FALL INSECTS

A PRAYING MANTIS

CORNELL RURAL SCHOOL LEAFLET

VOLUME 25 NOVEMBER, 1931 NUMBER 2

Cornell Rural School Leaflet

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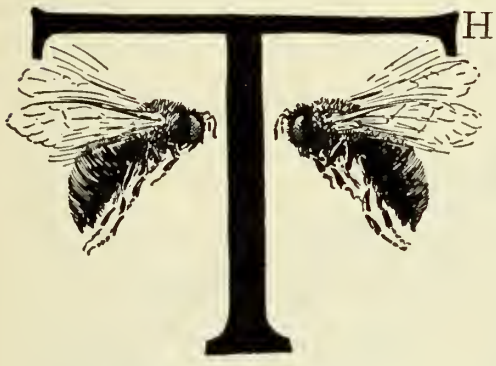


THIS Leaflet is called "Fall Insects" because most of the creatures about which it tells are conspicuous during the fall months, although many of them are to be found at other times; so it may be used throughout the year.

The life-history charts and identification plates at the end of the Leaflet will help in the recognition of the insects mentioned. Only thirty-two are discussed in this number, and these form only a very small proportion of those common to New York. Others, some of which are also fall insects, have been described in earlier Leaflets: aquatic insects in the November, 1920, number; land insects in November, 1922; pests of plants, pets, and people, in the January, 1925, number; and moths and butterflies in the March, 1926, Leaflet.

Insects, like many other things, can be studied from a number of points of view, such as beauty, variety, behavior, or value to man. Some of these are suggested in the following pages of "Fall Insects."

INSECTS AND BEAUTY

To most of us, the beauty of the fall months is largely due to the gorgeous autumn colors of the trees and smaller plants. Many of the common insects show bits of color as attractive as these, though less conspicuous. I know that all of you have seen the little flies that poise in the air before flowers. Most of these are syrphid flies, many of which are useful to man. The shining iridescence of their wings is even more beautiful than the brilliant green of the tiger beetles that so often on hot sunny days fly up from dusty roads and paths and alight facing us.

The delicate green wings of the lacewing fly are worthy of close examination. While you are looking at the wings, you must be sure to notice that the eyes of these insects are a beautiful golden color much like the golden spots found on the green chrysalids of monarch butterflies. It is only fair to warn you that you will not be so delighted with the odor of the lacewing as you are with its appearance, but you must not let that keep you from learning about its life history and valuable food habits.

Fireflies also add to the beauty of nature. Most of us have enjoyed

PHOTOGRAPH BY G. W. HERRICK

A SYRPHID FLY

These irridescent-winged insects are generally useful to man

watching the myriads of tiny flashes glowing in the darkness of summer evenings. Fireflies have been known to flash their lights in unison but ordinarily there seems to be no system and the result is a delightfully attractive illumination. You may have caught fireflies and tried to have them light up your room. In some parts of the world fireflies and glow-worms are kept in little cages for this purpose, though it must be a rather unsatisfactory light.

WHERE TO LOOK FOR INSECTS

Insects can be found almost anywhere. They are to be found as high in the air as it is probable you will go and as deep in the soil. They are found on dry land and in water. Each kind is more or less limited to a particular kind of place. You know, for example, that you are not likely to find monarch butterflies swimming in a brook.

The cluster flies that gather about your windows in groups are con-

spicuous at this season of the year. At the same time, we find the Polistes wasps trying to get into our homes by way of any possible crevice. They will do no harm, and can sometimes be picked up in safety, though I should not advise you to attempt this with yellow jackets or white faced hornets.

Ponds and streams provide homes for the little haliplid, or alga-beetle, mentioned in this Leaflet, and for the snowfleas, or springtails. The springtails are most spectacular when they are found leaping about over the snow or crowding around the sap-buckets in the spring. At other times of the year they are conspicuous on the surface of streams.

Water serves as a nursery of a number of insects which spend much of their adult life some distance from it. The deerflies that make life so generally miserable for you and for other animals in the woods in late summer are of this type. Other insects found near water or in moist soil at one time or another are the fireflies, the horse flies, and the cat-tail moths.

Woodlands and shrubbery provide excellent dwelling places for many of the fall insects. Fruit trees support oyster-shell scale, engraver beetles, cherry sawfly miners, and plum curculios. Shade trees and ornamental shrubbery provide home and food for walking sticks, elm-leaf miners, red-oak leaf miners, knotty-horn beetles, and elm sawflies. On some of the plants that support these insects may be found carnivorous insects such as the lacewing flies, the snowy tree-crickets, robber flies, ichneumon flies, and some of the hornets.

Grasslands and gardens harbor some of the insects we have already mentioned and we are likely to find in such places the spittle insects that remain under their protecting froth, squash bugs that ruin many of our garden plants, thrips that hide in daisies or other flowers, and the serpentine leaf miners that carve out such interesting homes in leaves like those of the nasturtium. Meadow grasshoppers and their close relatives are to be found in almost any grassland in the early fall months, and humming bird moths are not uncommon on sunny days about our flower gardens.

Even the soil under the plants provides food and shelter for some of the insects mentioned. Under logs in moist places we will find cave crickets. In other kinds of soil will be found the immature stages of horse flies, cluster flies, and many other insects. You might read through the life histories in this and in other Leaflets to learn how many of the common insects you know spend at least a part of their lives under ground. Then list all the insects you can think of and find out which of them have this habit.

The carrion beetles choose what we probably would think the least desirable place in which to live. They may be found by turning over dead animal matter that you find in the open.

While you are thinking of the places in which insects are found you may be interested in determining what parts of our State or of the world support insects similar to those you see in your own back yard. You will find this information in the charts at the end of this Leaflet.

HOW INSECTS MOVE

Insects move from place to place in a great variety of ways. The springtails, which we have already mentioned, have a very strange method of locomotion. A springtail moves by freeing its "tail" which is caught back under the body when not in use. When released, this "tail" hurls the little creature forward much as though it had been thrown from a

PHOTOGRAPH BY G. W. HERRICK

A CAVE CRICKET ON A MUSHROOM

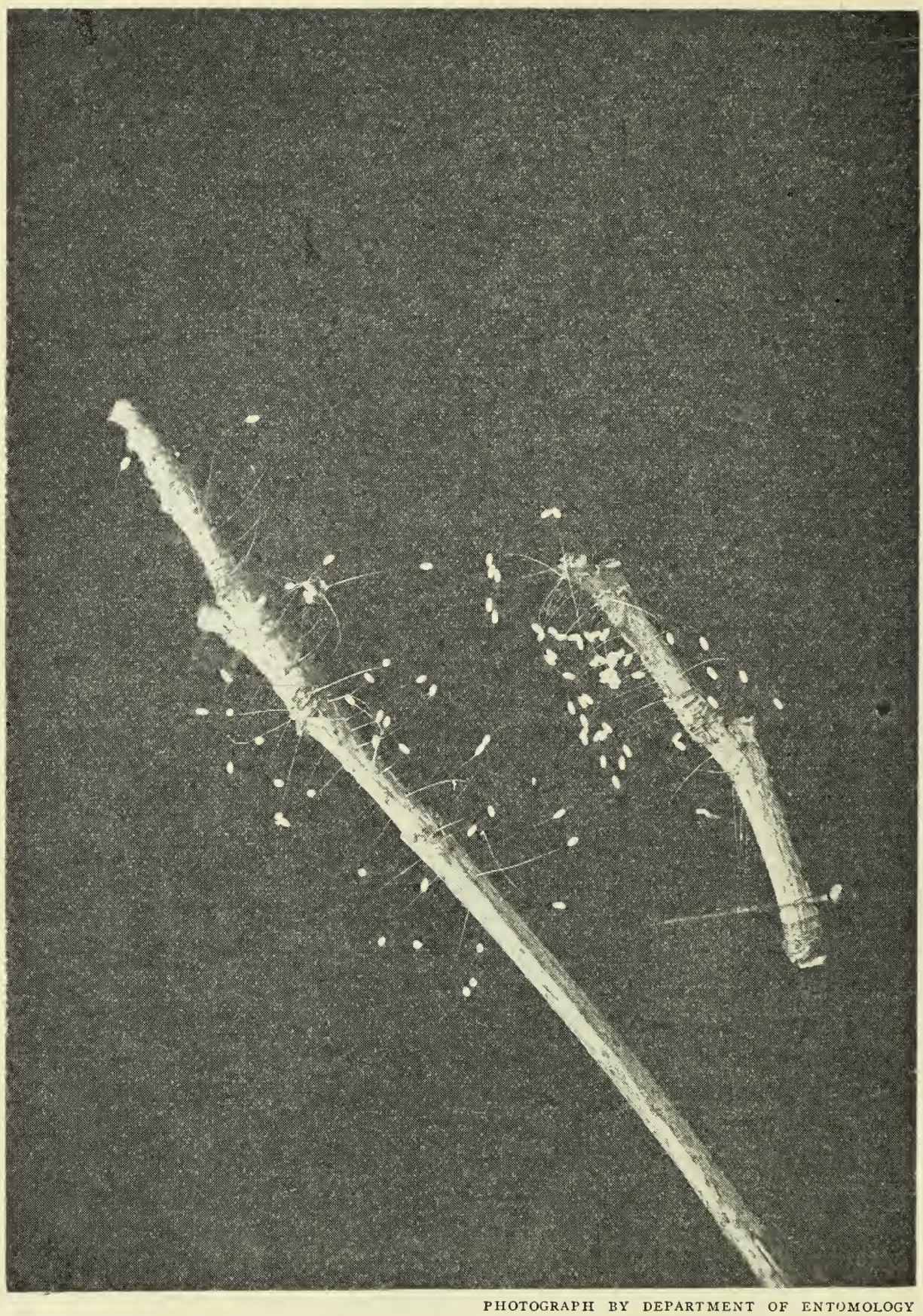
springboard. The difference is that it takes its springboard along with it and has it ready for the next jump. The haliplid beetles which live in ponds and streams, swim by means of their paddle-like hind legs. Some other water insects merely crawl about among plants or on the bottom or banks of the body of water in which they live. Land insects differ, too, in their methods of locomotion. You might enjoy making a record of all the different ways you can discover in which insects move about over the earth.

Some of the insects that seem to have the poorest means of transportation are nevertheless rather widely distributed over the country.

LIFE HISTORY NOTES

The study of the life histories of insects brings out many exceedingly interesting facts. The lacewing fly, which we see often in late summer and early fall, has one of the strangest habits to be found among insects. We mentioned it briefly in the Leaflet for last March. The mother lacewing places each of her eggs at the tip of a tall springy thread that stands erect or at least holds the egg at some distance from the main support. She does this because the young lacewings, which feed on small insects, begin an immediate hunt for food as soon as they hatch; and, as Mrs. Comstock once said, if the mother lacewing "merely laid her eggs on the leaf in a group, the earliest hatched larva, in hunting for something to satisfy his first hunger, would surely turn cannibal and make his first meal off his unhatched brothers and sisters." But, since each one is at the top of his own stalk, he is saved from such a fate, and given a chance for life. The young lacewings feed so extensively on plant lice, or aphids, that they are usually called *aphis lions*. They finally go into papery cocoons in which they may spend the winter From these cocoons, they emerge as adults; and, after mating, a female may lay as many as six hundred eggs.

If you have examined the twigs of maple, dogwood, or apple, you have no doubt seen oyster-shell scales. These sometimes completely cover and finally kill twigs and small branches. If you will pry loose a goodly number of the scales, you will find some that have eggs under them. One scale may cover as many as a hundred eggs, all of which were laid by the one mother who used that scale for protection and who laid all of her eggs under it. About the time apple blossoms appear, the eggs hatch into little insects that soon crawl from beneath the scale. They may move away a considerable distance. Within a few hours, however, they settle down and form a scale of their own. The females never move from the spot they have chosen. They get their food by piercing the



PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

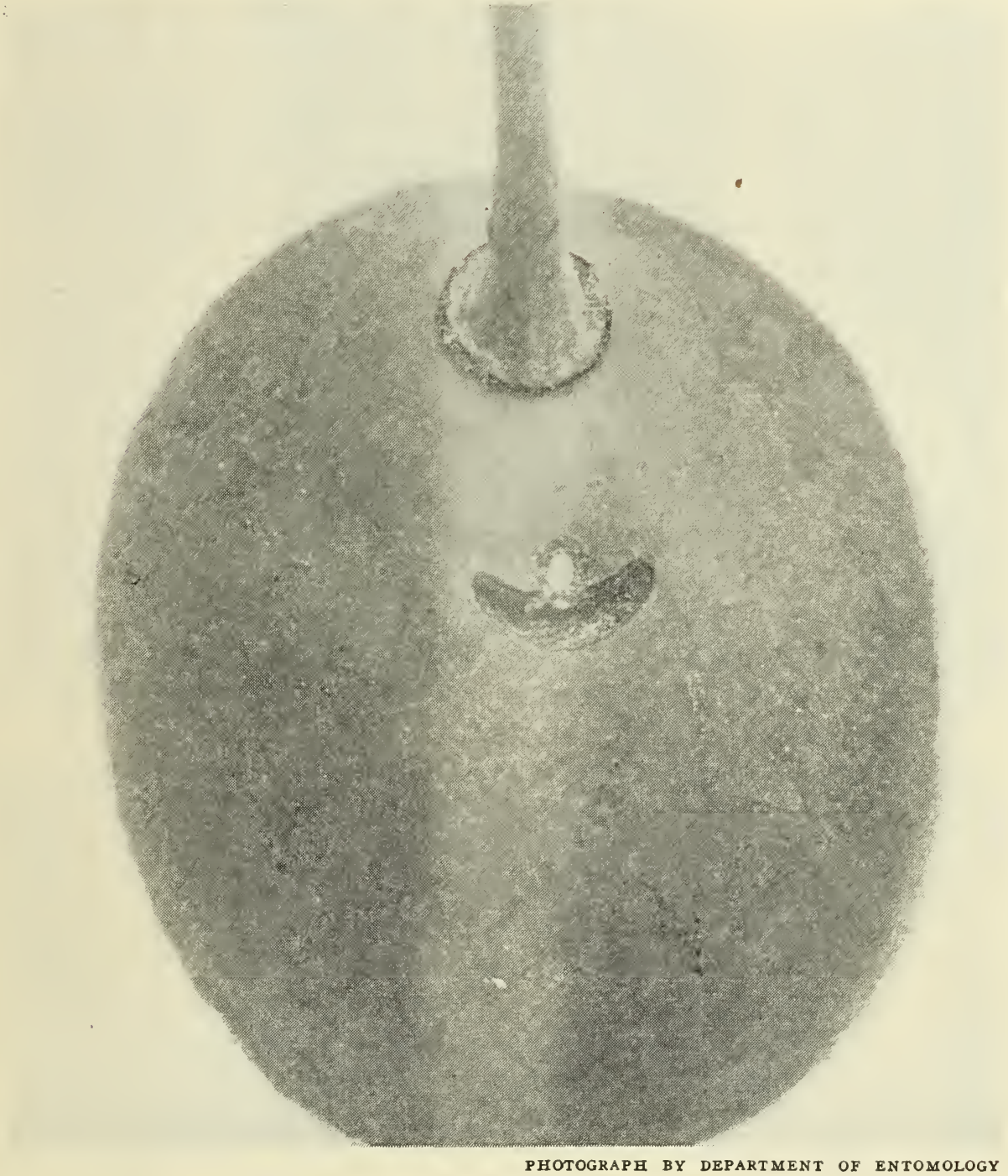
EGGS OF THE LACEWING FLY

Because each is on the tip of its individual stalk, the earlier hatched of the young larvae cannot devour their brothers and sisters

plant on which they live and sucking its juices. Of course when a twig has to supply food to hosts of these insects that are crowded on its surface it cannot support itself also.

Scale insects are of many kinds but they all have some things in common in their life histories. The lacquer which is used in many shining paints is obtained in part from certain scale insects closely related to the oyster-shell scale that lives on your own apple trees.

While you are looking for oyster-shell-scale insects in your orchard you may come upon some knotty apples, plums, pears, cherries, or other fruits that have been attacked by the plum curculio. This insect lays



PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

CRESCENT AND EGG OF PLUM CURCULIO

her eggs in the spring in a tiny cavity beside a crescent-shaped hole in the fruit. She may lay as many as three hundred eggs. From these, hatch brown-headed, footless, white grubs that feed upon the fruit and cause the injuries which make the fruit unmarketable. Frequently the wounds caused by these insects exude a sticky gum. The pupal period, which follows the grub stage, is spent in the ground. It is estimated that this kind of insect alone causes injury costing more than $8,000,000 a year to our fruits. For this reason, if for no other, it is worth our while to know its life history so that we can control the insect to some extent. The control measures are outlined in the life-history section.

Probably most of you have seen the work of the engraver beetle under the bark of fruit trees. When the dead bark is stripped off, usually there is found a rather broad central chamber with many finer burrows leading away from it. Each of the branches generally grows larger as it progresses away from the main burrow. You may find somewhat similar burrows under the bark of pine trees but these are made by a different species of beetle. However, we find that the life story of each species is somewhat as follows:

The male engraver beetle digs a burrow of his own. When he has his home as he wishes he brings to it a mate. She lays her eggs in the walls of the room and may be succeeded by a second mate who does likewise. The male protects the nursery, a decidedly unusual procedure among insects. The eggs of the various females hatch into little grubs that start eating into the soft wood nearby. Generally they continue to eat their way from the central chamber where their father lived. They gradually grow larger and form larger burrows. Finally they go through the usual resting pupal stage and emerge as adult beetles. Before leaving for the open world outside, they may eat their way still farther through the wood. Eventually, however, they emerge in the open air and mate and live as did their parents.

The burrows of the engraver beetles are probably more permanent and conspicuous than those of many other insects. However, it is not unusual for the many offspring of an insect to live in parallel burrows. This is true of the cat-tail miner. A moth is responsible for these mines which occur rather conspicuously in cat-tail leaves and less conspicuously in the stems. The female lays her eggs in masses of from thirty-five to sixty near the tip of the cat-tail leaf. The larvae which hatch from these eggs immediately eat their way into the leaf. If you examine a cat-tail leaf, you will see that it is composed of a number of parallel veins between which are soft spongy areas. Each of the young larvae enters the area between a pair of these veins and works its way downward separated from its brothers or sisters by the veins. The result is a blotch on the

PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

A HOME OF ENGRAVER BEETLES

leaf. Eventually the larvae leave the narrow tunnels which they have made in the leaves and bore into the stem where they spend the winter as larvae. In the spring, they go through the pupal stage in the old cattail stem and finally come out as adult moths that mate and produce the eggs of a new generation.

You might like to know the life histories of other leaf miners, some of which are flies and some beetles. Examples of each of these are discussed in the life-history sections of this Leaflet. Probably the most conspicuous mine is that of the serpentine leaf miner so often found on nasturtium leaves. Insect mines occur on almost any kind of plant but generally they represent one or another of the types outlined in this Leaflet.

PHOTOGRAPH BY S. W. FROST

A TRAIL OF A SERPENTINE LEAF MINER

The egg was laid at the base of the leaf near the midrib

Another unique life history is that of the cluster fly that you see so commonly about the windows of your houses in the fall months. This life history has not been understood until comparatively recently. The

adults commonly appear on the sunny side of some building in early spring. They usually mate at this time, and considerably later the females lay their eggs on the soil. One female has been known to lay as many as ninety-seven eggs in a single evening. Four to six days later, these eggs hatch into little larvae which attack and enter the bodies of earthworms. They live in the earthworms as parasites, sometimes, but not always, causing the death of the worm. A single worm may have more than one fly larva as a parasite. After living in the worm for about three weeks, the larvae again enter the soil and spend from two to six weeks as pupae. From this stage, they emerge as adult flies which live largely upon the sap of fruits or other plant juices.

Since the fall months almost always bring to our attention the wasps Polistes, we might tell something about them and show you how you may find out more for yourself. These are the wasps that build the small paper nests under the eaves of your houses and may frequently be seen in the fall hovering about your windows, apparently seeking an entrance. The females, alone, of the Polistes wasps live through the winter, and they seek shelter for that period. The males remain active until they are killed by the severe weather. In the spring, the females build their paper nests and in them place the eggs. The larvae that hatch from these are fed honey and chewed insects by the mother. They spend the pupal stage in the paper house built by the mother, but during that time are protected by a covering much like a cocoon, which they make themselves. You will find it fairly safe to examine these small paper nests though I should not suggest that you try to do this with the larger nests of the white-faced hornets until after the occupants have been killed by the cold.

The white-faced hornets are known by most youngsters. With them, as with the honeybee, certain individuals are fitted for doing only certain kinds of work. Also, like the Polistes wasps, the females are the only individuals that live through the winter. In the spring, the queens start the nests and care for the first brood of young. The first young are all workers and as soon as they are able they relieve the queen mother of the duties of caring for her many young and of housebuilding. Later in the season drones, or males, are reared from unfertilized eggs laid by the queen, and still later new queens are reared. The young hornets are fed upon other insects and upon nectar. Often this nectar-insect combination is obtained by killing a nectar-laden honey bee, and not infrequently we find hornets becoming pests where we wish to raise bees.

In the hornet society the males, or drones, are given something to do besides mating with the new queens. When they are developed they take over some of the house-cleaning duties performed by the workers.

PHOTOGRAPH BY VERNE MORTON

THE HOME OF A PAPER WASP

A nest like this can be examined safely in late fall or winter

They may also assist in circulating air through the nest to provide the desired ventilation.

I must tell you about the life story of one other insect before going on to other things about fall insects.

In some nearby brushland you will undoubtedly find elderberry, sumac, or raspberry. Probably the first two will be the better ones to examine. If you split a number of the dead twigs of these plants, you may eventually find one in which a number of crosswalls have been built. Between each pair of cross walls there may be either an insect or some insect food. If these partitions are made of wood dust, you have probably found a nest of the small carpenter bee. If they are made of mud it is probably the nest of a carpenter wasp.

The small carpenter-bee mother starts to build her home and nest in early summer. She does this by hollowing out a burrow in the pith of plants such as those mentioned above. At the end of this burrow, she lays an egg and beside it puts a supply of pollen food for the young larva which will hatch from the egg. She then builds a partition across the tunnel at a sufficient distance above the end to allow room for the development of her young one. Above this partition she places another egg and another bit of food supply. She continues this until the tunnel is filled. She then remains nearby to protect her family. The first egg laid, which is at the bottom of the tunnel, hatches first and develops through the usual stages. The young bee cannot leave its place as soon as it is ready to emerge because the tunnel above it is occupied by its younger brothers and sisters. These develop in turn, but all of them must wait to emerge until the youngest has developed and left the tunnel. When this time has come, the next older frees itself by tearing down the wood-dust wall above it. The next older bee follows its example, and so on. Eventually, the whole family is freed. They return to the burrow for protection and shelter, and the mature bees from the fall brood winter in the nest.

HOW FALL INSECTS PROTECT THEMSELVES

Not all insects protect themselves by the same method, although closely related insects often use similar methods. For example, we know that hornets protect themselves by stinging. We are not surprised that their close relatives, the bees and the wasps, also use the same weapon. You know from experience, I am sure, that some of these insects are much more ready to attack an intruder than are others, and that the sting of some is much more unpleasant than that of others.

You must not think, however, that all of these creatures use their stings only in self defense. Many of the wasps use them to paralyze the creatures which serve as food for their young or for themselves. These wasps are generally less prone to attack one than are the white-faced hornets that use their stings more consistently as weapons of warfare.

An effective means of defense is employed by the larva of the willow sawfly. You may have found these greenish creatures coiled around a willow or cherry leaf. If you look closely, but not too closely, you will

PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

LARVA OF THE AMERICAN ELM SAWFLY

An offensive protective fluid can be squirted from the holes along its side

find that these larvae squirt fine streams of liquid from the sides of their bodies. This material is an offensive fluid which is disliked by some of the enemies of the insects.

The offensive smell of the stink bugs and of the lacewing flies probably helps them avoid being destroyed by enemies which otherwise would eat them. In fact, production of an offensive odor or taste may be just as valuable to an insect as a sting would be.

Another interesting method of defense to be found among the insects here discussed is that used by the spittle insects. Probably more of you have seen the spittle than have ever seen the insects that produce it. I am sure that most of you have seen the froth so common on grasses and weeds in the summer. If you brush back the froth, you may uncover the little nymph of the frog-hopper that has used it possibly for protection. Protection, of course, is a rather general term and may include protection from death as well as protection from too much moisture or too little, too much air or too little, and too much light or too little. Probably the froth of the spittle insects serves to protect the nymph in more ways than one.

We have already mentioned the oyster-shell scale insects, but it might be well to call to your attention the unique way in which they remain

PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

ABODES OF SPITTLE INSECTS

protected. Even though they live practically their whole life exposed at one spot on a bare twig, they succeed only too well in escaping harm.

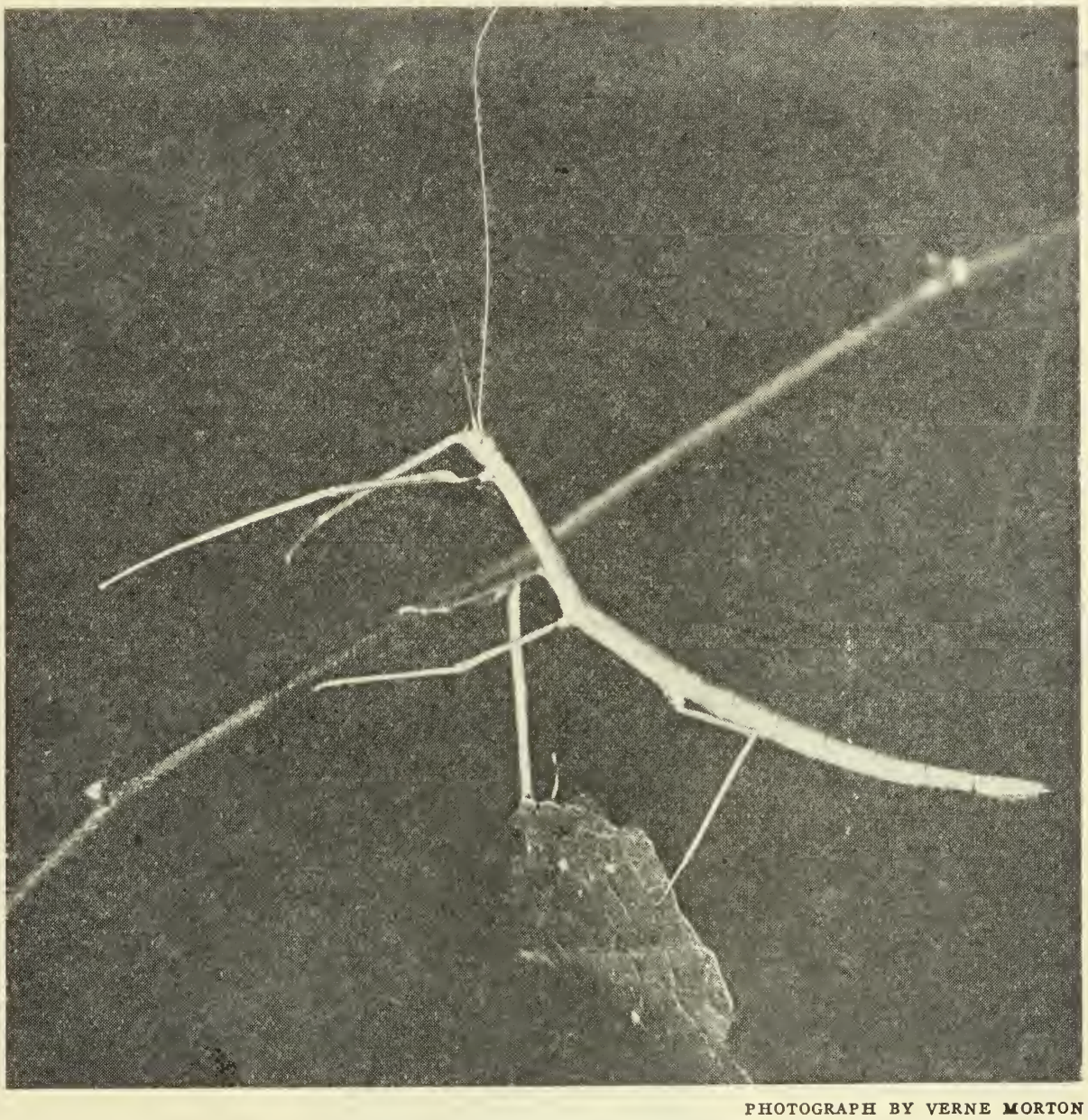
Some insects apparently have no means of protection. They have no stings. They do not hide. They may even make noises which attract their enemies. They may seem to do everything which would make them conspicuous and yet they more than hold their own. They often do this by sheer numbers; there are so many that while hordes of them may be killed plenty of others are left to take their places.

An effective means of protection employed by some insects and by other animals is that of remaining unseen. So successful is this method that there is good reason to believe that the meek may inherit the earth more completely than their more violent brethren. If you do not think this is an effective means, go out some late summer day into a field and look for grasshoppers without disturbing them. See how easily they disappear against a background of green even without being actually covered by vegetation. Some evening try to locate the snowy tree crickets that we hear from dusk to sunrise; or go out some bright day in early summer and search for the cicadas, or locusts, that you can hear all about you. If you are not convinced that insects can hide, try to catch a few mosquitoes in the house. You may see them occasionally for a few seconds but most of the time they are quite invisible to you.

Some insects are very well fitted for remaining unseen, under certain conditions. Many of them would be very conspicuous if placed in any environment other than that in which they live. The walking-stick insect is fairly common about my home but I rarely see one during the earlier seasons of the year. Most people never see them at all, or they do not recognize them as being insects. If you find one of these insects try putting it on the wall of your school building or on some plant in your school room and see how few people notice it, or know it to be an insect.

The ability of the walking stick to resemble something other than itself is possessed by many other creatures also. Measuring worms look like twigs; mourning-cloak butterflies look like leaves; underwing moths look like bark and tree hoppers look like thorns. Try to list the insects you know that resemble something in their environment. Can you think of any birds that do anything of this sort? Is it true of any mammals that you know?

Some one of these means of protection may seem to you to be more effective than another, but you must remember that what is a useful method for one creature might be useless to another with other habits.



PHOTOGRAPH BY VERNE MORTON

A WALKING-STICK INSECT

These are far more common than most persons realize

FOOD-HABITS OF FALL INSECTS

Not infrequently we find that the means of protection employed by an insect is in some way associated with its food habits. The insect may resemble its food or it may use its food-getting organ as a weapon. We know that a dog protects itself with the mouth that it uses for obtaining food. The same may be true of a cat or even of a horse. There are many other cases where no such association exists. Few if any of the insects discussed here protect themselves by biting; deer flies and horse flies bite but probably not to protect themselves. The weapons of most bees, wasps, and hornets are not used in food getting except in quieting the insects captured as food for the young.

Some insects, like the meadow grasshopper, snowflea, walking stick, thrips, squash-bug, spittle insect, oyster-shell scale, knotty-horn beetle, plum curculio, elm-leaf beetle, adult firefly, oak-leaf miner, halipiid beetle, engraver beetle, cat-tail miner, humming-bird moth, serpentine leaf miner, adult cluster fly, cherry saw-fly leaf-miner, and elm saw-fly are plant eaters. Most of these chew their food but others suck the juices. Among these are squash-bugs, spittle insects, and oyster-shell scale. These insects are able to obtain their food with little difficulty, but for the insects that live on animal food it is not such a simple matter. Their food supply may object to being eaten, a thing which most plants cannot do.

The food habits of the snowy tree cricket make it a rather useful insect. In both the young and adult stages, it preys upon plant lice.

PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

EGG OF SYRPHUS FLY

The egg was laid on a bud infested with plant lice

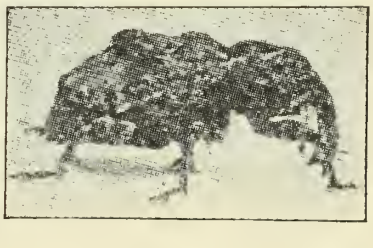
Were it not for the fact that when the mother lays her eggs she injures some of our berry canes we would feel like defending these interesting musicians whole-heartedly. Unfortunately they may cause considerable injury to a berry patch.

The food of the lacewing fly in both the larval and adult stage is other insects. When they lay their eggs they do no damage; thus they are considered as friends to man. A few of the thrips feed upon animal matter but most of them are plant eaters.

PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

PLUM-CURCULIO BEETLE AT WORK

We have already mentioned that carrion beetles may be found about decaying flesh. They are there, of course, for the food they can obtain from it, and are therefore classed as scavengers. The larvae of some of the fireflies get their food underground from the soft bodies of such animals as earthworms, and we have already mentioned the role played by the larvae of cluster flies in living as parasites of earthworms. The larvae of deer flies, horseflies and robber flies also live in the ground and prey on other forms of animal life found there. Of these, the first two live either in very moist soil or in water, and the last in drier ground. The adults of each of these live upon other animals; the deer flies and horseflies suck the blood of animals such as our-



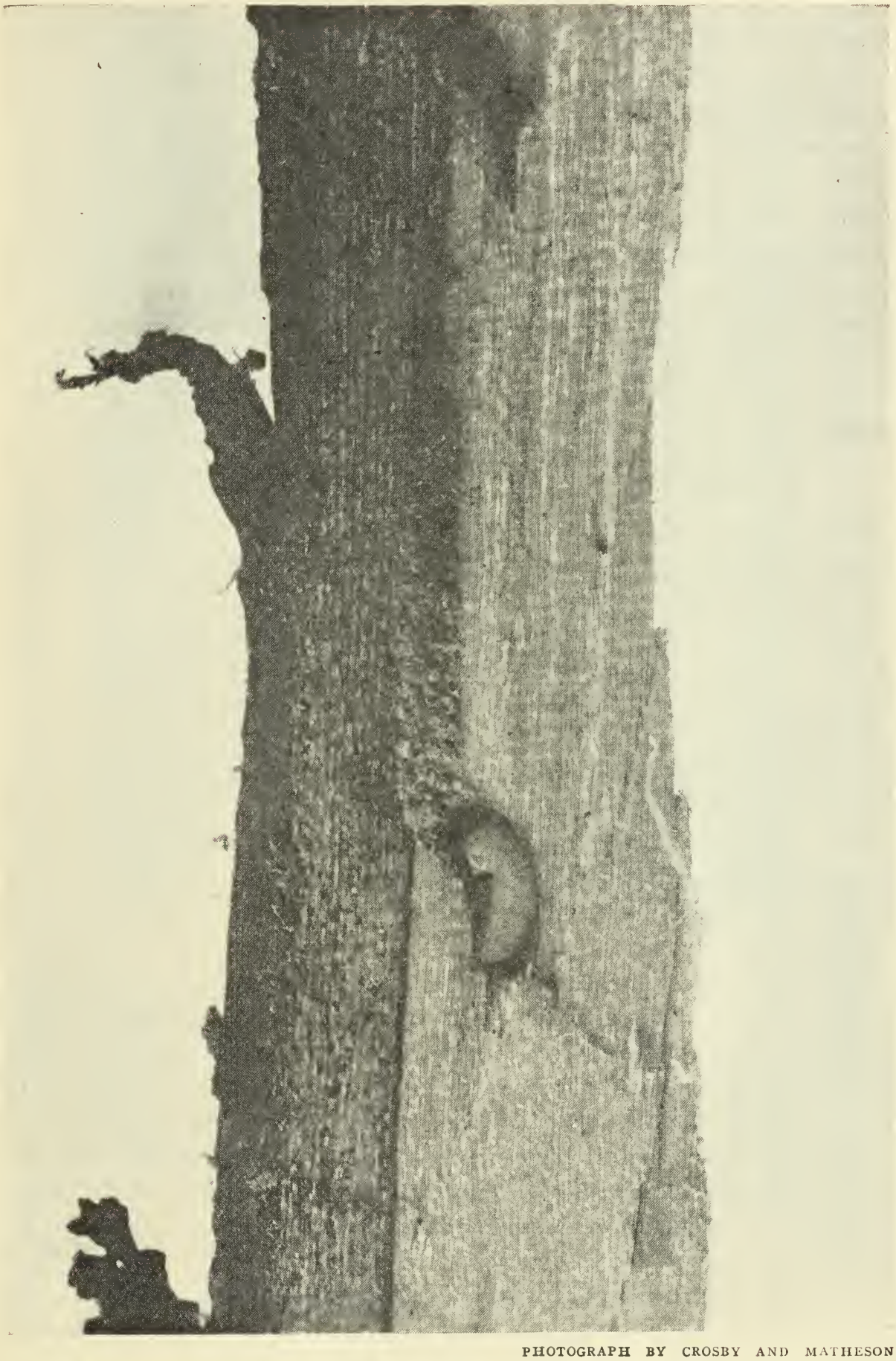
A PLUM-CURCULIO BEETLE. ENLARGED

ELM-LEAF BEETLES

selves; the robber flies prey upon other insects. It is always worth while to watch a robber fly that you may find perched upon some stick or stone by a roadside. If you are fortunate, you will see the insect fly up into the air and capture another insect, returning to its perch to devour it. Deer flies are altogether too ready to get their supper from our blood, and horseflies are generally avoided whenever they are seen. They are frequently the worst pest of a sunny swimming pool since they swoop above the heads of bathers and then bite, often drawing blood. Only the female horsefly annoys animals; the male feeds on plant products.

The pretty little syrphid flies have a peculiar food habit. The mother lays her eggs in a cluster of plant lice and the grubs that hatch from these eggs eat the lice. The adult flies feed upon nectar and pollen of flowers, generally without interfering with the prosperity of the plant.

Food habits of bees and wasps are decidedly varied. Bees, of course, are plant eaters or nectar gatherers. The wasps, on the other hand, eat other insects. For this reason, they have some value, even though this value may be offset by damage done. The ichneumon flies, however, are strong allies to man in destroying harmful insects. Each species seems to have its own particular food and a unique apparatus with which to obtain it. The larvae of one of the ichneumon flies live upon the larvae of certain wood-boring insects. In some way, the mother ichneumon fly can detect a place where one of the larvae is boring. She then drills through the wood with her long ovipositor and lays her egg in the burrow of the larva. The egg hatches into a grub which kills and feeds upon the wood-boring larva. How the ichneumon fly can locate the place where the borer is working and how she is able to penetrate wood with her slender ovipositor are difficult to understand. Sometimes the mother ichneumon fly cannot remove her ovipositor after she has forced it into the wood and dies without performing the function which is so useful to us.



PHOTOGRAPH BY CROSBY AND MATHESON

LARVA OF ENGRAVER BEETLE, IN PUPAL CHAMBER

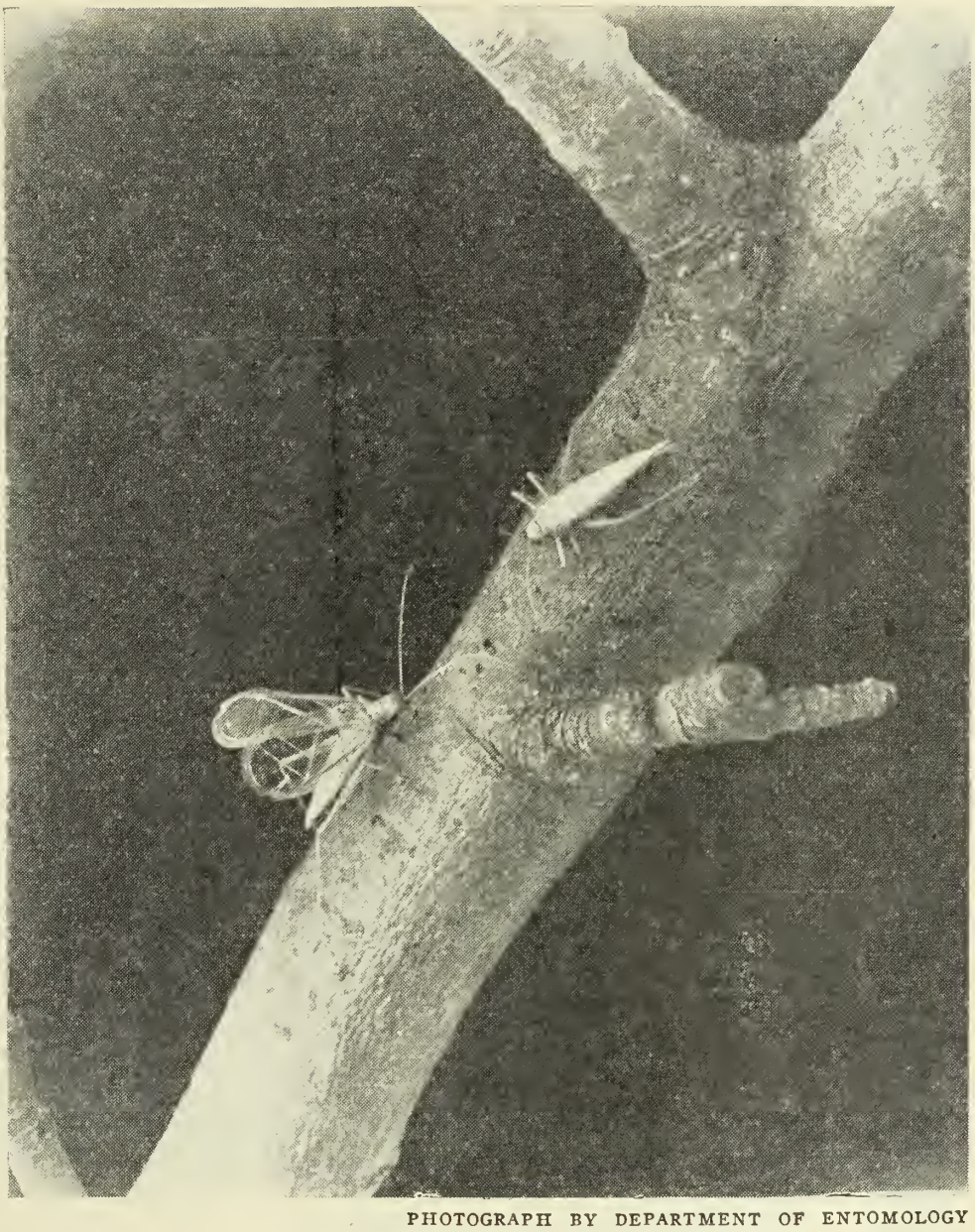
Man judges values in terms of good to himself. If an insect destroys things which we want, that insect is bad from our point of view. Sometimes the usefulness of a thing is determined in a rather indirect way. In one instance, the flies of a certain group are injurious to useful plants. They are kept in some control by spiders but the spiders are preyed upon rather effectively by a wasp. Because of this, the spiders are kept few in number and their prey multiplies. To control this situation there was introduced a wasp rather closely related to the ichneumon fly, which lives as a parasite upon the wasp that destroys the spiders. This is only one example of many of a similar nature where we have protected our friends by destroying their enemies. Men who are able to figure out how to protect animals and plants in this way are very valuable members of society.

SOUNDS PRODUCED BY FALL INSECTS

If we observe insects to satisfy our curiosity, or for the purpose of controlling them we will find that they have innumerable strange habits and characteristics.

The noises made by insects make a fascinating study for fall. Many of these noises are reputed to be made by creatures very different from the insects that cause them. In Hawaii, where I write this, the natives believe that a noise made by a certain grasshopper-like insect is made by the snails that they find on the trees. They hear a noise and on reaching the place from which they think it came they find a snail. This would seem to be rather satisfying evidence, but for the fact that they do not actually see the snail when the noise is made; whereas others who have studied these noises carefully have seen and heard the grasshopper noise makers at their work.

The snowy tree crickets are among the most unique of the sound-making insects. They are little, light-green creatures, the males of which have broad and relatively free wings while the females have their wings wrapped closely about their bodies. The noise is produced only by the males who use their wings in the act. The strangest things about their music are that the males chirp in unison and that the frequency of their chirps is related closely to the temperature at the place where they are. A number of students have studied this phenomenon carefully and have found that it is possible to determine the temperature with some accuracy by counting the number of chirps in a given period of time. If the number thirty-seven is added to the number of chirps given by the insects in fifteen seconds the result will be the approximate temperature in Fahrenheit degrees. The chirps are given only during the warmer months and are



PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

A PAIR OF SNOWY TREE CRICKETS

The male (lower) is chirping as he approaches the female

probably for the purpose of attracting the attention of the females, although it is rather dangerous to make such a statement since it has been found that many of our common crickets often give their chirps without any effect whatever upon the other sex. Dr. Frank Lutz, of the American Museum of Natural History, in New York, has made some most effective experiments in this field. He put the little crickets in boxes where they could not see each other and found that the chirps had little or no effect in bringing the two together. Some of you might like to carry on some experiments of your own with crickets.

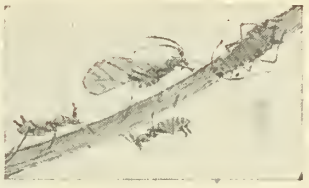
In some parts of the world, crickets are kept in little cages because people like to hear them chirp to each other. They are also kept captive because some people like to see the males fight one another. Cricket

PHOTOGRAPH BY DEPARTMENT OF ENTOMOLOGY

INJURY CAUSED BY THE EGGS OF THE SNOWY TREE CRICKET

fights are sometimes just as thrilling to Chinese as are bull fights to the Spaniards.

Many of the insects related to grasshoppers and crickets can produce sound. As is true of birds, each species has a more or less characteristic sound. Of course, the wingless members of this group, like the cave



PLANT LICE, THE FOOD OF SNOWY TREE CRICKETS

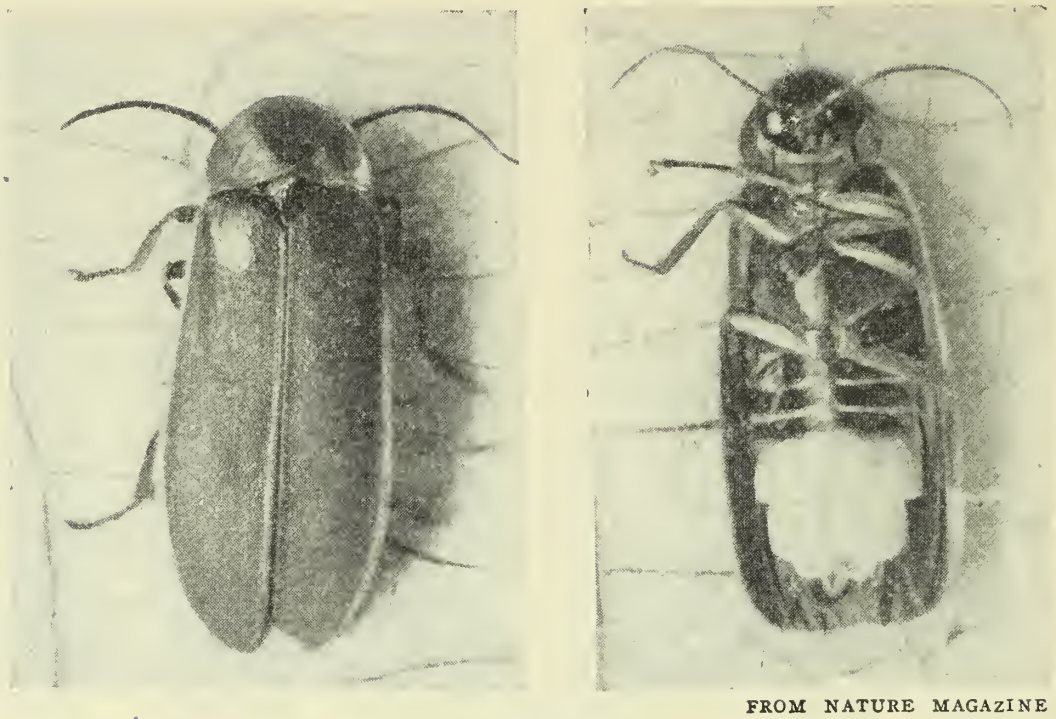
crickets and some others, cannot give calls, since these are produced by the wings. You should be able to recognize without difficulty the chirp of the snowy tree cricket, that of the katydid and of the common cricket, and possibly you may be able to recognize the little zipping sounds made by some of the commoner grass-hoppers. You must remember that their calls may be given to defy rival males, to invite females, or for pure pleasure. Many of them are so tuned that they are not audible to our ears, and many are just audible. We do not hear many sounds in nature simply because our ears do not record their vibrations. It is hardly probable that you will hear the calls of many of these creatures except in the early fall months.

OTHER HABITS OF FALL INSECTS

Some insects probably communicate with others of their kind by means of characteristic sounds, but some use other means. The glowworms and fireflies, for example, use light. Man himself uses light and noise to communicate with others of his kind. In spite of all of man's invention, he has not been able to produce light without heat as does the firefly. The light of these insects might be thought of as the purest form of light because practically none of the energy of the insect goes into the production of heat. The substitutes which man has used in place of sunlight produce much more heat than does the firefly light even though it is light and not heat that man wants. Possibly some day we may be able to find the secret. We know that such light can be made because the firefly is making it. While it is believed that fireflies use the light to attract one another, the larvae, or glow worms, produce the light when there is no need of attracting others of their kind. In some, even the eggs are luminous and there can be no reason why this should be desired. On the contrary, it might be better for the eggs if they were less conspicuous.

The larvae of fireflies have some claim to distinction for another reason than that they produce light. It is unusual for insect larvae to clean themselves, but firefly larvae do this.

If you have ever watched ants or bees you may have noticed that they communicate with one another at times, obviously by means of the sense of touch. As they meet or pass they may be seen to touch "feelers" and go on. Many insects probably use the antennae, or feelers, to learn of their surroundings much as a cat or a rat uses its whiskers. With insects the antennae may be used in still other ways. It is believed, for example, that they may help smell what is in the air and it is quite certain that



FROM NATURE MAGAZINE

A FIREFLY

The figure on the left shows the back of the beetle; that on the right is a view from below showing the light-producing organ

many insects and other animals use the sense of smell to find their way about. We cannot appreciate what abilities they possess in this direction since man has a poor sense of smell. We even rely upon dogs to seek game in the open or to follow trails of criminals or lost children. If we could understand insects completely we should probably appreciate the value of this strongly developed sense of smell much more than we do at present.

You might be interested in conducting some experiments of your own to find out more about the ability of insects to smell. Put a little stale meat outdoors on a warm day and you will find that it is quickly visited by certain flies even though you cover the meat so that it cannot possibly be seen. You may try similar experiments with other things whose characteristic smell even you can recognize. If you find that certain insects seem to visit regularly certain flowers in your garden, try covering the flowers so that they cannot be seen but so that their fragrance can escape into the air. See for yourself if any of the flowers so concealed are visited by the insects involved in your study.

You might vary this experiment to determine whether the insects being studied use sight instead of smell. In this case, you might use some of the same flowers that you have found were visited by insects, because of their fragrance, and leave them conspicuously exposed after you have removed the nectar glands. These suggestions are made to show you how simple it is to learn many things without the help of books.

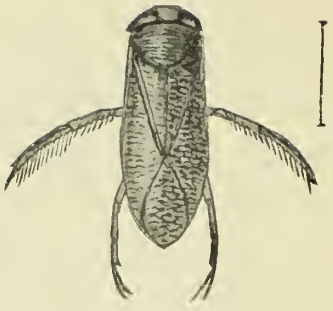
If you experiment with insects as I have suggested, you might keep some records of the relationship between insect activity and temperature. I have already called to your attention the relationship between temperature and the calls of the snowy tree cricket. It is probable that if we had abundant records of this sort on other kinds of insects we might be able to use the information in combating them. We know for example that it is the habit of squash bugs to crowd together under rubbish when the sun goes down. Knowing this, we provide convenient places for them to hide and then kill them when they have gathered there. Why can it not be expected that we will learn that other injurious insects have habits which will lead to their destruction if we can take advantage of them. In the west where the orange growers use lady beetles to keep the trees free from certain pests, they bring the beetles to the orchards in great quantities. It is a much simpler problem to collect these beetles if we know that at certain times they crowd together in great numbers.

If you are interested in making studies of this sort you might start by arranging in groups the insects with which you are familiar, some of which you know can be found active in broad daylight and others which you know are active mostly at night. You may be able to find others that are most active during the hours of dusk. If you begin experimenting with insects and with light you will find that an exposed light at night attracts many insects. Insect collectors often use trap lanterns to collect the insects that are attracted to the light. You will find that a number of kinds of insects seem to be insensible to light or that they are sensible to a combination of light and temperature, and that only the males of some species are attracted by light. The snowy tree crickets' activity is obviously associated with temperature and with light. Most insects are distinctly sensitive to considerable changes in temperature, but such insects as the snowfleas and some of the stoneflies seem to be active in either warm or cold weather.

When we add moisture to the list of things to which insects are conspicuously sensitive we have another series of studies, which might include spittle insects, cave crickets, and water insects. Some of these were discussed in the Leaflet for November, 1920. Most water insects, at least in the adult stage, come to the surface of the water for air. A few obtain it from plants under water. The little haliplid beetle that you find crawling around in pond scums has one of the most unique methods of carrying an air supply. If you look at one closely you will see that there are broad plates at the base of the hind legs. Behind these plates are spaces in which the beetles store their reserve air supply. It is much as though they stuffed it into their "trouser pockets" and then went under water.

DIVING BEETLE

BACKSWIMMER



WATER BOATMAN

These insects are equipped to carry air under water from the surface

If you follow these studies, you will find that some water insects get a new air supply by sticking a tube above the surface as does the water scorpion, while others use their legs to collect or hold the new supply. Watch such water insects as back swimmers, water boatmen, scavenger beetles, electric-light bugs, and diving beetles, to see if you can find the secret of how they carry their air supply with them. Each seems to have its own particular method and each may be discovered if you will merely use your powers of observation.

See how many insects you can identify by the injury which they make. Among the conspicuous injuries made by insects discussed here, probably the most characteristic are those made by the different leaf-miners, the engraver beetles, the scale insects, the plum curculio, and the egg masses of the snowy tree cricket.

The homes of many insects show amazing craftsmanship. You might take a nest of the paper wasps into the school room some time during the winter and explore the inside. Of course the best way to observe the ability of insects to build is by means of something like an observation bee hive. If you have one of these you can carry on your study even in the dead of winter, since the bees, unlike many other kinds of insects, live through the year.

LIFE HISTORY CHARTS AND IDENTIFICATION PLATES

Acknowledgment

In preparing the manuscript for this Leaflet, the writer's personal experience has been supplemented with information gleaned from standard and reliable publications. The manuscript was reviewed and criticized by Professor J. G. Needham. The reference books found to be the most valuable are as follows:

An introduction to entomology. John Henry Comstock. The Comstock Publishing Co., Ithaca, New York. 1924.

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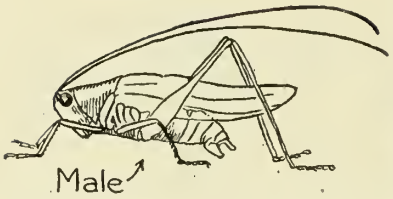
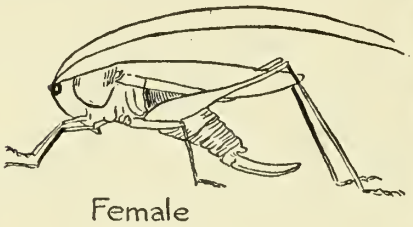
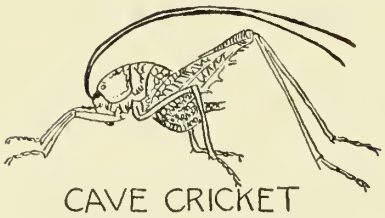
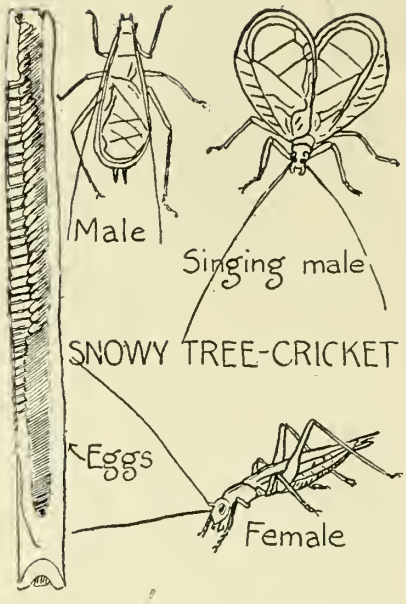
SPRINGTAIL

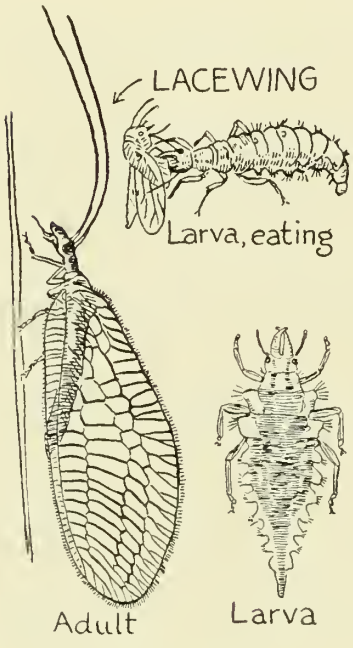


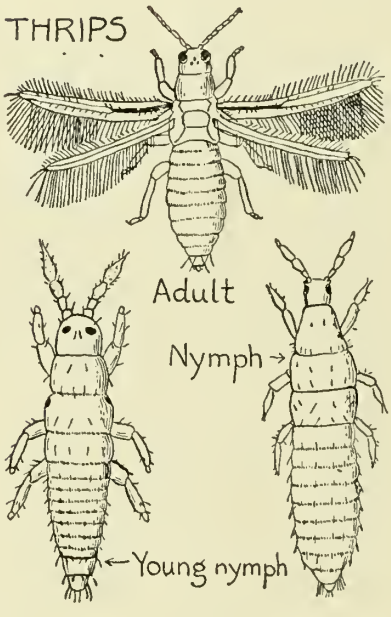
MEADOW GRASSHOPPER

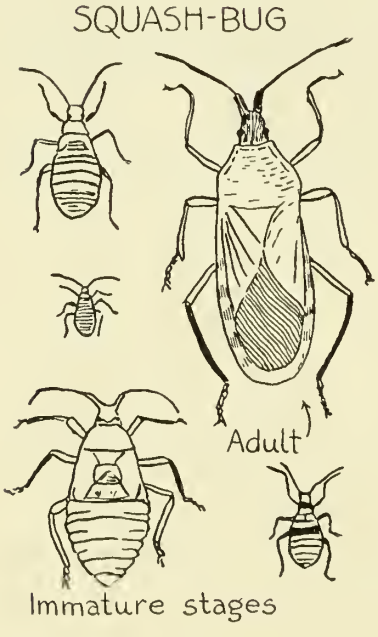

Female

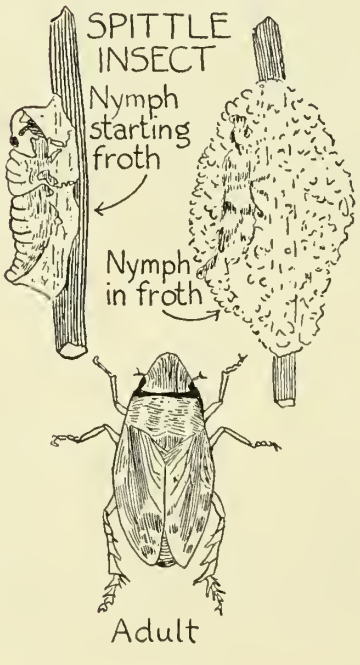

CAVE CRICKET

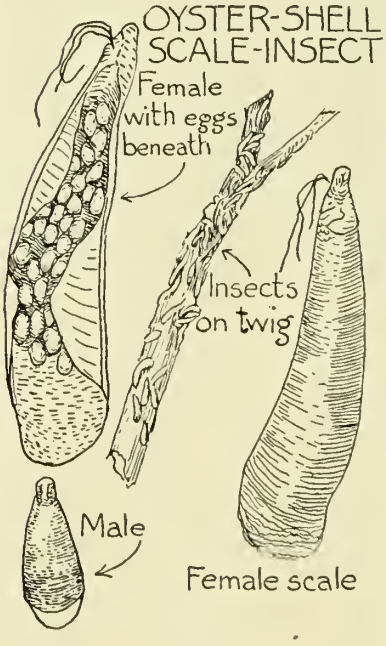


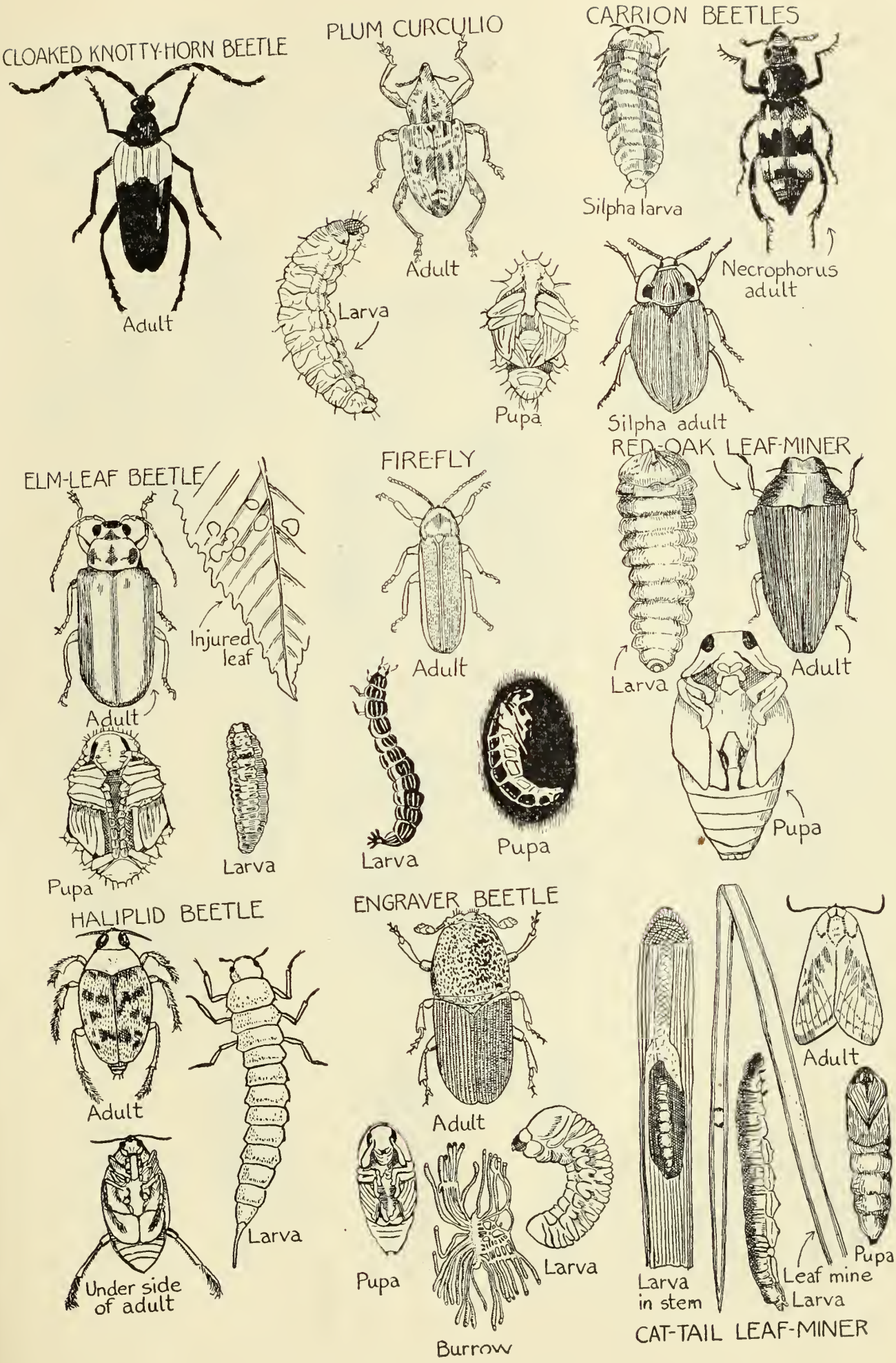






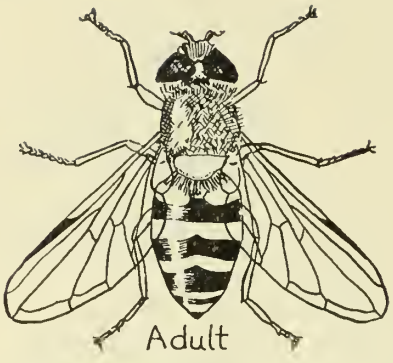





CLOAKED KNOTTY-HORN BEETLE
Adult
PLUM CURCULIO
Adult
Larva
Pupa
CARRION BEETLES
Silpha larva
Necrophorus adult
Silpha adult
ELM-LEAF BEETLE
Injured leaf
Adult
Pupa
Larva
FIRE-FLY
Adult
Larva
Pupa
RED-OAK LEAF-MINER
Larva
Adult
Pupa
HALIPLID BEETLE
Adult
Larva
Under side of adult
ENGRAVER BEETLE
Adult
Pupa
Larva
Burrow
Adult
Pupa
Larva in stem
Leaf mine
Larva
CAT-TAIL LEAF-MINER

HUMMINGBIRD MOTH

Adult



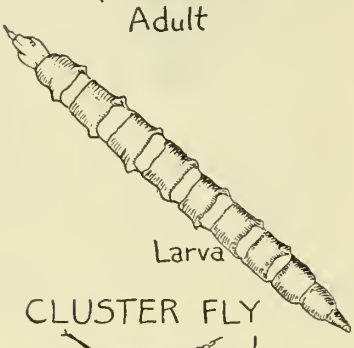
Adult

Larva

SYRPHID FLY

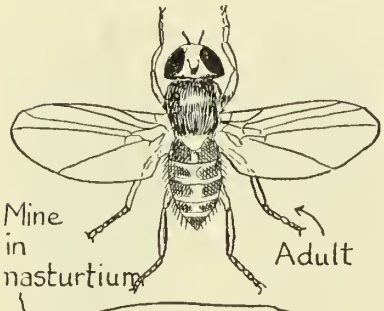
DEER FLY

Adult



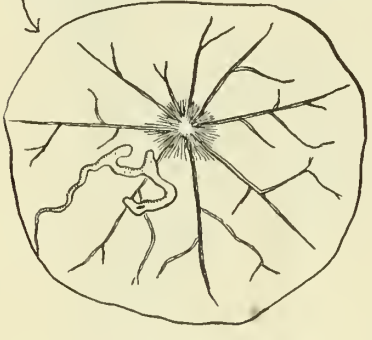
Larva

SERPENTINE LEAF-MINER

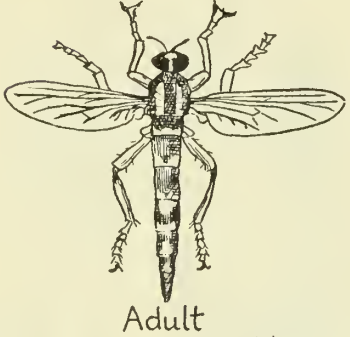


Mine in nasturtium

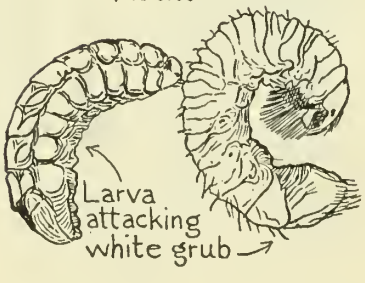
Adult



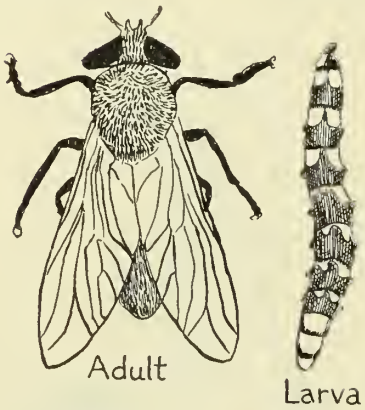
ROBBER FLY



Adult



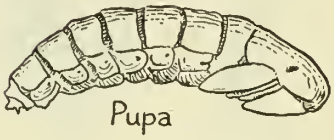
Larva attacking white grub



Adult

Larva

HORSE FLY

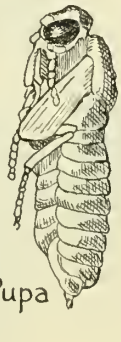


Pupa

CHERRY SAWFLY LEAF-MINER

Adult

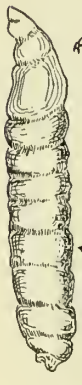
Larva



Pupa

CLUSTER FLY

Adult

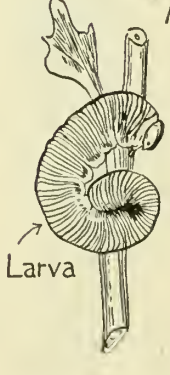


Larva

Pupa

WILLOW SAWFLY

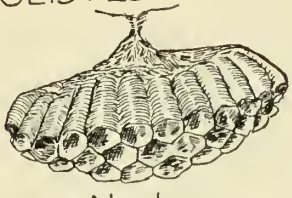
Adult



Larva

Cocoon

POLISTES WASP

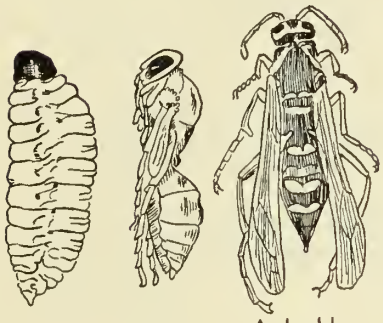


Nest

SMALLER CARPENTER BEE

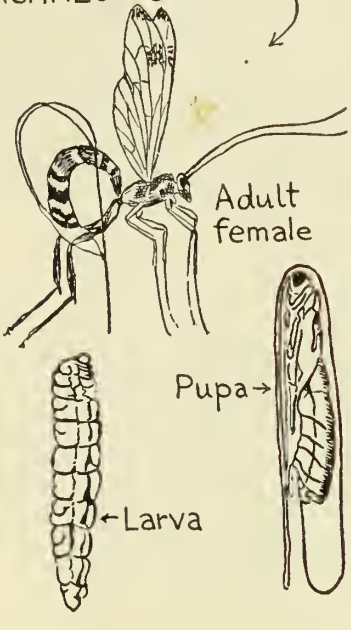
Adult

Adult, enlarged

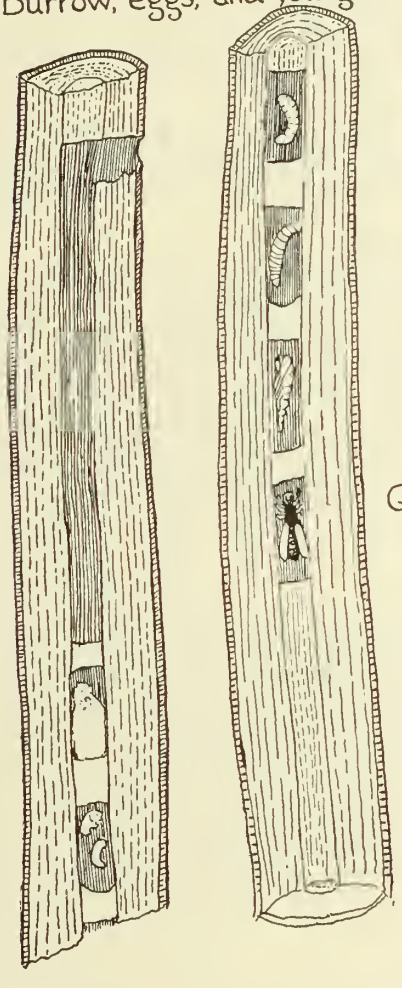


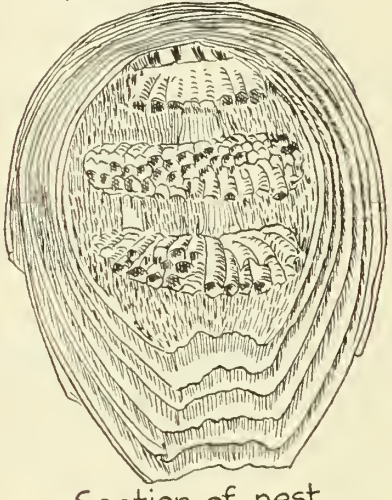
Larva Pupa Adult

ICHNEUMON FLY



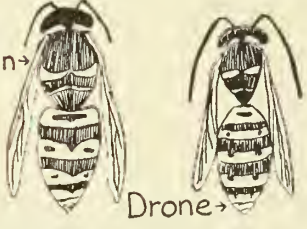
Burrow, eggs, and young





Section of nest

Queen→



Drone→

Egg and young

WHITE-FACED HORNET

Common name	SPRINGTAILS, SNOWFLEAS	WALKING STICKS	MEADOW GRASSHOPPERS	CAVE CRICKETS
Scientific name	*Sminthurus* sp.	*Diapheromera femorata* Say	*Orchelimum vulgare* Harr.	*Ceuthophilus gracilipes* Hald.
Appearance	Appear like tiny, dark specks crowded together; spring about when disturbed. Wingless creatures with "tails" which at rest are held bent back under the rather egg-shaped bodies, rarely as much as $\frac{1}{8}$ inch long	Body, 2 to 3 inches long, with legs and antennae about the same length; slender and sticklike; wingless female larger than male; green at first and later green or brown; movements generally slow and deliberate	Slender green grasshoppers with long slender antennae; about 2 inches from wingtips to tip of head; female with curved ovipositor; head, slender and pointed, with eyes relatively small and near front of head	Grasshoppers which are wingless even as adults characterized by abnormally developed hind legs and long antennae; commonly pale brown with darker mottlings; female with upward-curved ovipositor
Where found	On water or on leaves of vegetables; frequently seen on snow or crowding in and around sap-buckets	On low plants when young; later, on trees, most commonly oaks; generally solitary or in pairs	Commonly in meadows and moist pastures usually off the ground but on low plants	Common in cellars and in dark, moist places such as dense, moist woods and gorges; also in wells
Range	A number of kinds of springtails are found through the State	Through northern United States though much more common in the south	Species listed is found from the Rocky Mountains east to the Atlantic	Closely related forms are to be found throughout the United States where situations are suitable
Ancestry and life history	Related to the silverfish described in the Leaflet, "Pests of Plants, Pets, and People." Young are like the adults except in size	Related to grasshoppers and crickets. Eggs white with black stripe, dropped on ground in the fall; hatch in spring; young resemble the adults in shape but not in size; become full-grown in about 6 weeks after time of hatching	Closely related to the katydids, coneheaded grasshoppers, and crickets. Eggs laid generally in plant tissues with the aid of curved ovipositors; hatch in spring; young resemble adults but lack wings at first; reach full size at maturity in early summer	Closely related to the meadow grasshoppers. Eggs are laid in late summer, probably in the ground. They sometimes hatch in the fall but probably more often in late spring. The young nymphs resemble the adults in general form
General behavior	Leaping is done by releasing a spring from a catch which holds it beneath the body. This hurls the creature sudden'y through the air. Feeds on plant materials; some species are found on the water; most commonly noticed on water or snow	Generally more active at night than during day when they remain quiet, avoiding enemies by resemblance to sticks; locomotion entirely by walking; make no noises such as those made by katydids, crickets, and grasshoppers; eat leaves voraciously	Rather solitary grasshoppers; eat vegetation, but not seriously destructive; mature male capable of producing a call by means of fore-wings, upper ends of which provide sounding organs; when calling, the whole insect seems to tremble so much that it is evident at a considerable distance	Food is varied, including meat, fruit, and vegetables, where these are available. Because it is wingless, it cannot produce sounds such as are common with the winged grasshoppers, since the wings produce the sound
Reactions to heat, light, moisture, and chemicals	Prefers an abundance of moisture but temperature does not appear to influence greatly the behavior	Generally light reduces activities; may remain practically motionless throughout day	Has the habit of hiding from observation by quickly moving behind plant stems, but may fly if further molested; does not survive severe frosts	The habit of this insect of shunning intense light and seeking humid atmosphere, differs quite considerably from the behavior of most grasshoppers
Relation to man's interests	May be pests in sugar camps and on plants growing in moist places. Controlled by Bordeaux spray with pyrethrum powder	Rarely so abundant or destructive that control is necessary	Not of great economic importance as compared with many other grasshoppers; their cheery chorus, a familiar summer sound	Not of great economic importance. Probably serve as scavengers in such places as caves and cellars

SNOWY TREE CRICKETS *Oecanthus niveus* DeG	LACEWINGS, GOLDEN-EYES *Chrysopa occulata* Say	THRIPS *Frankliniella tritici* (Fitch)	SQUASH BUGS *Anasa tristis* DeG.
Slender, pale-green insects; wings of female closely wrapped about the body; those of the male broad and relatively free; body of male slender; antennae, very long	Pale green insects with transparent lacy wings; length, without antennae, about $\frac{4}{5}$ inch; eyes, golden; some black markings on head; antennae, slender, yellow and brown	Pale yellow insects about $\frac{1}{25}$ inch long frequently found actively working in flowers; have two pairs of small, feather-like wings not ordinarily noticed	Unpleasantly odored bugs with dark brown back and dirty yellow underparts; head, with two black stripes; a sucking beak under head; wings folded on back and extending beyond end of body; $\frac{5}{8}$ inch long
Commonly found singly, on trunks of trees or shrubs but very easily overlooked because of color	On various plants, commonly collected from automobile radiators and about lights	Most commonly on daisy heads, though they live in other plants	Commonly on leaves of squash, melon, pumpkin, or similar plants or under garden trash
Several species are to be found in United States and Canada	About 60 species of lacewings are found in United States	Several species found throughout our country and elsewhere	124 species of the squash-bug family are to be found in the United States
Related to grasshoppers and katydids. Winter as eggs which are deposited in bark or in stems such as raspberry canes, 40 to 50 together; eggs hatch in early summer into little crickets which resemble the parents; reach maturity by midsummer and remain active until killed by cold weather	Related to ant-lions. Eggs are placed on plants, at tips of erect slender stalks; larvae hatch in about 5 days and crawl down stalks, seeking animal food; larval stage about 2 weeks; skin shed twice; cocoons, papery, thick, egg-shaped, about $\frac{1}{6}$ inch long; in summer, pupate about 26 days; winter in cocoons	Young resemble adults in general form but lack wings; wing pads appear in last two moults preceding adult stage. Eggs of strawberry thrips are microscopic and are laid in leaf tissue. They hatch in about 4 days and the mature stage is reached in about 3 weeks	Related to plant-lice, cicadas, and "electric light" bugs. Adults appear in May. Brown eggs, laid in rows under leaves, hatch in 1 or 2 weeks into insects resembling adults except for absence of wings; moult 5 times in 33 to 56 days to reach adult form. A second generation of adults appears in August. These hibernate
Generally most active at night, at which time both young and adults feed upon plant lice; males fly readily and give call in unison with other males of their kind; females silent; males' song a characteristic noise of summer nights, described as "slumbrous breathing"	Adults have slow, fluttering flight; adults and larvae feed largely upon plant lice; adults have a very strong and disagreeable odor which may serve as protection from enemies; adults rarely live through winter, ordinarily short-lived; mating and egg-laying begin shortly after emergence; one female laid 617 eggs	Active, swiftly running insects; very common on clover blossoms; most thrips feed upon plant juices, and produce some injury, though some prey upon other insects; adults and nymphs hibernate through winter	Spend winter and nights generally under rubbish. Suck plant juices, causing plants to wilt; when insects are abundant plants are killed. Their habit of crowding together under rubbish near plants makes it possible to trap and kill the insects. They are known to carry bacterial wilt
Add 37 to the number of times the male calls in 15 seconds, to get the approximate temperature in Fahrenheit degrees at the place where the insect is; calling is done during hours of darkness and during warm months	Adults most active at night in warmer weather; come readily to lights; detect food apparently by feeling rather than by smelling or seeing; appear in May and remain through summer season	Apparently prefer feeding in regions shut off from direct sunlight	Feed by day and hide during winter and at night; susceptible to calcium cyanide when young, or to kerosene emulsion
Destroy plant lice; the species *O. nigricornis* injures raspberry shrubs by laying eggs closely in stems	Adults and larvae valuable destroyers of plant lice	Often greenhouse pests, necessitating fumigation; nicotine sprays effective for onion, bean, pea, strawberry, and grass thrips	Very destructive garden pests, killed by sprays, as suggested, and by trapping under boards placed for that purpose

Common name	SPITTLE INSECTS, FROG HOPPERS	OYSTER-SHELL SCALES	HALIPLID BEETLES	CARRION BEETLES, BURYING BEETLES
Scientific name	*Lepyronia quadrangularis* Say	*Lepidosaphes ulmi* (L.)	*Haliplus fasciatus* Aubé	*Necrophorus americanus* Oliv.
Appearance	Best known by frothy covering of the young. Adults, brownish bugs less than $\frac{1}{3}$ inch long bearing on wing covers, two oblique, darker brown bands; vaguely frog-like in appearance though this is not responsible for name	Generally recognized as small crowded oyster-shell-like scales on the bark of woody plants; females, under scales about $\frac{1}{8}$ inch long; males, under smaller scales; males usually winged; females wingless	Very small water beetles easily identified by rather large plates under bodies at base of hind legs and by rather slow movements, when compared with most other water beetles	Large stout beetles with bowed hind legs, almost cylindrical bodies, and wing covers each bearing large red spots. An inch or more in length; orange-red on head
Where found	Common on grasses and other low plants in the summer months	This species common on dogwood, apple, and maple; those on willow and ash are different	In fresh water, often among the masses of pond scum so common in springs and still water	On or near carrion; this species apparently favors the bodies of reptiles
Range	Some 25 species of the spittle insect family are to be found in the United States	World-wide in distribution		More than 100 species of carrion beetles in the United States
Ancestry and life history	Closely related to the cicadas and tree hoppers, leaf-hoppers, and plant-lice. The young live upon the juices of plants. They free from their alimentary canal a mucous fluid which they beat into a froth commonly called "frog-spit." This completely covers the young and protects them during the transformation	Related to plant-lice. Spend winter in egg, 25 to 100 under a scale; emerge usually in late May and crawl about for 3 or 4 hours then form own scale, maturing in early August; there may be two generations in New York, first eggs hatching 2 to 3 weeks after apple-blossom time	Closely related to diving beetles. Adults mate in May or August and females lay 30 to 40 eggs, scattered among water plants. Larvae, slender with many side spines, may live in this stage through winter; pupate 12 to 14 days, in chambers about 1 inch under moist ground, remaining 3 days as larvae before pupating.	Related particularly to diving beetles, rove beetles, and fireflies. Eggs are laid on carrion, and larvae feed upon it, finally passing into pupal stage from which adults emerge; adults are reported to bury the carrion on which they and the young feed; but some observers question this fact; adults active in summer
General behavior	The function of the "spit" covering has been studied but probably not definitely established. Some scientists contend that it helps in respiration, others that it protects against parasites and drying. Adults have power of leaping about. Several young may inhabit the same froth mass at the same time	Once the insects have established the scales, they remain there until death; the female lays her eggs under the scale which protected her in life; food is sucked from host plant and often great damage results. Most species of the group are destructive	A summer generation lives from May to August and a second generation lives through the winter. Food, the contents of cells of algae or pond scums. Contents are removed from cells often without breaking thread. The food habit and existence in crowded masses of algae may be related to habit of moving slowly	Food of this species, decaying meat; other species live upon plants, some to the extent of becoming plant pests; members of the different families of burying beetles seem to have decided food preferences
Reactions to heat, light, moisture, and chemicals	Found only in summer months	Active only during summer months; lime-sulphur applied regularly in 10 per cent kerosene emulsion when plants are dormant, and a soap spray applied in late May when insects are free helps in controlling them	Not active during colder periods ordinarily. Animals such as beetles are air breathers and the adults of these beetles carry air reserve under plates supporting hind legs. This is renewed by journeys to or near surface	The insects have exceptional ability to detect the presence of decaying animal matter by the sense of smell. Adults active in summer
Relation to man's interests	Generally thought of little economic importance. Nicotine sulphate spray used for control	Very serious pest; it and its relatives among the most serious enemies of orchard trees. Related insect produces shellac	May serve as some slight control of multiplying pond scum or as food for fishes	Probably this species serves as a useful scavenger

FIREFLIES, GLOW-WORMS *Photinus* sp.	RED-OAK LEAF-MINERS *Brachys ovatus* Web.	CLOAKED KNOTTY-HORN BEETLES *Desmocerus palliatus* Forst.	ELM LEAF-BEETLES *Galerucella luteola* Mull.
Oblong beetles with rather long, "nervous" antennae and comparatively short legs; above, pale gray; beneath, the end of the abdomen in the male appears sulphur yellow from the fourth or fifth segments to the end	Small, oval beetles with short antennae; at first, white, but later darker with a metallic iridescence due to change in color of hairs and scales; mine, a blotch on oak leaves	Beautiful blue and yellow beetles, the yellow appearing as a band across the middle; antennae, about as long as body and about the same length as the legs; head small and about as long as wide	Medium-sized beetles, yellowish or grayish in color; bodies 3 to 4 times as long as wide; antennae more than half as long as bodies and rather close together at base; heads short and broad as viewed from above
Common over meadows and swamplands; particularly abundant near water; larvae commonly in ground	Common on red-oak leaves; the mine visible at almost any time of year	Most common on elderberry	Adults commonly hide in cracks in buildings and under bark or on elm leaves
More than 50 kinds of fireflies are known in the United States		About 400 species of long-horned beetles in the same group as this species are found in America	Introduced into America near Baltimore from Europe about 1834; now, rather wide spread on English elm
Related to carrion beetles and blister beetles. The adults use the well-known flash to attract one another; in some species the eggs are luminous; in some the larvae also glow; larvae live in soil or under bark; some species feed upon soft-bodied animals such as earthworms; pupate in earth about 10 days; pupae luminous	Eggs laid on leaf of red oak in early summer or late spring; larvae burrow into leaf, leaving egg still visible as shining speck; blotch mines of larvae often cross leaf veins; larvae often remain through winter in fallen leaves; in May enter pupal stage of about one week, at the end of which the adults emerge	Related species are ribbed pine borer, beautiful maple borer, locust borer, painted hickory borer, and oak pruner. The larvae of this species bore into and live in the pith of elderberry	Closely related to potato beetles, asparagus beetles, and other leaf-eating Chrysomelidae. Eggs, orange-yellow, laid on end, in clusters of 5 to 30, on elm leaves; yellow-black larvae hatch in 1 week and mature in 15 to 20 days; pupate 6 to 10 days in ground or in bark crevices, then emerge as adults; second generation winter as adults
In some species, females wingless; in others their glow less bright; some species do not glow at all; light known to attract sexes since they are attracted to a captive in a glass bottle through which light shows, though not attracted when captive is in a porous box which interferes with light	Like all leaf miners the larvae have unique habit of living protected by upper and lower leaf-surface. The oak-leaf surfaces are genuine protections. Larvae live in leaves during winter making it unnecessary for them to seek a special hiding place at that time; pupal stage unusually short		Adults of first generation mate in spring; feed on and injure bursting buds, the injury appearing as holes in mature leaves; larvae which follow reduce leaves to skeletons by eating out the softer parts. Both larvae and adults chew food; therefore control is effected with poison sprays
Their light is cold; produced on ventral side of abdomen near the tip	Leaf provides ideal food and humidity for growing larvae	Common in June and July in New York	Adults may go into hibernation, yellow in color and come out a dark green
Of little economic importance; problem of solving method of light production a challenge	Hardly of great economic importance	Beautiful beetles of little economic importance because the plant on which they live is of little importance	Cause great injury to desirable shade trees; control, lead-arsenate spray applied just after buds open, and again 2 weeks later

Common name	PLUM CURCULIOS	ENGRAVER BEETLES, FRUIT-TREE BARK BEETLES	HUMMING-BIRD MOTHS, THYSBE CLEAR-WINGS	CATTAIL MINERS
Scientific name	*Conotrachelus nenuphar* Hbst.	*Scolytus rugulosus* Ratz	*Hemaris thysbe*	*Arzama obliqua* Wlk.
Appearance	Dark brown, "humpbacked" beetles about ¼ inch long with yellow, white, and black markings, and conspicuously long "snouts" curving inward and resembling an elephant's trunk	Small beetles 1/10 inch long, dark brown with dull red wingcover tips and red on legs; presence easily recognized by burrows, or burrow entrances which are about the size of a pinhead	Adult moths somewhat resemble humming birds in behavior; spread wings show large clear areas; other portions dark, reddish brown; antennae, half to two-thirds the length of fore-wings	Adults brown moths with bodies about an inch long and wingspread of about 2 inches; forewings with oblique brown stripe; hind wings with oblique black spot
Where found	On plums, apples, pears, cherries and peaches, about the time they flower	European species under bark on plum, cherry, peach, apple, and pear trees; other species on other trees	Adults about bright flowers; larvae on snowberry, hawthorn, and viburnum	On cattails or near them, where presence is easily detected by dead tops of cat-tail
Range	From Canada to the Gulf Coast, east of the Dakotas and Texas at least	This species found from Alabama and Arkansas to Massachusetts, Canada, and Michigan	The species is to be found in the Eastern United States	Found throughout United States and Canada where its host plant is found
Ancestry and life history	Closely related to grain weevils and snout beetles. Female lays 100 to 300 eggs in spring, in holes beside crescent slits in fruit; brown-headed footless, white grubs, about ⅓ inch long, hatch in 4 to 10 days and mature in 14 to 18 days. These enter soil 1 to 3 inches deep and pupate in 12 to 16 days, emerging about 4 days later	Male digs burrow in which female lays 40 to 70 eggs; eggs hatch in 3 to 4 days into white grubs with yellowish heads, which eat out burrows branching from the mother's; larval stage, 30 to 36 days from time of leaving brood chambers; pupal stage, 7 to 10 days; transformed adults may burrow further before emerging	Related closely to the tomato worm. Adults lay eggs on variety of plants. These hatch into caterpillars resembling small tomato worms with a "horn" at rear end; pupae enclosed in dense but crude cocoons formed on surface of ground or under fallen leaves, pupae without the free tongue case of some related species	Noctuid moths. Eggs laid near tip of new cattail leaves in masses of 35 to 60, each mass covered with waterproof froth; larvae mine down leaves as much as 20 inches, then molt, leave mines, and enter stem as solitary borers; grow to a length of 2 inches, winter as larvae; pupal stage of 16 to 19 days begins in March; adult stage follows
General behavior	Adults spend winter hidden away under leaves; fruits stung by adults generally fall or become knotty and unmarketable; often the wound is conspicuous because of exuding gum	The closely related pine slash bark beetle makes beautiful burrows under white pine bark; the male cares for several females in the reception chamber which he digs and guards the tunnel; it is unusual for a male insect to contribute a burrow for his mate or mates	Food of larva leaves; the adults are very active fliers, pausing in flight before flowers, like miniature humming birds; this species is unusual in having two forms, either of which may be produced from the eggs of the other	Young larvae eat the soft interior of the cattail leaf, working side by side; older larvae, as stem borers, kill the flower stalk and may otherwise injure the plant; in central New York eggs are laid about the last of May
Reactions to heat, light, moisture, and chemicals	Light is an enemy; thus it is an effective practice to prune trees so light falls on fruit; use lead arsenate spray, 2 lbs. to 100 gallons of water, about time petals fall and again 10 days later	Adults appear April to May; second generation may winter as larvae; may be controlled by whitewashing tree in late March and in July and October	Humming bird moths are unique, as moths, since they are most active in strong sunlight; other moths fly in dusk or darkness	The waterproofing of the egg mass and protection of larvae in the leaf make interesting studies
Relation to man's interests	Serious pests; cause perhaps as much as $8,500,000 damage a year in this country; shallow cultivation, while insects are in ground may kill them or cause them to fall prey to ants and other enemies	Unique family life interesting in spite of serious damage often caused to trees by larvae	Of little economic importance but very interesting because of their habits and because of existence of two forms	Insects not sufficiently abundant to seriously injure cattail

DEER-FLIES EARFLIES *Chrysops* sp.	HORSE-FLIES *Tabanus atratus* Fab.	ROBBER FLIES *Asilus notatus* Wied.	SYRPHUS FLIES, FLOWER FLIES *Syrphus* sp.
Small but vicious flies with smoky bands, or bars, on wings; conspicuous because of their attacks; when at rest, wings held extended at angle at sides; attractively colored	Females, one inch long, black, with blue-white bloom on back; wings smoky; eyes separated; males, similar but eyes touch each other and are much larger; outer wing margins not parallel; very fast fliers	Large flies, some as long as 2 inches; wings usually, though not always, held at right angles to body; eyes conspicuous; legs, large; abdomen slender; some kinds resemble bumble bees	Prettily colored small flies with yellow-banded black or dark abdomens; flight rapid and darting; some closely related species look and sound like bumble bees, and some like honey bees
Near woodlands or waterways during warm weather	In woods or open; frequently found annoying swimmers and cattle; individuals, solitary	On ground or on perch in open or in woods; individuals solitary	About plants, particularly those with aphids on them; also found in and about flowers
At least 63 species of deer-flies in North America	200 closely related species in North America	More than 500 kinds of robber flies are to be found in North America	Some 300 kinds of syrphus flies are to be found in America north of Mexico
Related to the larger horse flies and to other flies. The glistening black eggs are laid on water plants, above the water line or on exposed stones, and form conspicuous masses. Larvae which are worm-like maggots hatch and drop to the water where they feed upon other forms of animal life; their pupae are not enclosed in the larval skin	Green-headed monsters and gad flies closely related. 200 to 500 eggs, laid on marsh plants, hatch in 1 to 2 weeks when exposed to sun. Larvae greenish-white "worms," which may reach 2 inches in length; prey on small animals; winter in soil; in spring yellow-brown pupae, 1¼ inches long, form in drier ground; adults emerge in warm weather	Related to deer-flies, house-flies, and mosquitoes. Larvae of most kinds live under ground or in rotten wood; pupae formed in ground without covering; adults, active fliers	In this family belong drone flies, adults of rat-tailed maggots; in closely related families are the dungflies. The adult syrphus flies lay their eggs among plant-lice; when eggs hatch, the emerging maggots attack and destroy the aphids; larvae are greenish, slug-like maggots about ½ inch long, often with white stripes
The vicious swoop and bite of females is known to any who have walked in our woodlands in summer; males feed on nectar and sap. Adults appear in late June and may be abundant until late August; eggs hatch in 6 days and pupae are commonly formed in marshy soil	Adults very annoying to cattle and occasionally to man. The females can pierce hides and suck blood, causing much discomfort. The males feed upon nectar of flowers. The larvae feed upon many sorts of small animals. No shelter is built by larvae or adults	Larvae prey upon insect larvae; adults swoop upon their insect prey, capturing it in flight from resting place; carry victim to perch and there consume soft parts; sufficiently able fliers to carry prey in spite of relatively small size of wings; they build no shelter; flight ability of adults protects them; vision probably exceptional	Adults feed upon nectar and pollen but without serious damage to the plants; the flies are most commonly noticed on bright sunny days. Some closely related species look and sound like bumble bees, and some like honey bees
Not ordinarily found far from water, or in cool weather; kerosene in water may kill larvae	Adults active during warmer seasons, particularly in bright fair weather; the larvae require an abundance of moisture either free or soaking the loose earth	Larvae and adults live in dry environment; adults active during warmer seasons and parts of day when light is bright	Bright sunny weather and gaily colored flowers seem to attract them
One man collected 108,250 eggs in one hour, from water plants, using a rowboat. Even though the flies are attractive their habits of biting are not	Do not produce bots or warbles in cattle; control hardly practical; carry anthrax	Control is not to be desired as they are useful destroyers of other insects, particularly stable flies	Very useful destroyers of aphids which in turn destroy useful plants

Common name	CLUSTER FLIES	SERPENTINE LEAF MINERS	AMERICAN, ELM, OR WILLOW SAW-FLIES	CHERRY OR HAWTHORN SAW-FLY LEAF MINERS
Scientific name	*Pollenia rudis* Fab.	*Agromyza pusilla* Meig.	*Cimbex americanus* Leach	*Profenusa collaris* MacG.
Appearance	Slightly larger than house-flies but much more slowly moving; dark colored; thorax with thick woolly hairs; abdomen brown with white spots; sluggish habit is characteristic	Small flies with rather large heads and outstretched wings; most frequently recognized by the winding burrows or mines of the larvae in leaves such as those of elm and nasturtium	Females about ¾ inch long with black heads and steel-blue or purple abdomens with 4 yellow spots on each side; wings, smoky brown; legs, black; antennae short, pale yellow	Small four-winged sawflies about ⅙ inch long; females with metallic black bodies, reddish in foreparts; abdomens of males more slender and lighter in color than those of females
Where found	In houses, hidden away in nooks or clustered on windows; sometimes on snow or on soil or walls	Mines of this species may be found in at least 55 species of plants, woody and otherwise	On a variety of woody plants but more especially elms and willows	On cherry and hawthorn; sometimes a pest in New York and Massachusetts
Range	Introduced probably from Europe at an unknown date	About 100 species in North America north of Mexico	More common in the middle west but abundant locally in New York State	
Ancestry and life history	One of the blow-flies, closely related to the blue-bottle and screw-worm flies. Adults mate about February; eggs laid a month later on soil, sometimes as many as 97 in one evening; eggs hatch in 4 to 6 days into white maggots which live as parasites in earthworms about 3 weeks, then pupate in soil for 2 weeks to a month and a half	Rather closely related to horse bot flies. Females insert their eggs under skin of leaves; maggots eat winding burrows within leaf, mines constantly growing wider; full-grown maggot retreats from end of burrow about ¼ inch, cuts slit in leaf and drops to ground to form pupa, or pupa may form in leaf	Related to wasps and other species of sawflies. Eggs, laid in pockets in leaves, hatch into yellowish white "worms" which reach mature size by July or August; mature larvae, which have black lines down middle of backs, descend tree, burrow into ground and spin cocoons in which they winter; change to pupae in spring	In same large group as wasps and bees. Eggs laid singly in slits in upper leaf-surface usually in basal part of leaf; larvae hatch in mid or late May; make twisted mines; moult 5 times before leaving mines; pupate about 1 week underground in earthen cells in cocoons about ½ inch long
General behavior	Found as adults in large numbers only in autumn and spring when seeking or leaving hibernation; story of larvae interesting; of 107 earthworms examined, 74 had 87 larvae; earthworms not necessarily killed by maggots; adults eat fruits and plant sap; larvae found in some species of earthworms and not in others	Adults lay eggs in early spring; pupae, formed in early summer, may rest through winter, though in some cases there are a number of generations a year; maggots change skin twice in mine; mines generally twisted, though sometimes of the blotch type; rarely more than one mine to a leaf; some closely related species live in plant galls	Food, which is chewed, includes birch, willow, elm, and basswood; affected plants seem to have been struck by fire; may even be stripped of leaves; larva has habit of holding to plant by coiling end of body about it; may squirt liquid from glands in side if disturbed, probably as defense	Most habits are summarized above. The adults appear in early May and pupation just precedes this. Most conspicuously developed mines are found in early June when larvae are making their greatest growth; larvae enter soil about mid June but do not pupate until following spring
Reactions to heat, light, moisture, and chemicals	Larvae may possibly drown in water-soaked soil. At temperatures below 50° F., adults squeeze into crevices; above 50° they seek the light	Seasons affect generations considerably. In Florida, larvae continue growing through winter; in Arizona, until Christmas; the maggots are protected from drying by leaf surfaces	Since the larvae chew their food, a lead arsenate spray is effective control	Cell built by larva underground made of earth glued together and cemented with a waterproof cement; this is built during the drier part of the year; nicotine spray kills on hawthorn but not on cherry
Relation to man's interests	Disturbing and annoying in houses	Not of serious injury to the plants in which the larvae or maggots mine	A pest which may need control; interesting to test larvae to see how far they can shoot their defense liquid	About only effective control of cherry miner is the picking of mine-bearing leaves in early summer

ICHNEUMON FLIES *Megarhyssa lunator* (Fab.)	POLISTES WASPS *Polistes* sp.	WHITE-FACED HORNETS *Vespa maculata* L.	SMALL CARPENTER BEES *Ceratina dupla* Say
Large slender insects well over an inch long with dark patched wings; spindle legs; females with unique, long ovipositors, as long or longer than the rest of the insect	Medium-sized wasps, rather long, slender; brown with red spots on the abdomen and one or more yellow rings; females, with brown faces; males with white faces and longer antennae	Black with white markings on body and face as distinguished from yellow and black yellow-jackets; at rest wings fold lengthwise over back; queens, largest; drones, next; workers, smallest	Small, slender bees about ¼ inch long, with metallic blue bodies and rain bow tinted wings. The large carpenter bees are about the size of bumblebees which they also resemble
Frequently found alighted on tree trunks	About buildings, on the ground, and in various places	In various places particularly about the suspended nests; often about flowers in fall	Commonly in the pith of such plants as sumac, elderberry, or raspberry
A very large and widely distributed family of parasitic insects	A half-dozen species of Polistes in United States and about 50 in the world		Very common in almost any part of the United States
Closely related to species that frequently parasitize large caterpillars, covering their bodies with cottony cocoons; the species named lays eggs in wood in burrows of the destructive pigeon horn-tail grubs; the grub of the ichneumon fly attacks and kills the horn-tail grub; adult eats way free after pupation	Most closely related to hornets. Only females live through winter; in spring they build paper nests in cells of which eggs are laid and young reared; grubs develop head down in cells and are fed honey and insects by females; pupal stage passed in cells in cocoons spun by larvae. Mating occurs in fall	Related to ants and bees. Eggs laid by queens in nest develop in about a month; (egg stage 5 to 8 days; larva, 9 to 12 days; pupa 10 to 13 days); first produced are workers; then drones, then queens; all but drones, or males, hatch from fertilized eggs; all but females die in winter; females mate once, soon after emerging	Related to the bees and wasps. In early summer females hollow pith of shrub to make burrows; in these, each egg with a supply of pollen, is separated from others by a wall built by the females; larvae feed on pollen, pupate, and transform to adults, each emerging after the exit of those above; two generations a year
Cannot sting though it looks as if it might. Related species that parasitize exposed insects do not possess the long ovipositor	Polistes ordinarily is not vicious and, on occasion, may be safely handled; food not ordinarily stored, since young are fed as need exists; house of paper supported by a single stem and composed of a single unprotected layer of brood cells; females alone care for young	Feed upon nectar and insects, principally the latter; build paper nests of many layers of comb, the whole enclosed in a paper envelope which is torn down and enlarged as need develops; queens start nests and rear first workers but later abandon this to workers and spend time laying eggs	Females protect young and eggs in burrow in winter as well as in summer; one nest of carpenter bees may contain as many as 14 bees; nests may be confused with those of carpenter wasps that make partitions of mud instead of wood dust; carpenter-wasp females probably do not protect young thus
The ability of this insect to insert its slender ovipositor into solid wood makes the egg laying a process worth watching. Sometimes she becomes so firmly wedged that she cannot free herself	Females burrow in for winter while males remain active until killed by weather; nests are waterproofed by repeated application of new material "licked onto" surface until it appears varnished	Nests are kept clean at first by queens, then by workers, then by drones who also keep air circulating through nest	Nests serve as protection from inclement weather as well as from enemies
Very useful insect worthy ot all sorts of protection; close relatives equally valuable	Of some economic importance as destroyers of other insects; generally unduly feared	Of some use as destroyers of other insects; often become pests about apiaries where they kill honey laden bees	Of little economic importance; larger carpenter bees nest in solid wood and may do some damage, but help in pollination

This Week in Nature

THE Cornell Rural School Leaflet brings you a seasonal discussion, by times of the year, such as fall, winter, and spring.

But if you have a radio in your school, you can have a weekly reminder of objects and events to look for in field and forest during each current seven-day period.

Professor E. Laurence Palmer, supervisor of the Leaflet, talks to you for fifteen minutes

Every Wednesday

from quarter before twelve until twelve o'clock, noon.

He tells you of the weekly calendar, or log, which nature records for your wonder and enjoyment.

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