceris*.

By EMILY A. SMITH, Peoria, Ills.

(Plate VI.)

SYNONOMY.

Chermes aceris ovatus, Geoffroy. Geoffroy Histoire abrégée des insectes. Paris 1762. 4°, T. 1. p. 509.

Pseudococcus aceris, Geoffroy. V. Signoret, "Essai sur les Cochenilles." (1875) p. 329.

HISTORY.

The first account I have been able to find of this species is that of Geoffroy, in 1763, a celebrated French physician and entomologist, who made the following remark concerning the species:

"This small species is quite flat and oval. It is of a clear brown color and has in the middle a lengthy brown and richly colored stripe, on both sides of which are stripes of a white ash color. It is found on the underside of the leaves of the maple."

The next account is a brief one by Fourcroy in "Entomologia Parisiensis" 1785, 12°, and is only an extract of Geoffroy as *Chermes aceris*, T. I. p. 230. Also Latreille "Histoire naturelle du Crust. et. insect" Paris, (1804) Vol. 12, p. 389, makes a repetition of Geoffroy.

Curtis in the Britanic Entomology gives the male of *Lecanium* for that of *coccus*—Westwood likewise, in his Introduction to Entomology 11, p. 446, seems to have described the male of the *Lecanium*.

V. Signoret in his "Essai sur les Cochenilles" (1875) p. 329, 330 gives, under the name of *Pseudococcus aceris*, a short description of the young larvae and grown female, but says the male is not known to him. In America I find nothing written on the subject, and neither can I learn of specimens in any of the collections. Letters

I would like to return thanks to Dr. H. A. HAGEN, for his kindness in assisting me in obtaining the History of the Species.

from H. A. Hagen, and P. R. Uhler have greatly assisted me in seeking information regarding the species. In only two localities have I found the insect in Peoria and my attention was first called to the subject through the kindness of Col. D. P. Grier of this city in December 1877.

The *Acer saccharinum*, Hard Maple, is the only tree I have thus far met the species on. V. Signoret says: It is one of the commonest species in all the countries and is peculiar to the Maple, although found on many other trees as the Elm, Linden and Chestnut. The scarcity of the insect in America and their abundance on the few trees here, together with the short account of the life habits, and the male not having heretofore been described, have all combined to bring my attention to the insect with the following result. Although the Embryology and Internal Anatomy have received considerable attention, I will leave the description until a future time.*]

THE EGG.

The egg is regular and subovate, the widest part near the center, Fig. I. The size varies, but is from 5 to 6 millimeters long and 3 to 4 wide. When first deposited, the egg is of a light yellow color, nearly cretaceous, but soon attains a dull, yellow brown, as the embryo develops, as in Fig. II. From fourteen to twenty one days are required for the development of the embryo, the condition of the weather and the season of the year having much influence upon the time.

THE LARVA.

The young larva, Fig. III, is twice as long as wide, and is from 7 to 8 mill. long and 3 to 4 mill. wide. The width increases from the head, is broadest at the mesothorax, and decreases posteriorly. The segments of the body are quite indistinct, the indentures only defined after the body is boiled in turpentine or $\frac{1}{10}$ % of caustic potash and mounted in Canada Balsam. The entire number of segments in the body are thirteen, one, or head, three thoracic and nine abdominal segments. When first hatched, the insect is of a uniform yellowish color, the sides are regular, and admit of a slight compression at segmentations. The body is sparsely covered with hairs; several long and stout ones project from the head, as also from the sides of thorax and abdomen, but from the last two seg-

*] Since the above has gone to press I learn through Mr. Putnam of Davenport, that Dr. S. S. Rathvon of Lancaster, Pa., has found the *Pseudococcus aceris* on the Hard Maple in that city, and from the specimens of the egg mass furnished I judge it to be the same.

ments of the abdomen they are more specially observable. The surface of the insect is covered with small tubes or round openings from which no hairs issue.

The head, when examined under a low power, appears rounded in front, but, when highly magnified, is composed of five circular waves, the central one smaller than the others.

The eyes, two in number, are situated behind the antennae and the outer extremity of the head, making them visible from both above and below. They are globular and very dark, if not black, and form a prominent contrast against the yellow of the insect. The antennae, Fig. IV., are situated a short distance from the margin, and arise from slight fleshy tubercles, their outline admits of slight waves but they are otherwise quite smooth, yet forming no regular number of hairs. The number of the joints are six. The first five are of nearly equal size, the second and fifth slightly longer than the others, the sixth and last joint equal in length to the first four combined. From the first five segments one or two strong hairs project from the sides usually from a small tubercle or projection of the skin and from the sixth joint as many as twelve hairs issue, which are of nearly equal length, the apical one the longest and they all proceed from a slight elevation.

Beneath, the clypeus is nearly of a triangular shape, rounded on the anterior margin, the sides nearly straight, the buccal setae are evidently supported by the frame work of the clypeus.

The *labium*, or beak, is similar to that described by Mr. J. D. Putnam in his treatise on *Pulvinaris innumerabilis*, Proc. D. A. N. S., Vol. 11, p. 301, "it consists of a single joint which appears to be formed by the sides of the *labium* being turned forward and then inward, becoming united to form a flattened conical sheath through which the buccal setae are eventually thrust." The sheath however is more triangular than conical in this species as compared with *innumerabilis*. Fig. V.

The thorax is nearly as long as the head and abdomen together and is the widest part of the insect. The prothorax is closely united to the head, and is nearly as long as the meso- and metathorax combined, the widest part is gained in the mesothorax. The metathorax is as wide as the prothorax and half as long. The sides of the body admit of a compression at these segmentations. The legs are situated the same distance from the sides and from each other, and are set well under the body. The anterior pair are attached to the prothorax, just at the side and a little below the la-

bium. The coxa, Fig. VI., (*cx.*) is quite distinct and bears upon its surface several small hairs. The trochanter (*tr.*), when in the bent position as in the figure forms a triangular shape, but when in motion becomes nearly square; this joint is firmly united to the femur, and is movable with the coxa.

The femur (*fr.*) is stout but not longer than the tibia (*ti.*), both joints are of good size. The tarsus (*ts.*) is longer than the tibia, the claw at the end of the tarsus is strong and single, the joints are all furnished with hairs, which, although strong, are not as stout as those on the antennae. The two posterior pair of legs are similar in proportion and size to the one just described, the metathoracic pair having the joints proportionately larger than the two preceding pairs.

The nine abdominal segments are quite easily traced, the width is greater at the sides than in the middle of the body, and the decline of the first eight is a gradual depression occurring at the intersection of each segment. The ninth and last segment is smaller than the others and ends in a deep half circular fissure, as in Fig. III. One long and strong spinous hair projects from each side of the commencement of the fissure and these are followed by many shorter and less strong ones, which become in the centre thick and cemented together, at times in one body as seen at *e* in Fig. VII. and again these hairs are divided into two or more parts.

Habits. When first hatched the young larvae remain upon the leaf and beside the unhatched eggs of the remainder of the egg-mass, and thrusting their slender setae into the leaf, they commence drawing the sap, which sustains their life. There is no uniformity with reference to the position assumed by the newly hatched insect, neither is there a choice shown for any part of the leaf, whether beside a vein or midway, they remain on the lower side of the leaf and do not settle on the upper side even temporarily. When first hatched there is no appreciable difference between the larvae, they are all of the same bright yellow color before described, but soon after a white substance issues from the body and gives the insects a powdered appearance. Shortly after red and yellow ones are found. The insects which become red are the males, Fig. VIII. and are of the same length and width as the yellow, the appendages are similar, with the exception of the antennae which have seven joints instead of six Fig. IX. The white coating appears upon these as well as on the yellow ones or females. When the number of insects upon a leaf becomes greater than it can furnish food for, those first

hatched pass down the stem and seek food from some uninhabited leaf. After fifteen or twenty days, the insects have increased their size two fold, the body has accumulated a quantity of food, globules of adipose tissue, until its thickness has also increased and the two setae are coiled spirally on each side of the head. There is nothing by which a moult can be determined at this time, yet the general appearance of the insect is changed. This is more particularly true of the female larvae. The spines upon the integument have become stronger, and from each segment at the side from three to five strong spines project, while the hairs except from about the head and anus are more rare.

The head is less rounded, and from between the eyes thirteen hairs of an unequal length project, and in addition to these are four quite strong spines. The fissure of the last segment has become deeper and the central part thickened. The hairs projecting from the sides of the fissure are both longer and stronger. From the division of the last two segments, two long spinous hairs extend below the body, and from the lobes strong spines and numerous pores are scattered irregularly over the surface.

The antennae have also gained one joint more and now present seven, Fig. X., the last article shorter than in the newly hatched larva. The legs have increased in strength, and the tarsi become shorter while the tibia lengthens.

With the red or male larvae there is less change, the body has become narrower and longer, and no apparent change has taken place with the posterior portion. The white coating has not increased in quantity and the color of the insect can at once be determined.

THE MALE PUPA.

Soon after birth, the sex of *Pseudococcus aceris* can be determined by the difference in color; the females retaining the yellow color throughout their entire existence, while the males as decidedly retain the red color. They change slightly in structure and the number of articles in the antennae remain the same. They soon become restless and wander aimlessly about over leaf and limb, they are met by the young females, who partake also of their restlessness and together they wander about over the trunk and the limbs of the tree for from seven to ten days, when the females return to the leaves and the red males secrete themselves underneath the roughened outside bark of the tree and undergo their transformation to the imago. A limited number of them return to the leaves and change thereon. From the spines and pores of the integument of the body issues a

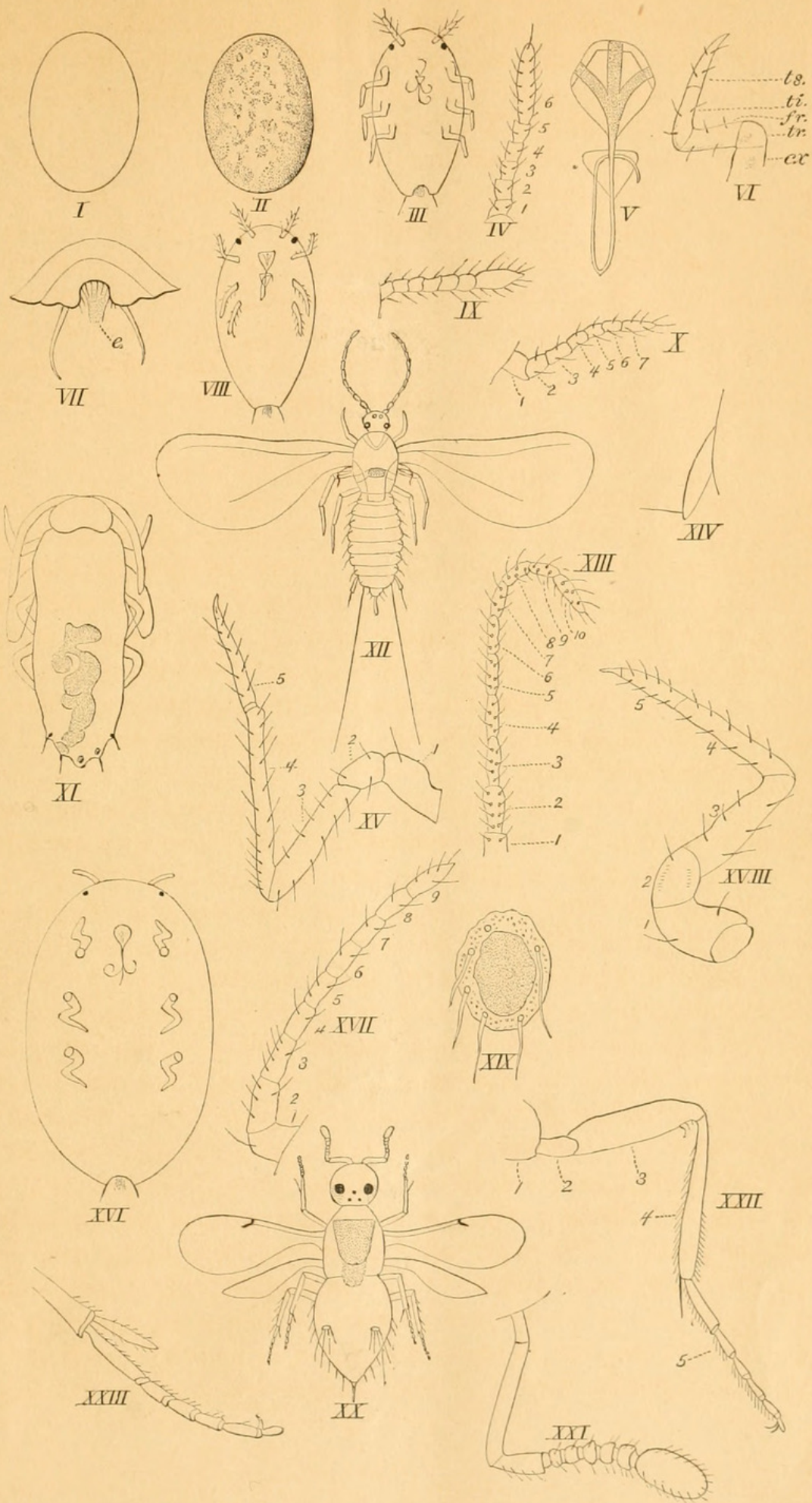
white substance in which the larva is enveloped. This covering soon assumes an oval form, and is composed of threads, the inner coat cemented closely together, while the outer threads are irregularly arranged, although the form is retained perfectly. The entire cocoon is held in place by attached threads to the bark or leaf. Inside of the cocoon the larva gradually changes from the wingless insect to the mature or winged state, the rostrum disappears and two wings form. The transformation is gradual, the pupa, Fig. XI., is of a solid red color and measures from 9 to 10 millimeters long and 8 to 4 wide. The antennae, eyes and legs change their form and after about fifteen days one end of the cocoon opens and the perfect male comes out; the opening through which it emerges is circular and covers the entire end of the cocoon.

THE MALE.

When the male first issues from the cocoon it is inactive and does not fly readily, but after drying the wings by vibrating them, and exercising the other appendages, it is ready for flight and action. The male, Fig. XII., is very beautiful, the same red color which characterized the larva and pupa remaining in the imago. The insect measures 8 mill. long, exclusive of the penis, and with it 9 millimeters and is nearly 3 millimeters wide across the mesothorax. The wings are large in comparison to the body, the appendages strong and of the same color as the body.

The head is closely connected with the thorax, is somewhat globular in form and slightly pointed in front. The eyes are situated on each side of the middle, they are nearly round and full, so that they extend over the side of the head thus enabling the insect to see both above and below. Farther back on the head are two more eyes, larger and more prominent than the first pair. They are of a dark reddish brown color, and form a striking contrast to the bright red of the head. The mouth-parts are obsolete in the male, having disappeared during the transition of the matured larva to the imago.

The antennae are situated close to each other and arise from small tubercular projections, they are jointed, of a reddish cast, and the central part is deeper and darker than the edges. The joints are long and the antenna, itself is nearly as long as the body, the first or basal joint, Fig. XIII. at 1, is short and stout, having but few fine hairs issuing from the sides, the second joint is something over twice as long as the first joint and, approaching the apex, there is one abrupt enlargement terminating in a squarely cut joint; the hairs increase until five and six are found on each side. The



H. Chandler Sc. Buffala.

Smith-Pseudococcus aceris and Parasite.

third joint is nearly three times as long as the first and is narrower throughout, near the apex and on the outer edge is an abrupt enlargement, which at once resumes the former width, the sides are quite thickly filled with strong and long hairs. The fourth to tenth joints are similar in size and form, each decreasing in length and having the surface covered with hairs, the tenth and last joint having the apex rounded. The surface of the antennae is quite regular, the variations slight.

The *thorax* is large and rounded at the sides, the greatest enlargement being at the mesothorax. The sides are smooth and uniform, the entire portion thick, and the central portion of a deeper red than at the sides. The prothorax is rounded in front, is at that point the smallest, and increases rapidly until the posterior margin is twice the size of the anterior.

The wings are two in number, they are joined to the prothorax, and are membraneous and delicate. When compared with the size of the body they are very large, and extend over the abdomen. When folded at rest, they are nearly half as wide as long, and the superior margin is nearly a straight line, having near the middle a reflex nerve.

The ends are rounded, and the inferior margin is concave. The marginal vein is strong but decreases as it extends. Near this marginal vein a sub-marginal vein commences which soon subdivides into two parts, the former following near the marginal vein and parallel with it, having also the reflex curve, while the second division follows the inferior vein and both end abruptly a short distance from the end of the wing. The entire wing is evenly covered with a whitish, mealy substance, and forms a striking contrast to the deep red of the body and serves to make them conspicuous when in repose on the trunks of the tree; seen in the sunlight the wings have a metallic lustre and are as beautiful as conspicuous.

The balancers, Fig. XIV., are prominent and large and are attached to the mesothorax. They are two jointed, the first is large, while the second joint is slender and flexible, the end is often seen curled up instead of lengthened out as in the figure.

The legs are long and slender, and covered with hairs. The anterior pair, Fig. XV., show distinctly the five joints. The coxae are large in all six legs but in the anterior pair they are smaller than in the two posterior. The trochanter is prominent and is firmly united to the femur, which is itself long and becomes larger apically, the tibia is one third longer than the femur and retains a uniform slenderness throughout. The tarsus is nearly one half as long as

the tibia and gradually decreases in width until it terminates in a single movable claw, which ends in a sharp point. The two posterior pair resemble the anterior in all respects save that they are longer and the difference already alluded to in the coxa. The colors of the legs are red, the deepest hue is in the centre.

The abdomen is longer than the thorax and consists of nine segments, the same as that of the female. The integument is covered with fine short hairs, at the sides they become longer and project beyond the body. From the first to the sixth segment there is a gradual increase in size, which then as gradually decreases until the ninth and last segment is only one half the width of the eighth. When the male has nearly completed its transformation, from the division of the seventh and eighth segment a pair of thick spines issue, and as the insect matures, they increase in size until in the perfect insect they extend to the end of the ninth segment; these spines are surrounded by two long flexible hairs, twice the length of the spines. When the male first emerges from the cocoon, two long waxy filaments issue from the division of the eighth and ninth segments. They are pure white and longer than the entire insect. I am of the opinion that they consist of a number of filaments united together. These extended filaments are observed only on males who have recently issued from the cocoon, and are soon dropped off when the insect flies about, and become soluble when mounted.

From the ninth segment projects the penis, this organ is slender and slightly curved. The segments of the abdomen are flexible and possess the power of expansion and dilation.

Habits. The trees from which I have made the study of the *Pseudococcus aceris* were very badly infested and the number of males compared to the females were nearly equal. When they first emerge from the cocoon they are sluggish, but soon become active and fly about the tree with rapidity. They seek the females who have become likewise fully matured and are still wandering about the tree, some of them hiding in the crevices of the trunk while others seek the base of the larger limbs, and when in excessive numbers settle upon the ground at the base of the tree. In these places they partially conceal themselves by a white secretion exuded from the body. There they are sought by the males and at this time the impregnation of the female takes place. Ten days after the first appearance of the male, they have all disappeared, the probable life of each individual not exceeding two or three days. The mouth parts having become

obsolete during the transition, the males take no nourishment, and the short life obviates all necessity for food.

THE FEMALE.

The growth of the female is very rapid after the appearance of the male. There is no distinguishable metamorphosis and the female does not acquire wings. The dorsal and ventral integument are of the same bright yellow color that has characterized the sex from the beginning of the larval form. The divisions of the body become less distinct as the development proceeds until it is only after mounting that the insect can be studied with accuracy.

The dorsal integument is smooth, of uniform color throughout and the divisions of the body obscure. The sides are even in outline, with a slight restriction at the divisions and with short hairs irregularly projecting from the body. The small pores are more numerous and larger than in the earlier stages of the insect, and from all parts of the integument short, slender hairs extend which issue from circular projections.

The body of the female, Figure XVI, is nearly oval and becomes almost round as it fills with eggs.

The eyes are small and quite round, they are inserted a short distance back of the antennae and at the margin of the head. They are dark red, and appear black when mounted.

The antennae are situated on the underside and widely separated. They are nine jointed, having numerous long flexible hairs on the surface. The color of the antennae is the same as the body and uniform throughout.

The first joint of the antennae Fig. XVII is large and well secured to the body, the seven following become gradually shorter, the last and ninth is as long as the third and terminates in a point. Thus with the growth of the female an addition of three joints have been made. The female, unlike the male, has had no perceptible pupa state neither regular moults, and in the antennae do we find the greatest change of the appendages.

The *beak* consists of four long slender setae.

The *thorax* increases in size every way. The six legs are present, but the body becomes so distended that it is utterly impossible for the female when in the process of deposition to walk any distance, yet she can, with difficulty, proceed. The legs have not developed with the body and yet have not lost their use. They are quite similarly constructed and Fig. XVIII is a representation of one of them. The *coxa* is strong, and is both long and stout, with only a few hairs

on its surface. The trochanter is of corresponding size and has one hair on the outer surface. The femur is widest at the base, and gradually decreases until at the apex it is only one half the size. The tibia is of uniform width, is longer than the femur and both are equally distributed over with flexible hairs. The tarsus is one half the length of the tibia without the claw, from the tibia it gradually tapers and is more thickly covered with hairs, and the claw which terminates the tarsus is single and strong.

The abdomen occupies a trifle over one half of the entire insect and consists of nine segments, they decrease gradually. The vulva is oval, Fig. XIX, and surrounded by a narrow chitinous band with five or six long strong spines and numerous small perforations. In the figure the sixth spine is removed, the circular base present, surrounding the vulva and band, have also many small perforations and less strong spines. I feel quite sure that the secretion peculiar to the female comes largely from these pores about the vulva, and in less quantities from the pores on the body.

Habits. As soon as the males and females have united, the latter, if not already settled on the underside of the leaf, at once do so. Care is taken by the insects that not more than three or four remain on one leaf. As soon as settled the setae are inserted under the epidermis of the leaf and the position of the insect is determined for life. They make no particular choice on the leaf, and if they have a preference it is for the portion between the midrib of the leaf and the next rib in size.

The direction of the head is also immaterial with the insect. Soon after settling the dorsal integument is covered with a white substance and is equally distributed over the body. The insect also increases in thickness. In a few days the secretion becomes greater posteriorly and the insect is soon concealed from view. This secretion does not assume a regular form but is loosely formed and flatulent. The eggs as soon as laid become enveloped in the mass, and as the number of eggs increase, the quantity of secretion increases and those eggs first laid are pushed outward by the pressure of the others. The eggs form more rapidly in the body of the female than can be deposited, and thus the body becomes greatly distended. With the development of the body the female pushes the setae under the epidermis until the head is in close contact with the leaf, and when raised this organ will support the leaf on which it is situated. The white secretion is composed of a number of fine threads which are

elastic and admit of being drawn out. The number of eggs deposited by one female depends entirely upon the strength of the individual, since only a general wearing out of the system, or an untimely death through foreign agencies seem to control the number. They range from five hundred to the number which the strength of the insect admits of. The cottony secretion is soluble in alcohol, ether etc. and insoluble in water, glycerine etc. The deposition continues from fifteen to twenty days, the embryo is developed outside of the body and is much influenced by the temperature of the weather; the time required is less when the days are even and dry than when interrupted and irregular, it usually requires a little less than three weeks and it is not unfrequent that the young lice are crawling about on the leaf while the mother is still in the act of deposition.

When at length she is obliged to yield to the failing strength, her body dries beneath the cottony covering and, as frequently happens, the leaf has become so weakened that it can no longer remain attached to the tree, and falls to the ground conveying also the dead body, the young insects having previously left for more palatable food. At times the leaf is unable to remain until deposition has ceased and the female is then starved. This, however, more frequently follows a storm.

PARASITES.

The female is often stayed in her act of deposition by the presence of guests in her body. She commences her labor and at times proceeds until a portion of the egg mass is formed, when she yields to the lives within and becomes a victim to the enemy who gains an existence through her own life.

I regret the insect is unknown to science and that we have no specialist at this time who is describing the *Chalcididae*. Having submitted specimens to Mr. E. T. Cresson and others, who failed to recognize the insect, I supply the following descriptions in order to give so important an insect, as this species has proved to be, in the life of the *Pseudococcus aceris*, a place.

Acerophagus Nov. Genus, one species.

Head wider than thorax. Antennae nine jointed, second joint one third as long as the remaining eight taken together. First, third, fifth, sixth, seventh, and eighth joints shortest, ninth large and forms a club. The antennae inserted a distance apart. Tarsi five jointed; the stigmal branch long, strong and straight. Ovipositor exerted.

Acerophagus coccis N. S. described from fifteen bred specimens. Imago ♀ Length 9 to 10 mill. and 3 to 4 mill. wide, Figure XX. Body of a yellowish cast. Head solid, yellowish brown, wide as thorax, and wider than long, opaque. The antennae are not closely united, are pubescent and nine jointed, all the joints are of uniform color, a trifle lighter than the head (Figure XXI) first and second joints slender, second joint one third as long as the remaining eight, short hairs issue from the sides, the third joint increases in width at once and becomes at the apex twice the width as at the base. The fourth, fifth, sixth, seventh and eighth joints are short and increase both in length and width. The ninth and last joint is oblong and very large, the articles are not united closely and especially the last six, these are somewhat pedunculated.

The compound eyes are large, and are situated at the posterior portion of the head, reaching to the neck and sides, they are pear-shaped having a dark round spot on the inner and upper portion of each eye. The ocelli are three in number, triangular and of a brownish red.

The thorax is broad and stout. A shield extends from the shoulder to the metathorax and from the termination a second shield, less dense, projects slightly over the abdomen. When the insect draws itself together, the head presses down to the shield, making it appear as though it had no neck. The wings are membranous, hyaline, and ciliated. The fore wings have the rib-vein running parallel with the margin, one half its length, when it unites and extending outward and downward forms a stigma. About one third the distance from the base there is slight space extending across the wing free from pubescence. The upper and lower basal of the margin ends in a thickened edge, the remainder having a fringe of hairs.

The lower wings are smaller, without veins and form a fringe on the lower portion.

The six legs are of the same color as the body. The mesothoracic legs, Fig. XXII., have the coxa large, the trochanter, femur and tibia long, the apical spur of tibia strong. The tarsus is five jointed, the first joint longest, and the last ending in two claws. The apical spurs of the metathoracic tibiae are longer, Fig. XXIII., than of the two preceding tibiae and the first joint of the tarsus is as long as the remaining four together. The legs are hairy, the tarsi provided with the strongest and greatest number of hairs.

The abdomen is of uniform color throughout, the sides are furnished with long and strong hairs. On the dorsal side about one half the distance from the base to the apex and to the sides, a small black projection extends below the abdomen. It commences on the underside at the base of the abdomen and consists of two lateral valves, elongated and forming the sheaths of the ovipositor, which is nearly cylindrical and, as far as can be discovered, plain.

Habits. When the female of the *Pseudococcus aceris* is in the act of deposition, and concealed by the white covering, the parasite discovers it and thrusting its long ovipositor through to the insect beneath deposits from six to twelve eggs in the body. The larvae as soon as hatched feed upon their victim and pass through all stages of life within the body, issuing at last in the winged state. The young lice are not attacked by the parasite and only when the female is in the advanced state of deposition are traces of their presence to be found. From the external appearance no indication is visible that they are beneath, the female *aceris* becomes dried and hard even though the color remains the same. When the parasites are matured they break open the dried body and make their escape. They can both leap and fly.

NATURAL ENEMIES.

A species of *Syrphus* fly is beneficial by feeding, while in the larval state, upon the young lice and is in considerable numbers upon the tree. From the cocoon made by the fly, I have bred a species of *Eulophus* Geoff. of the *Chalcididae*. I am unable at this writing to identify these two species, neither am I satisfied that they are new species.

The *Hyperaspis signata*, Olivier, is abundant as also the *Chilocorus bivulnerus* Muls. The *Anatis* 15—*punctata* and a species of *Chrysopa* are found in limited numbers, all of whom assist in the destruction of the *Pseudococcus aceris*.

NUMBER OF BROODS.

There are three generations each year. In the winter months they are found in the larval form in the crevices of the bark of the trunk and at the base of the larger limbs, and are of two colors, red and yellow. During the warm days of winter they crawl on the outside and are quite active. They make a lining in the crevices of the cottony secretion and remain therein the greater part of the time from October to May. They also convert the empty *Chrysopa*



Smith, E. A. 1880. "Biological and other notes on |*Pseudococcus aceris*|." *The North American entomologist* 1, 73–87.

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