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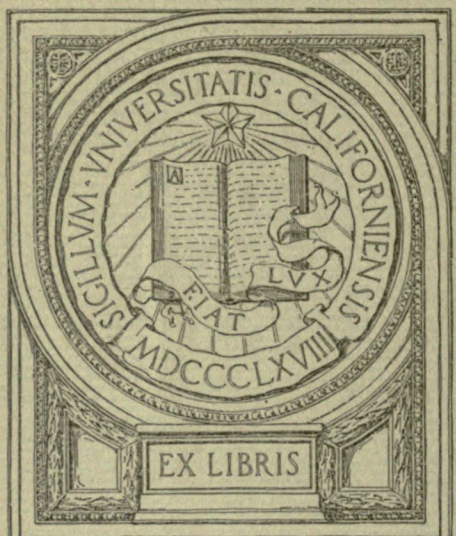

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Fourth Annual Report

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Insects Injurious to Maple Trees.

By E. P. FELT, D. Sc., State Entomologist,

University of the State of New York.

THE conditions under which shade trees are grown vary so widely from those under which the same trees live in the forest, that methods of controlling injurious insects found practicable in the one case can not be advised in the other. For this reason the present paper will be confined to insects affecting shade trees, and space limitations render it advisable to treat of only a few of the most injurious species affecting maples. It will be found, however, that most of these pests attack other shade trees, and that in one instance at least, that of the white marked tussock moth, the caterpillars prefer the horsechestnut; but as maples are the more abundant shade trees throughout the state, even this species is of greater importance on account of its injuring maples than because it attacks the horsechestnut.

Transformations. Before treating of individual species, it may be profitable to glance briefly at the life history of insects and the relation of the various stages to each other. All insects hatch from eggs, which present widely variable forms in different species and are frequently of exceedingly beautiful design. In certain cases the ova or eggs hatch within the body of the parent. Members of the very lowest or simplest order of insects, such as snow fleas, slides or silver fish and their allies, undergo no transformation, that is, there is very little difference between the young and the adults. Among grasshoppers and related insects, there is what is called an incomplete metamorphosis or transformation. The young grasshopper, as it emerges from the egg, is a curious, wingless little creature, bearing a general resemblance to the parent and can easily be recognized as a grasshopper. As the little fellow increases in size, it casts its skin from time to time and with each molt the wing pads become longer and in the final change the wing cases are slipped off and the organs of flight are at liberty to perform their proper functions. In the stage before the final one, the wing pads may be as long as the fully developed wings, but the two stages may easily be separated by the position of these organs. In the adult the fore wings fold over and conceal the hind ones, while in the immature grasshopper the hind wing pads are outside of the fore ones. Many insects like cockroaches, walking sticks, dragon flies, true bugs and others develop in this manner, but not all resemble the adult so closely in the earlier stages as do grasshoppers.

The most marked changes in development are seen in butterflies, moths, flies, beetles and bees. Comparatively few understand the relations existing between the voracious caterpillar, the quiet brown pupa or brightly colored chrysalis, and the beautiful moth or butterfly. The young caterpillar emerges from the egg and at once begins feeding, casting its skin from time to time in order to allow of increase in size. This, the larval stage, is the period of assimilation and growth, and it is while in this form that most insects are destructive. When full grown, the caterpillar (Plate 1, figure 1) sheds its skin and changes to a pupa, a form which is usually brownish and subconical (Plate 1, figures 7, 15). This transformation is frequently preceded by the spinning of a cocoon (Plate 1, figure 14) or by the formation of an earthen cell. During the pupal stage no food is taken and only a very limited activity is possible. It is the period of reorganization. From the comparatively simple caterpillar, there is developed the delicate moth or butterfly, which in due time emerges from the shroud-like pupal case. After a time, pairing occurs, eggs are deposited and the life cycle again commenced. On account of the great changes from the caterpillar through the pupa to the adult, the identity of a species in the various forms can usually be established only by rearing. All insects presenting such marked changes in their development are said to undergo a complete metamorphosis or transformation, a change which will be found true, in endless variation, of all members of the bee, beetle, fly, butterfly and moth families.

A study of the habits of injurious insects in their various stages is the foundation of applied or economic entomology, for such investigations usually reveal one or more weak points in the life history of each pest that render its control comparatively easy.

White Marked Tussock Moth.

Notolophus leucostigma Abb. and Sm.

This insect appears to thrive best in cities and villages and some seasons proves a veritable scourge in certain localities. In Albany and Troy, the horsechestnuts are usually partly defoliated each spring and occasionally stripped of all their leaves by the voracious caterpillars of this moth. The lindens frequently suffer nearly as much, and the maples and elms come in for a goodly share of attention from year to year. The above is probably true to a great extent of most of the cities and larger villages in the state. The summer of 1898 was marked by the abundant presence of this insect, and the extensive defoliations which occurred at the time aroused the people to the necessity of fighting the pest. This was done so effectively that very little trouble with this caterpillar was reported in 1899.

Description. The full grown caterpillar has a coral red head, a pair of long black plumes just over it, a single one at the opposite extremity of the body, four delicate yellowish or white brush-like tufts on its back and just behind them, separated only by a segment, two small, retractile, red elevations. Along the back, except for the tubercles and tufts, there is a broad black band bordered by yellowish subdorsal stripes. Each side is dark gray, except the yellowish tubercles. A black line indicates the position of the spiracles or breathing pores, and below this latter line it is yellow, the legs usually being paler (Plate 1, figure 1). This gives the general appearance of the caterpillar after it has become half or two-thirds grown, and at a time when its depredations begin to be apparent. The recently hatched larva is a pale yellowish or whitish creature with long, irregular hairs. As it feeds, increases in size, and casts its skin (Plate 1, figure 5) from time to time, one after another of the characteristics of the full grown larva are assumed.

When maturity is reached, the larvæ spin their thin cocoons in the crevices of the bark (Plate 1, figure 4), interweaving their long hairs, and within this shelter transform to yellowish white pupæ more or less shaded with dark brown or black (Plate 1, figure 7).

The difference between the sexes in the adult stage is strikingly shown by comparing in plate 1, figure 2, an illustration of the male, with figure 3, a representation of the female. The former is a beautiful moth with large, feathery antennæ, tufted legs, and the wings and body delicately marked with several shades of gray and grayish white. On the other hand, the female is a nearly uniform gray, with simple antennæ, and but rudimentary wings.

The eggs are deposited on the empty cocoon under a conspicuous white mass of frothy matter (Plate 1, figure 3), which soon hardens and forms a very effective protection. The individual egg is nearly spherical, about $\frac{1}{25}$ inch in diameter, white or yellowish white, and with a light brown spot surrounded by a ring of the same color.

Life History and Habits. The winter is passed in the conspicuous, white, easily removed egg masses, the young emerging about the latter part of May in this latitude. They begin to feed on the more tender lower epidermis of the leaf and soon devour all but the principal veins. While young, the caterpillars frequently hang by a silken thread and with continued jarring many may drop to the ground. The growth of the caterpillars occupies a month or a little more, pupation occurring the latter part of June and early in July. In Albany most of the larvæ had pupated by July 7 in 1898, and some recently deposited egg masses were to be seen at that time. A few individuals spin up earlier than the mass and some do not till numerous egg clusters indicate that most of the insects have already completed the round of life.

form of a scraper, the task is easily and quickly performed. Dr. Howard has recommended the use of creosote oil for the destruction of the eggs, since each mass has only to be moistened with the substance. In winter it is necessary to add some turpentine in order to keep the creosote liquid. On account of the female being wingless, a tree once thoroughly cleaned will not become reinfested very soon if larvæ are not abundant near by, and even then a band of loose cotton bound tightly near its middle around the trunk and the portion above the string turned down, will prevent their ascending and a consequent reinfestation. It should be kept in mind that only the eggs must be collected or destroyed, on account of the beneficial parasites which may occur in cocoons not bearing egg masses. This is specially true in the autumn and applies to a certain extent in the spring, since it has been shown that some parasites hibernate as larvæ within the cocoons of the host, and if these are collected and destroyed, it means the death of many beneficial forms. The egg masses are

Figure 2.—DIBRACHYS BOUCHEANUS: *a*, larva; *b*, pupa; *c*, adult female—greatly enlarged; *d*, head of larva; *e*, antenna of adult—still more enlarged. Lines beside figures represent natural size. (After Howard: U. S. Department Agrienlture, Division Entomology. Tech. ser. No. 5, 1897).

more readily seen after the leaves have fallen and in localities like Albany, where one annual generation is the rule, the gathering of the eggs may well be deferred until autumn, or, better still, until early spring, since there will then be less chance of destroying valuable parasites. As the young caterpillars begin to hatch the latter part of May, collection of the egg masses can not be delayed with safety after the middle of that month. In Boston, New York city and more southern localities, it may be necessary to collect in midsummer the eggs laid by the first brood of moths.

In case it is impracticable to collect the eggs, dependence must be placed upon spraying with some arsenical poison. This is satisfactory if properly done early in the season under favorable conditions. In many instances there will be more or less

FIGURE 3.—POWER SPRAYING OUTFIT IN OPERATION.

delay and in practice it is very difficult to have the spraying properly done, and then there may be hindrances incident to several days or a week of rain at the time the poison should be applied.

Not a few wait till the trees show signs of serious injury and then ask for some means of stopping the ravages. Under such conditions, resort may be had to spraying with a larger proportion of poison in order to kill the caterpillars quickly or they may be shaken from the limbs, provided the tree is not too large. The latter means will give a certain amount of relief where practicable and should be supplemented by the use of cotton bands or other means of preventing the ascent of those shaken from the tree.

In order to spray trees successfully, certain rules must be observed. Apply the poison at the time the insects begin to feed and where they must eat it if the tree is attacked. In the case of this insect and the following, it is best to throw the spray on the under surface of the leaves so far as possible, as the young caterpillars prefer the tender lower epidermis. Do thorough work, that is, try to cover every leaf with the mixture and spray till the tree begins to drip, but no more. The finer the spray, the better, as a more even distribution is ensured. The poisonous mixture must be kept agitated while spraying is in progress. While a power spraying apparatus is the best, good work can be accomplished with hand pumps, but plenty of hose must be supplied as a fine spray can not be thrown far and it is, therefore, usually necessary to do more or less climbing. One pound of Paris green, one pound of quicklime, to 150 gallons of water is a very good spraying mixture for this insect. London purple may be used in place of Paris green, if desired. Though costing a little more, arsenate of lead is probably the best poison for most to use, since it adheres an indefinite time to the foliage, its whiteness renders it easily detected, and it can be applied in large quantities without danger of burning the foliage. It is prepared as follows: Dissolve eleven ounces of acetate of lead (sugar of lead) in four quarts of water in a wooden pail and four ounces of arsenate of soda (50% purity) in two quarts of water in another wooden pail. As the acetate of lead dissolves rather slowly in cold water, the process can be hastened by using warm water. Pour the resulting solutions into the spraying tank which should contain about eighty gallons of water. This poison may be used in much larger proportions without the slightest danger of burning the foliage.

Power Spraying Outfit. In the extended work against insects conducted by certain cities and villages, it has been found necessary to have apparatus that will admit of more rapid work than is possible by hand. This has led to the refitting of retired fire engines and the designing of more or less cumbersome outfits for this purpose. In all cases these makeshifts have been successful, though they are not usually so satisfactory in operation as those specially fitted for the purpose. Probably

the best apparatus yet designed for spraying trees is that constructed under the direction of Dr. E. B. Southwick, Entomologist of the Department of Public Parks of the city of New York, which is the form used in Albany. The whole outfit is represented in the accompanying figure (3). It consists of a "Daimler" gasoline motor operating a Gould force pump—the motor and pump, weighing but 300 pounds, can be placed in the bottom of a spring wagon along with the one hundred gallon tank containing the poisonous mixture. This motor has the advantage of being almost noiseless in operation and is scarcely noticed by passing horses. It is very inexpensive to operate as a gallon of gasoline is sufficient for a day and it requires little attention. The smallest size Gould three-piston pump is the one used with the motor, though Dr. Southwick now recommends a larger one in order to utilize the power more fully. This apparatus, with the tank, 400 feet of 3/8 inch rubber hose and other necessary fittings, can be bought for about $500. Other engines and pumps could undoubtedly be used and would give excellent results. This power can easily supply four lines of hose, though in Albany it was found that not more than two could be used to advantage in most places.

Forest Tent Caterpillar: Maple Worm.

Clisiocampa disstria Hübn.

Stripping a large proportion of the foliage from maples has been a marked characteristic of this species for the last three years in many sections of New York. In 1897 and 1898, the sugar maples of Delaware, Greene and Otsego counties suffered most severely from the attacks of this pest, large areas being left with hardly a green leaf. The destructive work of this caterpillar in 1899 was more general than in the preceding two years, there having been complaints received from about half the counties in the state, and in some sections the depredations were worse than ever. This species appeared in force in many cities and villages, threatening thousands of handsome shade trees with defoliation, and had it not been for most energetic efforts on the part of local authorities and private individuals, many maples along streets and in parks would have been stripped of leaves. As this native species is generally distributed, its comparative abundance in a locality is due to natural causes, favorable or otherwise, and very rarely can it be said that the insect has migrated to any extent, except in a very local and restricted sense.

Description. This insect can be distinguished at once from the common apple tree tent caterpillar, *Clisiocampa americana* Fabr., by the fact that no conspicuous web tent is spun. This caterpillar (Plate 1, figure 13) has a row of somewhat diamond

FIGURE 4.—SUGAR ORCHARD DEFOLIATED BY FOREST TENT CATERPILLARS, ARKVILLE, DELAWARE COUNTY, JULY 8, 1898.

shaped, whitish spots down the middle of the back, while its close relative possesses a narrow whitish stripe in place of the dots. The egg belts (Plate 1, figure 12) encircling the more slender twigs, are smaller, usually with one or two wrinkles or depressions in the brownish, protective covering, and the ends of the belts are more abrupt than are those of the species usually found on apple trees. An average sized egg belt, collected in Albany, of the forest tent caterpillar contains about 150 eggs. If an egg is opened in September or later, a well developed, nearly black caterpillar with a few whitish hairs may be seen. The recently hatched caterpillars are nearly black with whitish hairs and are found clustered together or traveling along certain silk lined paths. After the second molt, the characteristic row of whitish spots along the back appears and as the caterpillars increase in size, the colors become brighter and more distinct. The white or yellowish white cocoons (Plate 1, figure 14) are spun in leaves on the tree or lying on the ground, in crevices of the bark, under stones, in fence corners and under almost any convenient shelter. Within the cocoon is found the dark brown pupa (Plate 1, figure 15). The moth is a light, buff colored, active creature (Plate 1, figures 10, 11). The male may be recognized by his richer coloring, smaller size and feathery antennæ (Plate 1, figure 11).

Life History and Habits. The winter is passed by the well developed larva within the egg shell. On the appearance of warm weather, the young caterpillars begin to emerge and if no food is at hand, await the unfolding of the leaves. From eggs received in early spring, young caterpillars emerged April 17. There is considerable latitude in the time of hatching, even in one locality, about a month as reported by V. H. Lowe, and there is a corresponding variation in the time the caterpillars attain maturity. As the young increase in size, they molt from time to time, leaving their cast skins in small clusters on the bark (Plate 1, figure 16). When not feeding, the larvæ may be found in clusters on the limbs. They also resort to such places when about to molt, an operation requiring at least a day or two. A wind or jarring causes these creatures when small to drop and suspend themselves with a silken thread, a position very annoying to persons obliged to pass under an infested tree, and as many shade trees were attacked last summer, this feature was painfully apparent. If the shock is sudden the caterpillars drop without spinning a web. As they become about half grown, they frequently form good sized clusters on the larger limbs and trunk of an infested tree. If the creatures are very abundant, they may strip the tree before full growth is attained and then be forced by hunger to invade neighboring orchards. The maple leaves represented on plate 1 show well the work of this insect. Ordinarily, as the caterpillars approach maturity, many of them forsake the tree and crawl in all directions. Thus in obedience to a natural impulse, they may crawl in numbers over walks, piazzas and swarm on sides of houses. This wandering, prior to

Explanation of Plate 1.*

White Marked Tussock Moth (*Notolophus leucostigma* Abb. and Sm.).

1. Full grown caterpillar.
2. Male moth at rest.
3. Female moth laying eggs on her recently vacated cocoon.
4. Several cocoons.
5. Cast skins of caterpillars.
6. Work of young caterpillars on under surface of leaf.
7. Male pupa.
8. Branch girdled by caterpillar.
9. End of branch broken off at the point where it was girdled.

Forest Tent Caterpillar: Maple Worm (*Clisiocampa disstria* Hübn.).

10. Female moth.
11. Male moth.
12. Egg belt encircling twig.
13. Full grown caterpillar.
14. Cocoon in a leaf.
15. Pupa.
16. Cast skins of caterpillars.

* Plates 1–3 were executed from nature, under the author's direction, by Mr. L. H. Joutel of New York city.


PLATE I
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HOUTEL

pupation, occurs about June 1, the transformation to the pupa taking place from about the middle to the last of June. The insect remains in the pupa state about two weeks, the moths appearing the latter part of June and during July, mostly in the latter month. The eggs are deposited during July, a large proportion of them being laid on the lower twigs, but many are found over twenty feet from the ground and numbers even in the tops of tall trees.

Food Plants. Like the apple tree tent caterpillar, this insect can subsist on a large variety of plants. Its favorite species of oak in the southern states, as given by the late Dr. Riley, are those belonging to the same group as the black oak. In New York and adjoining states this insect is reported more frequently as defoliating the sugar maple than any other tree. This may be owing to the fact that large sugar orchards afford the most favorable conditions for the caterpillars in the north, and as the maples are of greater value than forest trees, complaints of attack are more frequent. The caterpillars have been reported by various writers as feeding upon the following trees and shrubs: Linden, maples, locust, peach, plum, cherry, rose, strawberry, apple, sweet gum (*Liquidambar styraciflua*), dog wood, "black gum," sour gum (*Nyssa sylvatica*), ash, elm, black walnut, hickory, walnut, oak, black oak, post oak, white birch, gray birch, willow and poplar.

Natural Enemies. Like the preceding, this species has a number of important natural enemies. A fungous disease is known to attack this caterpillar, but at present little has been done in attempting to disseminate it. One of the most fruitful methods of keeping the pest in check through the aid of its natural enemies, will probably be found in encouraging and protecting the native birds known to feed on it. Robins, orioles, chipping sparrows, cat birds, cuckoos, the red eyed, white eyed and warbling vireos, cedar birds and nuthatches have been observed feeding on forest tent caterpillars by Miss Caroline G. Soule. "The nuthatches would stand by a patch of larvæ lying close together below a tar band on a tree and eat so voraciously and with such an entire abandonment of self-consciousness that I could go close and put my hand on them before they would fly. This experience was repeated several times." Mr. E. H. Forbush, Ornithologist to the Massachusetts State Board of Agriculture, has kindly supplied me with the following list of native birds observed by him feeding on forest tent caterpillars: Oriole, black billed cuckoo, yellow billed cuckoo, crow, blue jay, redstart, nuthatch, wood thrush, chewink, black and white creeper, red eyed vireo, flicker and scarlet tanager. Mr. V. H. Lowe has observed the black capped chickadee feeding on the eggs and the

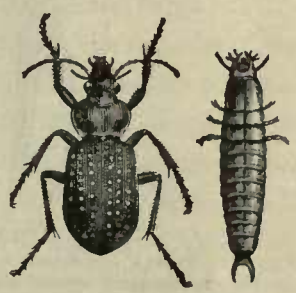


Fig. 5.—FIERY GROUND BEETLE. (After Riley).

robin on the caterpillars, beside others mentioned above. Professor C. M. Weed states that the robin, chipping sparrow, yellow bird and English sparrow feed on the moths.

The value of birds in keeping other pests under control is also strikingly shown in the experiment conducted by Mr. Forbush. In a typical orchard at Medford, Mass., a little trouble was taken to attract the native birds, the nests of the English or house sparrow being destroyed. The results were greatly in favor of protecting our indigenous forms. In the neighboring orchards it was evident that canker worms and tent caterpillars were very numerous, but in the orchard in question, the trees were seriously injured in only one or two instances, though no attempt was made to control the insects by spraying or other artificial means.

Our native birds are undoubtedly of great value and will richly repay any slight effort that may be made for the purpose of attracting them to a locality. Winter birds

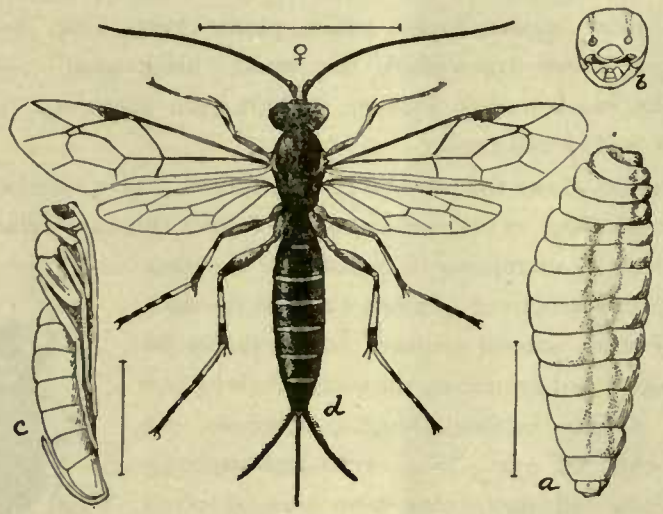


Figure 6.—PIMPLA CONQUISITOR: *a*, larva; *b*, head of same; *c*, pupa; *d*, adult female—all enlarged. Lines beside figures represent natural size. (After Howard: U. S. Department Agriculture, Division Entomology, Tech. ser. No. 5, 1897.)

may be induced to remain in a neighborhood by hanging in the trees pieces of meat or partially picked bones, and will spend much time in searching out and devouring numerous insects and their eggs, relying on the meat only when conditions are unfavorable for obtaining insect food. Migratory birds may be induced to remain in large numbers in a locality by providing them with suitable nesting places and materials, and by protecting them from cats and cruel boys. Thickets in the vicinity will afford shelter for certain species and if a few mulberry trees are set out, their fruit will serve to protect cherries, as the birds are said to eat the mulberries by preference. Most of these suggestions are taken from a very practical paper by Mr. Forbush.

A number of insects prey on this caterpillar. Several fiercc ground beetles do valiant work in this way. The beautiful fiery ground beetle, *Calosoma calidum* Fabr., and *C. scrutator* Fabr. are the two species specially known as enemies of the forest tent caterpillar. Several parasitic flies attack this pest and a number of hymenopterous insects. Of the latter, one of the most important parasites is known as *Pimpla conquisitor* Say, which is represented in the accompanying figure. Whenever cocoons of the forest tent caterpillar are collected, they should be placed in a box and covered with a rather coarse wire netting, about $\frac{3}{16}$ inch mesh, so as to confine the moths but allow the beneficial parasites to escape.

Remedies. As a large proportion of the eggs of this species occur on twigs within twenty or thirty feet of the ground, something can be accomplished in winter by cutting off the infested twigs and burning the egg clusters, specially if the trees are not very large. But in the case of good sized maples, it is very doubtful if this could be done to advantage, and even with moderate sized trees there would probably be enough inaccessible egg belts near the top to stock the trees with a host of leaf consumers. At best, the collection of eggs can hardly be regarded as more than one of several repressive methods, no one of which can be depended upon in itself to prevent serious injury. The egg belts can be seen best on a bright day and if there is snow on the ground, it will be easier to find all cut twigs dropped to the ground. The collection and burning of the eggs is necessary in order to insure thorough work. A long handled pruning hook is of great service in cutting off the infested twigs.

As soon as the presence of the young caterpillars (indicated by the thinness of the foliage on the upper branches) is detected, much can be accomplished by crushing them as they collect on the limbs or by dislodging them with a brush or torch. If the latter is used, care must be exercised not to injure the tree. Many caterpillars can be jarred from the tree by using a padded mallet, or even violent shaking will cause some to drop. Driving the caterpillars from the trees by jarring or otherwise, must be followed up by some means of preventing their ascent. A band of cotton batting eight to ten inches wide tied tightly in the middle around a tree and the upper portion turned down over the string and allowed to hang loosely, is a difficult obstacle for caterpillars to surmount, so long as it remains dry. Wide bands of paper coated with tar or of sticky fly paper will also prevent the pests from ascending for a time. A band composed of equal parts of lard and sulphur is said to be an effective barrier. In one locality bands of cottolene were used to prevent the caterpillars from climbing the trees. When the pests are very abundant, it will not do to depend entirely upon shaking and bands, the dropping creatures must be collected on sheets spread under the trees before they are jarred, and then killed, or crushed as they collect under the bands. Nothing but the most vigorous measures will protect a badly infested tree

from severe injury. The masses of caterpillars found on the larger limbs and trunk can be crushed in large numbers with a stiff broom or thickly gloved hands. A more agreeable method is spraying these clusters with kerosene emulsion, whale oil soap solution (one pound to four gallons), or pouring boiling water over them. For methods of preparing kerosene emulsion, see a subsequent page.

Thorough spraying with any one of the poisons described on a preceding page and in the manner directed, will kill these caterpillars very quickly. If they are nearly full grown and many are crawling to the sprayed trees from others, it is perfectly possible that all the foliage may be devoured before the caterpillars have eaten enough poison to kill them, but under most circumstances there need be little fear of the arsenical spray proving ineffective. The cost attendant upon this method will lead people to depend largely on other means. Even a hand spraying outfit requires some outlay, while if many trees are to be sprayed a power outfit, described on a preceding page, is the most economical in the long run.

After the damage has been done, many of the insects are within man's power and can be killed in their cocoons. From about the middle to the last of June, thousands of cocoons can be collected with little labor, and if this is done, opportunity should be given the parasites to escape before the cocoons are destroyed, as stated on a preceding page. Every healthy female pupa killed means one less egg mass to produce its approximately 150 hungry caterpillars another spring. During the summer of 1899, many hundreds of cocoons were collected and destroyed. Local authorities in Glens Falls, Saratoga Springs and several other villages offered the school children ten cents a quart for these cocoons. In Glens Falls, alone, 1,350 quarts of cocoons were destroyed through the efforts of the school children.

Leopard Moth.

Zeuzera pyrina Fabr.

In New York and vicinity, dead limbs may frequently be seen projecting above the leafy masses of many trees. These dead limbs and the sudden wilting of living ones are, in most cases, the effects of the destructive borings of the caterpillar of the leopard moth. This is probably the worst insect enemy of shade trees in the vicinity of New York city. It not only bores in slender twigs, but as the caterpillar increases in size it enters larger limbs and frequently works serious injury in the trunk before attaining its growth.

Description. This insect is most easily recognized in connection with its work. Boring within the smaller twigs, there may be found a pinkish or white caterpillar

about three eighths of an inch long, with numerous well defined, darker spots or tubercles on its body, a brown head and thoracic shield and an anal shield of nearly the same color. Short hairs grow from the tubercles and are also found about the head and posterior extremity. The burrows in the larger limbs and trunk may contain caterpillars over three inches long, nearly white, and with larger, more distinct spots or tubercles than in the earlier stages (Plate 2, figure 4). The beautiful white moths marked with blue and black are well represented, the female, with wings folded at 2 and the male with them expanded at 3, on plate 2. The salmon colored eggs are about the size of a common pin head and in captivity are deposited in a large mass.

History and Distribution in America. This insect is another of the bad pests accidentally introduced within recent years. The earliest authentic record of its presence in America is the brief note given by Jacob Doll in *Papilio*, for February, 1882, stating that he had taken a living example in a spider's web the preceding June at Hoboken, N. J. Its destructive work was observed in 1884 by Dr. E. B. Southwick in Central Park, New York city. It was taken in 1887 at Newark, N. J., and in 1889 at Arlington and Orange, N. J. Col. Pike, in 1892, after describing the widespread ravages of the insect in Brooklyn, reported it as present at Astoria, New Rochelle, Jamaica, New Lots and Flatbush, and at a later date stated that the pest had made its way to almost all parts of Long Island and had extended into Connecticut. In 1894, Dr. Southwick characterized this pest as "one of the worst insects we have to contend with." Mr. L. H. Joutel of New York informed me recently that this species was present at Kensico, Westchester county, some 25 miles north of New York city. As this insect occurs in southern and central Europe and possibly in southern Sweden, we may expect the pest to make its way farther north. On this account, the last American locality given has exceptional interest, showing, as it does, that this borer is working northward. It is yet early to state how fast the pest will spread, but it will certainly do no harm to keep on the watch for the appearance of the insect in new localities in the state. Searching for indications of the borer's presence along the Hudson River will probably result in its detection in several new localities.

Life History and Habits. Moths may be taken from early June till the latter part of September. European authorities state that the female places her eggs in crevices of the bark in branches as well as the trunk. Since the young caterpillars frequently enter the twigs at the base of a bud (Plate 2, figure 11*a*), it seems quite probable that many of the oval, salmon colored eggs may be thrust between the stem and bud or under a bud scale. Several observers have noted the deposition of about 300 eggs by the female in confinement and some writers estimate that she may deposit as many as 1,000 eggs. When a young caterpillar enters a twig, it usually tunnels along the pith, eating away the wood here and there almost to the bark. The expelled frass at the

Explanation of Plate 2.

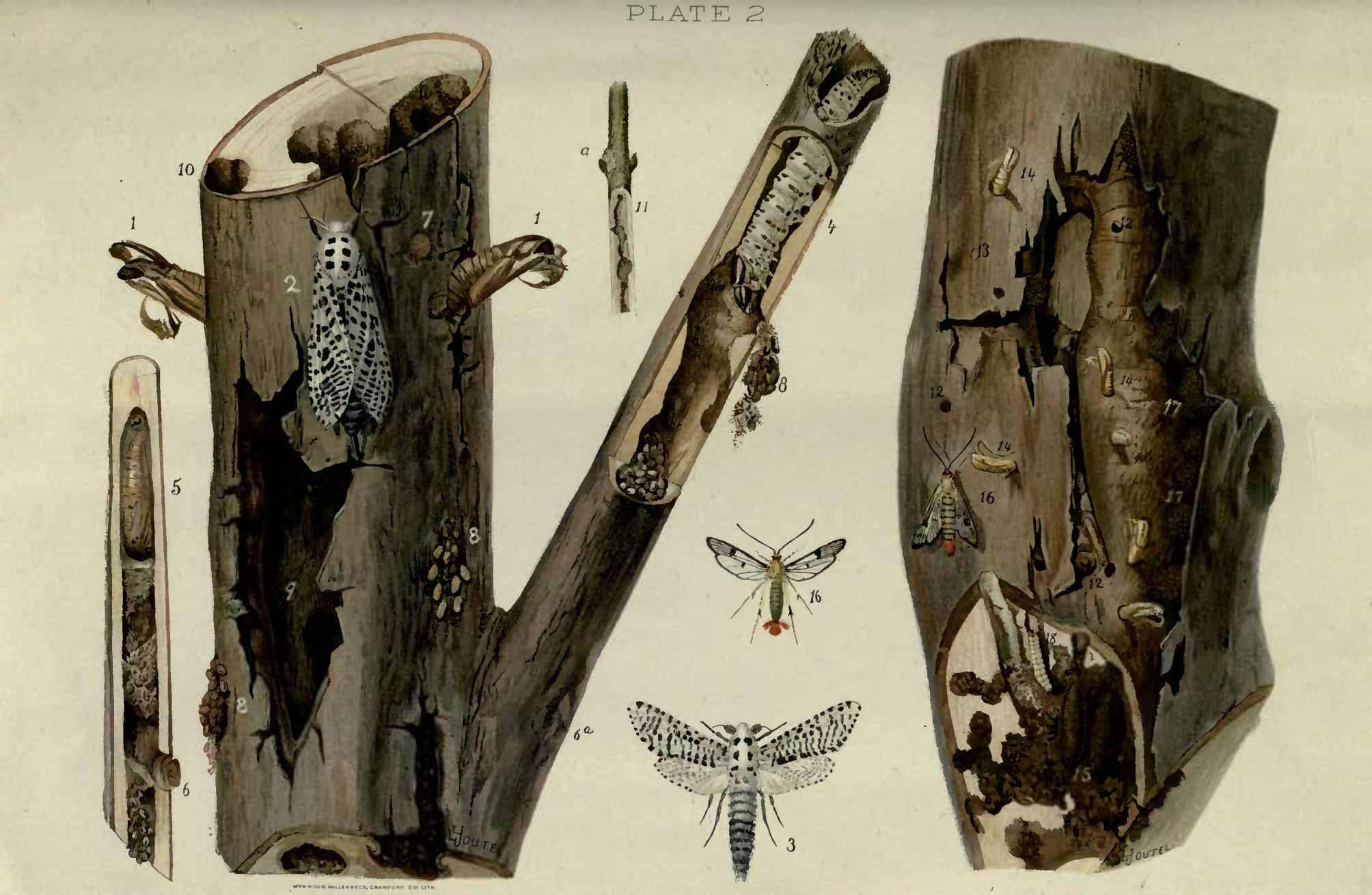
Leopard Moth (*Zeuzera pyrina* Fabr.).

1. Empty pupal case from which female moth has emerged.
2. Female moth with wings folded.
3. Male moth with wings expanded.
4. Nearly full grown caterpillar, probably a female.
5. Male pupa in its burrow.
6. Exit hole covered by a loose piece of bark which the pupa will push off as it partly emerges. 6*a*. Another.
7. Hole made for the pushing out of excrement and then closed by a silk web.
8. Same as above, but in use and with particles of excrement dangling by silken threads.
9. Work of caterpillar a preceding season.
10. Work of caterpillar the present season.
11. Young twig eaten by larva, point of entrance at *a*.

Maple Borer (*Sesia acerni* Clem.).

12. Hole from which pupal case has fallen.
13. Bark nearly eaten through ready for the pupa to push out.
14. Empty pupal skin.
15. Two cocoons as spun.
16. Moths expanded and at rest.
17. Excrement of caterpillars.
18. Caterpillar in its burrow.

PLATE 2



WYNKOOP HALLENBECK, CRAWFORD CO. LITH.

base of the bud indicates the point of entry. As the caterpillar works along the twig, it occasionally makes an opening for the expulsion of its frass, see plate 2, figure 8. After they have served their purpose, these orifices are closed by a web of silk, as represented at figure 7 on plate 2. This singular habit of closing these holes when no longer needed, probably affords considerable protection from insect parasites and it would also tend to prevent birds from finding the caterpillars so readily. The smaller twigs frequently wilt and break as a result of the work of this borer. The latter part of September caterpillars three eighths of an inch long were found, having probably hatched from eggs laid the latter part of the summer, and the larger borers, about one inch long, from eggs deposited earlier in the season. These creatures have a habit of leaving their burrows, wandering to another part of the limb or even to other branches, and commencing operations anew. As they increase in size, larger limbs are attacked and nearly full grown caterpillars are frequently found in the trunk. In the larger limbs and in the trunk, these borers make very bad work. Sometimes a caterpillar will nearly girdle a tree with a burrow just under the bark. Frequently several burrows run side by side, as represented in figure 10, plate 2. Many of the caterpillars will keep gnawing away just under the bark till an irregular chamber the size of a man's hand has been made. The bark covering these large wounds soon dies, breaks away and the following season there is an ugly scar, as represented at figure 9, on plate 2. In a short time small trees harboring several of these creatures are quickly girdled. Two years are required to complete the life cycle, according to most authorities. The first winter is passed by the small caterpillar, usually less than an inch long, in its burrow. The second winter it is nearly full grown (Plate 2, figure 4). The transformation to the quiescent pupa (Plate 2, figure 5) takes place in the burrow, the bark having previously been eaten nearly through by the caterpillar. Before the adult appears, the pupa works itself partly out of the burrow (Plate 2, figure 6) and the moth emerges, leaving the empty pupal case as represented at figure 1, plate 2.

This pernicious borer has been recorded as attacking eighty-three species of trees and shrubs. According to the observations of Dr. E. B. Southwick, Entomologist to the Department of Public Parks of New York, the elms and maples are most subject to attack, the horsechestnut, Ohio buckeye (*Æsculus glabra*), beeches, birches, dogwood, hickories, oaks, and walnuts suffering in the order named. Almost every species of tree and shrub in Central Park, except evergreens, was injured to some extent.

Remedies. Something can be accomplished by the destruction of the rather sluggish females before eggs are deposited. This is of most value where there are only a few small trees. In localities where this insect occurs, trees should be examined three or four times a year. The wilting of smaller twigs and the strings of expelled frass indicate the presence of this borer. Smaller infested branches can be cut off and

burned, but as the caterpillars leave their burrows on slight provocation, their destruction should not be delayed long after cutting. Limbs broken off by storms should be collected and burned, as they frequently contain caterpillars of this pest. The borers in larger branches or in the trunk should be cut out and destroyed whenever possible. In some cases they may be killed in their burrows with a flexible wire. Dr. E. B. Southwick, who has had considerable experience in fighting the pest in Central Park, New York, has found that it pays to use carbon bisulfid on the more valuable trees. The insecticide is carried in an oil can and when a caterpillar can be located, the chemical is inserted in the burrow and the hole sealed with putty. The deadly fumes soon make their way to the borer and kill it with little or no injury to the tree. As the carbon bisulfid is very volatile, its vapor inflammable and explosive, great care must be taken to keep it from all fire. Mr. M. F. Adams of Buffalo, N. Y., who has tried some experiments in fighting borers, recommends the use of newly made hard soap in the place of putty for plugging the holes after the carbon bisulfid has been inserted.

Maple Sesian.

Sesia acerni Clem.

The riddling of the new tissues around healing wounds on maples is usually the work of this borer. The round holes through the injured bark and the brownish, powdery borings are very characteristic of this insect's work. This pest has a special fondness for the tissues growing over wounds, though occasionally it may be found operating on comparatively smooth trunks. It is generally distributed over the state and evidences of its work occur in many localities. Trees wounded from any cause find great difficulty in the comparatively simple process of covering exposed wood with bark after being attacked by this insect. Thus relatively insignificant wounds result in scars constantly increasing in size and finally in a badly disfigured, gnarled maple. When abundant, these creatures may nearly girdle a tree. Very serious complaints regarding this pest have been made in Michigan, Missouri, and even in Buffalo, N. Y., and it has been stated that this insect annually causes much damage to hard maples.

Description. These beautiful, wasp like, red tailed moths (Plate 2, figure 16) are not often seen by the casual observer. An infested tree frequently presents the appearance represented on plate 2. Near a partly healed wound there may be found a number of round holes (Plate 2, figure 12) and considerable brownish, powdery matter (Plate 2, figure 17), the excrement or frass of the borers. Empty pupal cases may frequently

be seen in early fall projecting from the trunk as represented at figure 14, plate 2. On cutting into the injured wood, a whitish, brown headed caterpillar (Plate 2, figure 18) about one half inch long may be found in the latter part of the summer. In the early spring the silken frass covered cocoons (Plate 2, figure 15) may be found in the burrows.

Life History and Habits. The moths are most abundant at Buffalo, N. Y., from May 20 to June 15, according to the observations of the late Dr. D. S. Kellicott. The males have been seen by Mr. L. H. Joutel flying up and down the trunk of infested trees looking for a partner in much the same way as does the male of the lunate long sting, *Thalessa lunator* Fabr. The eggs are deposited on the bark of both soft and sugar maples, the female preferring as a rule to place them on roughened areas, specially in the vicinity of wounds, if one may judge from the injury inflicted. The eggs soon hatch and the young borers commence operations in the bark and sap wood. In the fall most of the caterpillars are about one half inch long and can easily be found in their burrows. The cavities made by the borers are nearly filled with frass. In the spring the caterpillar completes its growth, eats its way nearly through the bark (Plate 2, figure 13), then retires into its burrow, spins a loose silken cocoon and changes to a pupa. Shortly before the adult emerges, the pupa works its way partly out of the burrow, rupturing the thin piece of bark covering the outlet of its retreat in the operation, and the moth escapes, leaving the pupal case as represented on plate 2, figure 14.

This pest attacks both hard and soft maples. In some localities it is reported as most injurious to the former, in others to the latter. In Albany its work is most evident on soft maples. Woodpeckers are efficient aids in keeping this pest in check in forests, according to the late Dr. Kellicott.

Remedies. As the parent moth shows a marked inclination to deposit eggs on rough bark, the trees should be protected from injury by horses, boys and other agencies and the trunks kept as smooth as possible. The caterpillars bore near the surface and are easily dug out and destroyed. Infested trees should be inspected the latter part of the summer and the borers killed. The wounds in the trees should be carefully covered with grafting wax, paint or other protective substance. A plaster made of fresh cow dung and lime has been used for this purpose with excellent results. The deposition of eggs could probably be prevented to considerable extent by treating the trunks of the trees about the middle of May with a wash prepared as follows: Thin one gallon of soft soap with an equal amount of hot water and stir in one pint of crude carbolic acid (one half pint refined), let it set over night and then add eight gallons of soft water. Apply thoroughly to the trunk, specially about all crevices and wounds, from the ground to about six or eight feet high, and renew if necessary before the middle of June.

Sugar Maple Borer.

Plagionotus speciosus Say.

Sugar maples along the roadsides in the state of New York probably have no more serious insect enemy than this pernicious borer. The attacks of other insects upon our maples, specially the depredations of the so-called maple worm or forest tent caterpillar, *Clisiocampa disstria* Hübn., are from time to time pictured in most glowing colors, and while these other pests undoubtedly cause much injury, the fact remains that the sugar maple borer is quietly and unobtrusively carrying on its deadly work and in a series of years probably kills more of these popular shade trees than any other insect pest. In almost every city and village where sugar maples adorn the roadsides, evidences of the work of this borer are very apparent and in many of these places dead or nearly ruined trees are by no means scarce. The unthrifty condition of these maples is frequently attributed to drought, fungous diseases, leaking gas, pavements impervious to water, etc., whereas, in fact, the true depredators are gnawing within the trees.

Character of the Injury. Unlike many borers, this insect attacks trees in full vigor. The powerful, legless grub confines its operations largely to the inner bark and sap wood, and as it runs a burrow several feet long in one season, and as one borer will frequently work transversely half around a tree some eighteen inches in diameter, the dangerous character of this pest is at once apparent. The bark over the burrow, be it either a longitudinal or a transverse one, dies and the growing tissues forming underneath in the natural process of healing push the dead bark out, cause it to break and in the course of a year or two an ugly, naked scar is produced. A large patch of bark may be killed by several borers working near each other or possibly by one doubling back and forth, and the result is a large, unsightly area of exposed wood. The injury produced by a transverse burrow is shown at figure 7, and a blasted area resulting from the doubling of a borer or of the work of several near together is shown at figure 8. Two or three borers in the same trunk are very likely to nearly girdle a tree, if they do not kill it outright. Infested maples frequently have one or more large limbs killed by this pest. The base of the limb is girdled in the same way as the trunk, the first intimation of trouble in this manner usually being a sudden wilting of the foliage, followed by the leaves drying up and falling.

Description. The parent insect is a beautiful stout beetle about one inch long. It is black, brilliantly marked with yellow, as represented at figure 4 of plate 3. The borer or larva is a whitish, flattened, footless grub with brownish mouth parts. Small ones (Plate 3, figure 2), about one half inch long, are found in September just under

the bark and come from eggs laid the same season. The nearly full grown borer (Plate 3, figure 3) is about two inches long, white, with some rosy tints and in other respects closely resembles the smaller ones.

Life History and Habits. The parent insects or beetles occur from the latter part of June till into August. Most of the eggs are probably laid during the latter two months. The place of oviposition (Plate 3, figures 1, 1*a*) may be recognized by the irregular discoloration of the bark, caused in part by the sap flowing from the wound and partly from the expelled frass or excrement, the latter often hanging in small

Figure 7.—Injury produced by a transverse burrow in a sugar maple about eighteen inches in diameter (original).

Figure 8.—Large dead area produced by the intersection of several burrows. Tree about fifteen inches in diameter (original).

masses from the point of entrance. I have found burrows about thirty feet from the ground, but most of them occur in the trunk or near the base of the larger limbs. The latter seems to be a favorite place for the deposition of eggs. The young borer passes the winter in a rather shallow excavation in the sap wood, the following spring renewing operations with increased vigor. The boring of the second season is largely just under the bark, the burrows being about one half an inch in width and one third of an inch in depth, and running in almost any direction, though usually longitudinally or obliquely upward and partly around the tree. Sometime during its life, probably in the second fall when the borer is about sixteen months old, a deep burrow is made,

Explanation of Plate 3.

Sugar Maple Borer (*Plagionotus speciosus* Say).

1. Place where egg was laid, showing excrement or borings thrown out by borer. 1*a*. Another more than normally discolored.
2. Borer or grub in September from egg laid the same season.
3. Nearly full grown borer.
4. Adult or beetle.
5. Hole through which the beetle escaped from the trunk.
6. Sawdust or borings packed in burrow.

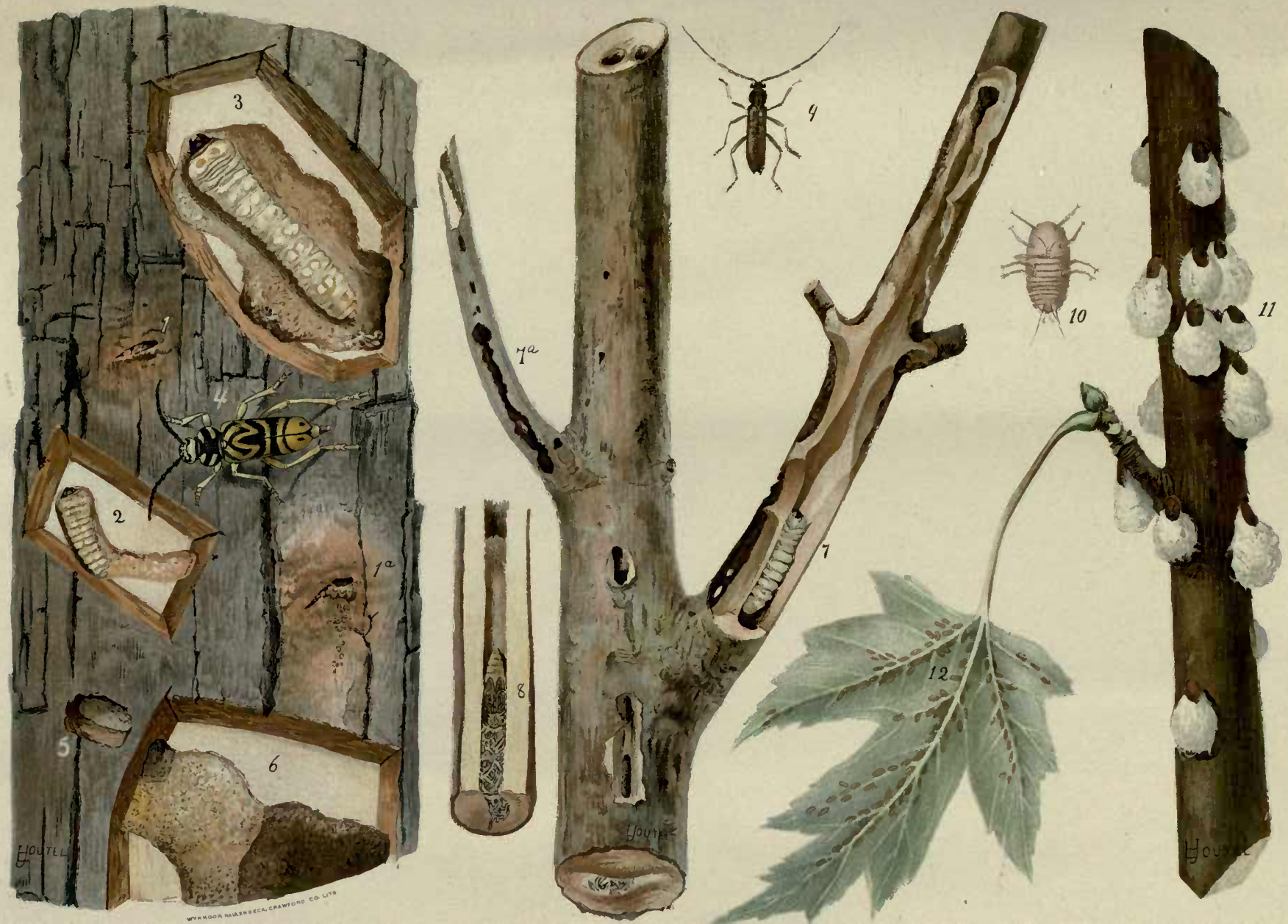
Maple Tree Pruner (*Elaphidion villosum* Fabr.).

7. Grub or borer in its burrow, a portion of the twig being cut away to show its work. 7*a*. Small twig with only a thin shell of bark, the wood being nearly all eaten.
8. Pupa in the burrow. The base of both twigs represented has been nearly eaten off by the larva.
9. Adult or beetle.

Cottony Maple Tree Scale Insect (*Pulvinaria innumerabilis* Rathv.).

10. Active or recently hatched young.
11. Adult females, many eggs can be found in the woolly masses.
12. Leaf with many young scales on its under side.

PLATE 3



usually penetrating about four inches in an upward, oblique direction toward the heart of the tree and then running some distance parallel with the grain of the wood, as represented in figure 9, which was drawn from a photograph. At the end of this deep burrow the larva transforms to a pupa and from that to a beetle, the beautiful adult emerging from the trunk through an oval hole (Plate 3, figure 5) about three eighths by five eighths inch in diameter.

The only natural enemies observed preying on this insect are woodpeckers. Dr. Packard records having seen them at work. Mr. A. H. Kirkland has seen the hairy woodpecker, the downy woodpecker and the flicker feeding on white larvæ taken from beneath the bark of infested trees

Figure 9.—Deep burrow in which the grub transforms to the beetle (original).

Associated Insects. As previously pointed out, the sugar maple borer attacks trees in their prime. It is well known to students of nature that an enfeebled plant invites insect injury by presenting favorable conditions for their multiplication. Trees suffering to any extent from the attack of the sugar maple borer are usually infested with the pigeon Tremex, *Tremex columba* Linn., a species which assists materially in the destruction begun by the beetle. The pigeon Tremex is a magnificent four winged fly about two inches long, with a wing spread of two and one half inches, and a prominent horn at the extremity of the abdomen; hence the common name of "horn tail" is frequently applied to this insect and its allies. This species may be recognized by its cylindric dark brown abdomen with yellow markings as represented in figure 10.

The larva or borer producing the pigeon Tremex may be distinguished at once from that of the sugar maple borer by its cylindric form, the possession of six legs on the three anterior body segments and by its making a nearly round burrow. The perfect insects make their way out of the tree through holes about the size of a common lead pencil, and during the summer months are frequently found around diseased maples and elms, sometimes with the ovipositor bent at right angles to the body as the female is inserting it for the purpose of laying eggs. This insect can hardly be regarded as very injurious since its operations are confined largely to unhealthy trees.

There is also another insect commonly found around trees badly infested with the pigeon Tremex, drawn there by the presence of its prey, the larva of the pigeon Tremex. The lunate long sting, *Thalessa lunator* Fabr., is a slender, brown and yellow insect about one and one half inches long and with a delicate "tail" or

ovipositor about three inches long, whence its common name of "long sting." This beneficial parasite may frequently be seen with its long ovipositor arched over its back, and the membranes of its abdomen much distended as it forces its slender tool deep into the wood in an effort to place its eggs in the vicinity of a borer. The male is a smaller insect. On splitting open a log containing Tremex larvæ, the white, legless maggots of this parasite may be found sucking the life fluids from the borers. Like the Tremex, the females of the long sting emerge from the trunk of the tree

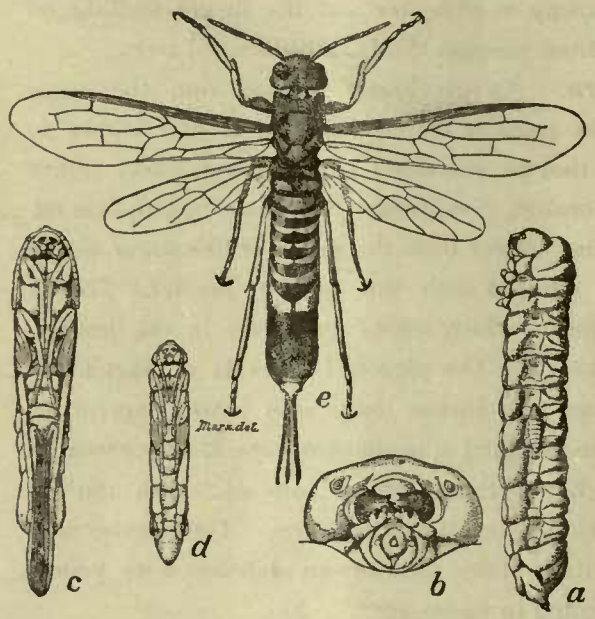


Figure 10.—PIGEON TREMEX: *a*, larva showing the Thalessa larva fastened to its side; *b*, head of larva; *c*, pupa of female; *d*, male pupa; *e*, adult female—all slightly enlarged. (After Marx.)
(Insect Life, Vol. I., Fig. 39, U. S. Dept. Agriculture.)

through holes about the size of a common lead pencil. The various stages of this interesting parasite are well represented in the accompanying figure (11).

Remedies. Badly infested trees should be cut and burned before the following June in order to prevent the maturing of the insects they contain. If the trunks of shade trees were treated early in July with the carbolic acid wash described on a preceding page, it is probable that deposition of eggs would be prevented to a considerable extent. Indications of oviposition should be looked for in the fall most carefully and the young borers should be dug out and destroyed. Wherever signs of recent boring occur, an attempt should be made to find the offender. The digging out will rarely do more injury than the borer would otherwise cause. If there is reason to believe a burrow inhabited but no larva can be found, the use of carbon

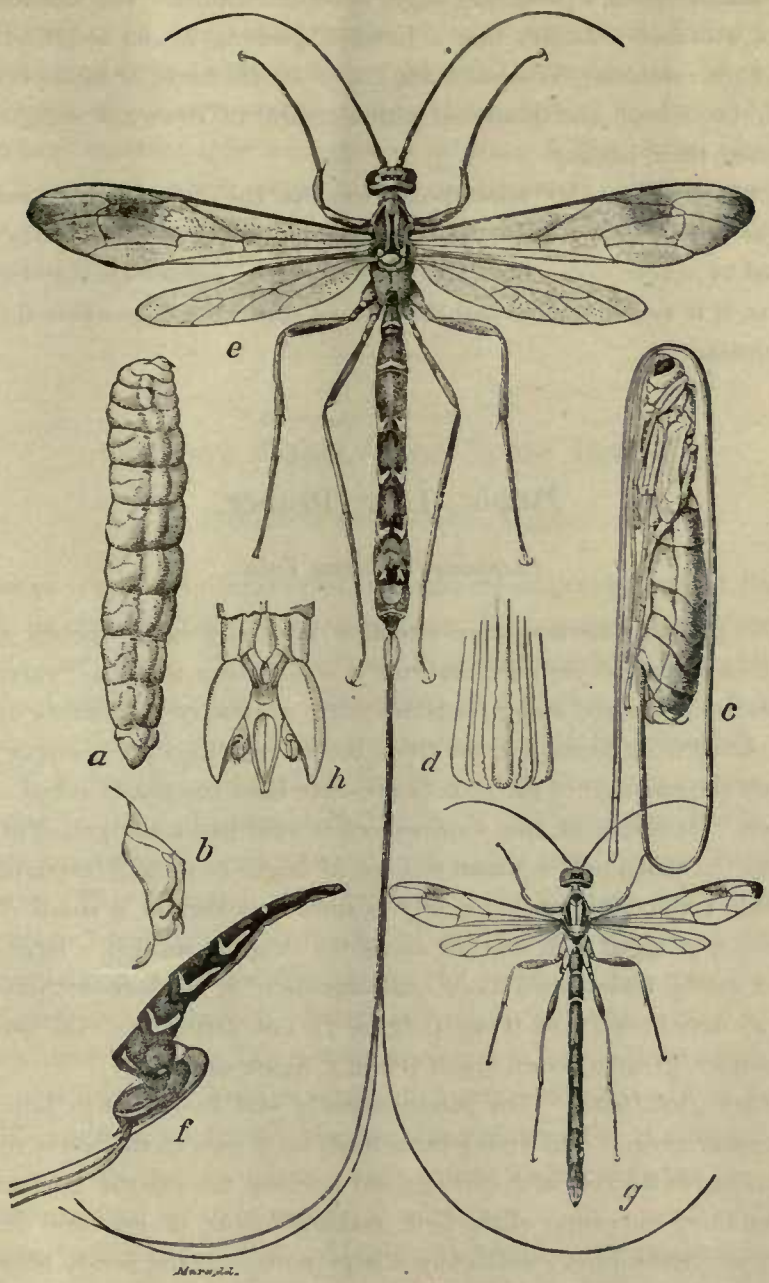


Figure 11.—The lunate long sting, THALESSA LUNATOR: *a*, larva; *b*, side view of head; *c*, pupa; *d*, tip of pupal ovipositor showing the five parts; *e*, female; *f*, side view of female abdomen; *g*, male; *h*, anal extremity of male, enlarged. (After Marx.)

(Insect Life, Vol. I., Plate I, U. S. Dept. Agriculture.)

bisulfid, as described on a preceding page, is recommended. The sudden wilting of the leaves of a branch indicates that a borer is girdling it and an effort should be made to find the creature. Wounds made either by the borer or by a person looking for it, should be cleaned and plastered with a cement of fresh cow dung and lime, in order to hasten their healing.

In sugar maple groves, Mr. Kirkland advises that the underbrush be left as much as possible, as he has observed that the clearing up of the shrubbery has repeatedly been followed by severe injury from this borer. As the beetles are known to be sun loving insects, it is very probable that they would place their eggs where the conditions were most pleasant.

Maple Tree Pruner.

Elaphidion villosum Fabr.

This insect probably attracts more attention than any other species causing the same amount of damage. As a general rule it is not very injurious, except possibly to shade trees on lawns and along roadsides where symmetry and beauty are desirable requisites. Aside from damage to the trees, the falling twigs are a source of annoyance and form the one sign of the insect's presence most commonly noted.

Description. This species, like some others, is most easily recognized in connection with its work. A fallen twig is found to have its larger end nearly eaten off, as represented on plate 3, the cutting being nearly as smooth as that of a sharp chisel. The central burrow is plugged with sawdust and if the twig be whittled, a large proportion of its interior will be found eaten away and somewhere in the burrow there is usually a whitish grub with brown jaws (Plate 3, figure 7), our carpenter. The parent beetle is a rather slender, grayish brown insect (Plate 3, figure 9).

Life History and Habits. The parent insect is said to deposit in July an egg in one of the smaller twigs. The young larva feeds for a time on the softer tissues under the bark, packing its burrow with castings and working toward the base of the twig. Later it bores along the center of the limb, making a more or less oval channel. In the early fall our borer quietly eats away a large portion of the woody fiber, plugs the end of its burrow with castings and waits for a high wind to break off the nearly severed branch. In this manner the larva reaches the ground in safety. Late in the fall or in the early spring the change to the pupa takes place, the transformation to the perfect insect occurring in the spring, the beetles emerging from the limbs in June and continuing abroad till September. Occasionally the insect completes its changes

in the portion of the limb remaining on the tree, but as a rule it drops with the severed branch. The life cycle is probably completed under natural conditions in one year, though when breeding in dry twigs the period may be considerably extended.

This twig pruner not only attacks maple and oak, two of its favorite food plants, but has also been recorded from a number of others. A few of the more important are: Apple, pear, plum, peach, grape, quince, orange. osage orange and hickory.

Remedies. The fallen branches usually contain the larva and should therefore be collected and burned sometime during the winter.

Cottony Maple Tree Scale Insect.

Pulvinaria innumerabilis Rathv.

This species is generally distributed throughout the greater part of the state, and occasionally becomes excessively abundant, specially on the soft or silver maple, one of its favorite food plants. This scale insect flourishes, particularly in certain seasons, on Long Island and in its vicinity. Sometimes the trees are fairly festooned with masses of conspicuous females. In 1890 it was so abundant in Brooklyn, N. Y., as to lead Mr. A. S. Fuller to report that thousands of trees were dying from its attacks. It was present in large numbers at Buffalo, N. Y., the same year and in 1898 many complaints of serious injury were received from widely separated localities.

Description. This pest most often comes to notice after the females have attained their full growth late in June or early in July and have excreted an abundant cotton-like substance, which protrudes from under the scale covering the insect, as represented at figure 11, on plate 3. Frequently the entire under surface of the limb is covered with these insects. The cottony fibers are full of minute eggs and young. A recently hatched scale insect is represented very much enlarged at figure 10, on plate 3. The young soon forsake the protecting filaments of the mother, wander to the leaves, settle along the veins as a rule, secrete a scaly covering and in the fall present the appearance shown at figure 12, on plate 3.

Life History and Habits. This species is very prolific. One female rarely deposits less than 500 eggs and must frequently produce over 2,000, as estimated by J. D. Putnam, who has published an exhaustive paper on this species in the proceedings of the Davenport Academy of Natural Science, of Iowa. Certain facts regarding the life history of this insect are taken from his treatise on this scale insect. The young leave the mother in immense numbers about the latter part of July, in the latitude of

Albany, N. Y., and establish themselves on the under side of the leaves. Some may be found on the upper surface and occasionally they attack the more tender twigs. The insects are yellowish for a time, the females showing deep red markings about the time the delicate two winged males appear, and later change to a brownish color, and migrate to the under side of the twigs shortly before the leaves fall. Mr. Putnam found that the males appear from August 1 to September 15, pair, and then die. The females pass the winter on the under side of the twigs and in the spring increase rapidly in size and secrete large amounts of honey dew, which gums the leaves and smears everything beneath the infested trees. The insects soon begin to excrete the familiar cottony matter in which the eggs are deposited and by July are very noticeable when present in numbers.

As is well known, this pest is most destructive to the soft or silver maple, though it occurs on many other plants. It also attacks other species of maples, elms and grape vines. The above named species are the more important plants which are most seriously injured.

Method of Distribution. The young of this scale insect are carried from tree to tree in about the same manner as allied species. Birds, other insects and even spiders frequenting infested trees are often compelled to assist in the distribution of this pest by the active young crawling on them as they rest on the twigs. Once a young scale is on a bird's foot or on an insect, there is a good chance that it will be carried to another tree before it leaves its host. Winds probably aid somewhat in the dissemination of the pest, and it is undoubtedly carried on infested trees which may be shipped to distant parts of the country.

Natural Enemies. Fortunately this prolific insect has a number of natural enemies which undoubtedly do much toward keeping it in check. The twice stabbed lady bird, *Chilocorus bivulnerus* Muls., is one of the more common insects found preying on the pest in New York. The fifteen spotted lady bird, *Anatis ocellata* Linn., *Hyperaspis signata* Oliv. and *H. bigeminata* Rand., are allies of the first mentioned in checking the cottony maple tree scale insect. An interesting lepidopterous enemy, *Lætilia coccidivora* Comst., was reared by Professor J. H. Comstock from this scale insect. Larvæ of lace wing flies, *Chrysopa* species, were observed by Mr. Putnam preying on the young. A species of harvest mite attacks this pest, according to Miss Murtfeldt. Two hymenopterous parasites, *Coccophagus lecanii* Fitch, and *Aphycus pulvinariæ* How., have been reared from this scale insect.

Remedies. Brushing with a stiff broom will dislodge many insects. This should be done before the young scatter and would be more effective if the brush was dipped frequently in kerosene emulsion or other insecticide. Professor C. M. Weed states that this pest can be fought with a considerable degree of success by washing them

from the tree with a stream from a hose. Where there is a good head of water this might prove the best method of controlling the pest. Otherwise, infested trees must be headed in and sprayed with kerosene emulsion at the time the young appear. Prepare the emulsion as follows: Dissolve one half pound of hard soap in one gallon of boiling water and while still hot add two gallons of kerosene and emulsify by passing rapidly through a force pump till it assumes a uniform creamy consistency and oil does not separate. Dilute this with ten parts of water before using. In limestone regions use the sour milk emulsion composed of one gallon of sour milk and two gallons of kerosene; emulsify and dilute as described above.