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INSECTS

INJURIOUS TO

FOREST AND SHADE TREES.

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INSECTS INJURIOUS TO FOREST AND SHADE TREES.

INTRODUCTION.

The design of this bulletin is to give to the public, especially those persons interested in forestry and the planting and cultivation of shade trees, a brief summary of what is up to this time known of the habits and appearance of such insects as are injurious to the more useful kinds of trees. It is hoped that such a compendium will be found useful, and lead the reader not only to refer to the works of Harris, Fitch, Walsh, Riley, Le Conte, Horn, LeBaron, Saunders, and others of our entomologists who have contributed to this neglected branch, but induce him to make careful observations on the habits of destructive forest insects and to carry on experiments as to the best remedies against their insidious attacks. The writer has added some notes of occasional observations made during the past twenty years in the forests of Maine and the woods of Massachusetts, as well as in Colorado, Utah, Montana, and on the Pacific coast, with a few original engravings; but the aim has been not so much to present original matter as to bring together from numerous entomological works, reports and journals and to present in a summary way, all that is of most importance to the practical man. It will be seen that really our knowledge of the subject is very scanty, and that the pamphlet is largely a simple list of the insects which live upon our more important forest trees. But the work may serve as a convenient synopsis, a starting-point, or handy book of reference for the use of future observers, and it is hoped that it will call the attention of the public to a neglected subject and stimulate entomologists and practical foresters and gardeners to do what they can to add to our knowledge of this department of applied or economic entomology.

The preservation of our forests and of old and valued shade trees in our cities and towns is a subject of pressing importance, and it is to be hoped that the government will foster private work and research in this direction. Next to the wanton destruction of forests by unthinking settlers and shiftless farmers, as well as fires caused by the sparks of locomotives, the attacks of injurious insects are most widespread and far reaching. Our forest and shade trees are yearly growing more valuable and indispensable, and at the same time the ravages of insects are becoming more widespread and noticeable. The diffusion of

a moderate amount of information upon the subject at the present time will attract the notice of the public and lead owners of land to pay a little attention to the subject and do something towards checking the ravages of noxious insects.

In France and Germany private persons, entomologists such as Perris in France, and especially Ratzeburg in Germany, have published beautifully illustrated general works of very great interest and value upon forest insects, and their works have done immense service in those countries, where an enlightened government and an intelligent people have felt the importance of building up schools of forestry and of making laws compelling due efforts towards repressing the more injurious forest insects.

Kaltenbach, in his work entitled "Die Pflanzenfeinde aus der Klasse der Insekten," or the Insect-enemies of Plants, has enumerated, in a closely-printed volume of 848 pages, the species of insects preying upon the different trees and plants of all sorts of Central Europe. The number of insects found upon some kinds of forest trees is astonishing, though it is to be remembered that all kinds are not equally destructive, the most injurious and deadly forms being comparatively few.

Kaltenbach enumerates 537 species of insects injurious to the oak, and 107 obnoxious to the elm. The poplars afford a livelihood to 264 kinds of insects; the willows yield food to 396 species; the birches harbor 270 species; the alder, 119; the beech, 154; the hazelnut, 97, and the hornbeam, 88. Coming to the coniferous trees, as the pine, spruce, larch, firs, etc., the junipers supply 33 species, while upon the pines, larch, spruce, and firs, collectively, prey 299 species of insects. In France Perris has observed over one hundred species either injurious to, or living upon without being especially injurious to, the maritime pine. These are described in an octavo volume of 532 pages, with numerous plates.

The number as yet known to attack the different kinds of trees in the United States may be seen by reference to the following pages. It is sufficiently large to excite great fears for the future prosperity of our diminished forests, unless the government interposes, and through the proper channels fosters entomological research in this direction. Our forests, moreover, are much richer in species of trees than those of Europe. We have, without doubt, on the trees corresponding to those of Europe as many destructive species as in Europe. But we have many more shade and forest trees of importance in the Eastern United States alone, and when we add to these the forest trees of the Western Rocky Mountain plateau and of the Pacific coast, and when we look forward to the attention which must be given in the immediate future to the planting of shade and forest trees on the great plains and in California, the subject of forest entomology assumes still more importance.

The author has here arranged the forest trees in the order of their importance, beginning with the hard-wood or deciduous trees, the oak

heading the list, and ending with the coniferous trees; and under each tree he has first described the habits of the insect on the whole most injurious, often merely giving a list of those insects found to be regular parasites of the tree but not specially injurious; but it should be borne in mind that any species of insect may at certain seasons so abound as to prove destructive.

This bulletin will be sent to entomologists and others who are interested in insects preying upon our shade and forest trees, or who are engaged in rearing coleopterous or lepidopterous larvæ, with the hope that they will aid the author by the communication of notes and specimens; or send the results of their discoveries for publication to some entomological journal. Insects in the larva and pupa stages may be put into alcohol, while the adult beetle or moth may be pinned, or enclosed in a tin box and the latter sent by mail; alcoholic specimens accompanied with the wood or bark or fruit infested, could be sent by express. Specimens showing the mines or burrows, or pressed and dried leaves containing the mines of leaf-borers, or twigs injured by twig borers, would be welcome. For purposes of full description and illustration coleopterous larvæ, as well as caterpillars, should be placed at first in weak alcohol, and after forty-eight hours transferred to alcohol of full strength. It is the writer's hope that the government may be ultimately induced to order the publication of an extended report, with the necessary illustration, upon forest insects, and any aid rendered in the preparation of such a volume would be appreciated and fully acknowledged. The author will be thankful for the correction of errors or omissions in this work. For valuable information regarding the food-trees of a number of beetles hitherto unpublished he is indebted to Mr. George Hunt, of Providence, R. I., and for aid in collecting specimens he would acknowledge the assistance received from Mr. Edwin C. Calder, assistant instructor in chemistry, Brown University, and Mr. H. C. Bumpus, a member of the sophomore class of Brown University.

INSECTS INJURIOUS TO THE OAK.

(Various species of *Quercus*.)

AFFECTING THE ROOTS.

The roots of various species of oak are, without much doubt, more or less injured by the attacks of the seventeen-year Cicada while in its preparatory state; as it is known that this insect, so abundant in the central and southern States of the Union, remains for over sixteen years attached by its beak to the rootlets of the oak and probably other forest trees, where it sucks the sap, thus in a greater or less degree injuring the health of the tree. Observations as to the subterranean life of the seventeen-year locust are few and obscure, and it is quite uncertain how much injury is really done to trees by this habit. They have sometimes been found sucking the sap of forest trees, notably the oak,

and also of fruit trees, such as the pear and apple. According to Riley (First Report, p. 24), the larvæ are frequently found at great depth, sometimes as much as ten feet below the surface. It has been claimed by Miss Margaretta H. Morris, in an account published in 1846, that pear trees have been killed by the larvæ sucking the roots. This has been denied by the late Dr. Smith of Baltimore, who says:

> The larva obtains its food from the small vegetable radicals that everywhere pervade the fertile earth. It takes its food from the surface of these roots, consisting of the moist exudation (like animal perspiration), for which purpose its rostrum or snout is provided with three exceedingly delicate capillaries or hairs, which project from the tube of the snout and sweep over the surface, gathering up the minute drops of moisture. This is its only food. The mode of taking it can be seen by a good glass.—*Prairie Farmer*, December, 1851.

Mr. Riley adds that Dr. Hall, of Alton, Ill., has often found them firmly attached to different roots by the legs, but never found the beaks inserted. He remarks as follows:

> The fact that they will rise from land which has been cleaned of timber, cultivated, and even built upon for over a dozen years, certainly contravenes Miss Morris's statement, while their long subterranean existence precludes the necessity of rapid suction. It is also quite certain that if they thus killed trees we should oftener hear of it, and I have captured a gigantic but unnamed species of Cicada on the plains of Colorado, 50 miles from any tree other than a few scattering willows.

We would add that in June, in Idaho Territory, we have seen numerous Cicadæ which had just appeared above the surface of the earth in a desert region with scattered sage bushes, upon whose roots, which it is known descend to a great depth, the young may feed. While, then, the Cicada may seldom do marked injury to the oak, the reader is referred to page 35 for a further notice of the injury done by this insect to the twigs and smaller branches of the oak and other trees.

In Europe the roots of oaks are affected by a small wingless gall-fly, which punctures the root and inserts an egg into the hole. The irritation thus set up causes the root to swell until a tumor or gall is formed, in the center of which lies the white footless larva or maggot of the fly.

Fitch has found similar wingless flies in this country, but they will always remain objects rather of a scientific than economic interest. He has described them under the names of *Biorhiza nigra*, *Cynips* (*Philonix*) *fulvicollis* and *nigricollis*. They are wingless, and occur in forests in November and December, often walking on the snow in company with other snow insects, such as Boreus and Chionea.

AFFECTING THE TRUNK.

1. The locust carpenter moth.

Xyleutes robiniæ Harris.

Order Lepidoptera; Family Bombycidæ.

> Boring large holes and galleries in the trunk; a large livid reddish caterpillar, nearly three inches long, greenish beneath, and the head shining black; the body somewhat flattened, and with scattered long fine hairs. The chrysalis also in the burrow, and transforming to a large thick-bodied moth in June and July.

In different parts of New England, from Maine to Rhode Island, and

southward to Texas, oak lumber and cord wood is commonly seen to be often honeycombed by the large black burrows of this common and destructive borer. It is the most directly injurious of all the insects preying on this noble tree, since it sinks its tunnels deep in towards the heart of the tree in the living wood, and is a difficult insect to discover until after the injury is done. It may be found in the autumn and winter months, of different sizes, showing that at least there is an interval of one year between the smaller and larger sizes, and that consequently the moth is two years in attaining maturity.

The female moth, without doubt, lays her eggs in the cracks and interstices of the bark of the oak or locust, in the latitude of Boston, about the middle of July.

I have taken the larvæ and chrysalis from the red oak in Maine, and the insect occurs westward to the Mississippi Valley and southward to Bosque County, Central Texas. At Houston, Texas, I have found a dozen or more of the cast chrysalid skins projecting from a stump of the pin oak; one pupa was alive early in April. It is said by Fitch to be more common in the southern and southwestern States than in the northern. It is also an inhabitant of California, and may be found to occur in nearly all the United States wherever the black, red, and white oak or locust trees grow. The habits and metamorphoses of the moth were first discovered by Peck,* who bred it from caterpillars found in the locust, but Harris afterwards discovered that it "perforates the trunks of the red oak."

The following account of its habits and transformations is copied from Fitch:

Of all the wood-boring insects in our land this is by far the most pernicious, wounding the trees the most cruelly. The stateliest oaks in our forests are ruined, probably in every instance where one of these borers obtains a lodgment in their trunks. It perforates a hole the size of a half-inch auger, or large enough to admit the little finger, and requiring three or four years for the bark to close together over it. This hole running inward to the heart of the tree, and admitting the water thereto from every shower that passes, causes a decay in the wood to commence, and the tree never regains its previous soundness. †

This is also a most prolific insect. The abdomen of the female is so filled and distended with eggs that it becomes unwieldy and inert, falling from side to side as its position is shifted. A specimen which I once obtained, extruded upwards of three hundred eggs within a few hours after its capture, its abdomen becoming diminished hereby to nearly half its previous bulk; and in the analogous European species more than a thousand eggs have been found on dissection. It hence appears that a single one of these insects is capable of ruining a whole forest of oak trees. This calamity, however, is prevented, probably by most of the eggs being destroyed, either by birds or by other insects, for these borers are by no means so common in our trees as the fecundity of their parents would lead us to expect.

Our moth comes abroad, as already stated, in June and the forepart of July. It flies only in the night time, remaining at rest during the day, clinging to the trunks of

* Mass. Agr. Report and Journal, vol. v, p. 67, with a plate, 1818.

† We have observed that the old burrows are lined by a dark layer, consisting of a mealy débris about as thick as pasteboard; this detritus is probably composed of the castings of the larva, forming a paste which in drying strongly adheres to the sides of the gallery.—A. S. P.

trees, its gray color being so similar to that of the bark that it usually escapes notice. In repose its wings are held together in the shape of a roof, covering the hind body. From observing her motions in confinement, I think the female does not insert her eggs into the bark, but merely drops them into the cracks and crevices upon its outer surface. They are coated with a glutinous matter which immediately dries and hardens on exposure to the air, whereby they adhere to the spot where they touch; and if the short two-jointed ovipositor be not fully exserted as the egg is passed through it, so as to carry the egg beyond the hair-like scales with which the body is clothed, some of these touching adhere to it, their attachment to the body being so slight.

The eggs are of a broad oval form, and about half the size of a grain of wheat, being the tenth of an inch in length and three-fourths as thick, of a dirty whitish color with one of the ends black. When highly magnified their surface is seen to be reticulated or occupied by numerous slightly impressed dots arranged in rows like the meshes in a net. From the fact that several worms of the same size are sometimes met with in a single tree, indicating them all to be the progeny of one parent, it appears that the female drops a number of eggs upon each tree that she visits, and probably disposes of her whole supply upon a very few trees. The size of the eggs doubtless renders them a favorite article of food to some of our smaller birds. And a bird in discovering some of these eggs will be incited thereby to search for others in the same vicinity, which search being successful, will be perseveringly continued so long as an egg can be found upon that or any of the adjacent trees. Thus it may be that of the whole stock of eggs which a female deposits, scarcely one escapes being picked up and devoured. This appears the most probable cause of so few of these worms being met with, although the females are so prolific.

The worm on hatching from the egg sinks itself inward and feeds at first on the soft inner bark, till its jaws acquiring more strength it penetrates to the harder sap-wood and finally resorts to the solid heart-wood, residing mostly in and around the center of the trunk, boring the wood here usually in a longitudinal direction, and moving backwards and forth in its burrow, enlarging it by gnawing its walls as it increases in size, whereby the excavation comes to present nearly the same diameter through its whole length. In an oak in which I met with two worms fully grown and several others but half grown, the whole of the central part of the trunk had been extensively mined by preceding generations of this insect and was in a state of incipient decay; and I thus had an opportunity to notice the fact that none of the worms were lying in the decaying wood, all being outside of this, where the wood was still sound. Hence it is evident that it is living healthy trees which this insect prefers, and not those which are sickly and decaying, which latter are preferred by the European Cossus, some authors say, though perhaps their observations have not been exact upon this point, for in the instance here alluded to it would have been said on a first glance that these worms preferred decaying wood, since the diseased heart of the tree was everywhere traversed with their burrows, and the sound wood showed few of them; and thus no doubt in many other cases we mistake the cause for the effect, and on seeing semi-putrid wood filled with worm-holes we suppose the worms have preferred wood of this character, when in truth it is these holes which have caused the decay of the wood.

These worms are probably three years in obtaining their growth. They cast off their skin several times, and after the last of these moultings their color becomes different from what it has previously been.

The larva previous to the last change of its skin is of a rose-red or a pale cherry-red color, often with a faint yellowish stripe along the middle of its back, on all except the three anterior rings. It is of a cylindrical form, slightly broadest anteriorly and a little flattened beneath. It is divided by transverse constrictions resembling broad shallow grooves into twelve rings, which are twice as broad as long. On each of these rings are a few pimples of a deep purple color, regularly placed, each

giving out a pale-brown bristle. Four of these pimples are on the back, placed at the angles of an imaginary square or a trapezoid having its hind side the longest, the two hinder pimples being larger. Small white dots confluent into broken lines may also be perceived, forming a transverse square in which the two anterior pimples are inclosed, and other dots less regularly placed, surrounding the two hind pimples except upon their hind side. Above the breathing pores on each side is also a large pimple, which, upon the four rings bearing the pro-legs, has a white dot in its lower edge, which dot does not appear in the corresponding pimples of the other rings. A minute pimple is also seen forward of the upper end of each breathing pore, below which all the under side of the worm is greenish white. The breathing pores are oval and light yellow, with a rusty brown oval spot in their center and a dark purple ring around their outer edge. Below them the skin bulges out, forming a longitudinal ridge, or rather two parallel ridges divided by a deep intervening furrow. Upon the upper one of these ridges near the middle of each ring is a round cherry-red spot in which are two small pimples, and on the lower ridge is a single one, placed farther back, whilst four others, equally minute, may be seen farther down and around the anterior base of the pro-legs. The second and third rings are shorter, each with fourteen pimples of different sizes, the larger ones forming a single transverse row. The first ring or neck is polished and of a dark tawny brown color on its upper side, with a white line in its middle disappearing anteriorly in a black two-lobed cloud. The head is but half as broad as the body, and is of a shining black color, tinged more or less with chestnut brown in its middle, with scattered punctures from which arise fine hairs. The antennæ are chestnut brown, conical and three-jointed, the last joint minute, with a bristle beside it given out from the apex of the second joint. The palpi are similar, with two small processes from the summit of their second joint, the outer one of which ends in a minute fourth joint. Of the eight pairs of legs, the three anterior are conical and end in a single chestnut-colored claw. The others are short, thick, and retractile, with their soles surrounded by a blackish fringe-like ring composed of a multitude of minute hooks, the last pair, however, having these hooks only around the anterior and outer half of their soles. Placed in a glass or tin vessel, this worm is perfectly helpless, being unable to cling with these hooks to a hard smooth surface.

With the last change of its skin it loses its bright-red color, and is then white, tinged with green at the sutures, and with a pale-green stripe along the middle of its back, which disappears at the sutures. The pimples are of a pale tawny yellow color with black centers. The head is light tawny yellow varied in its middle with greenish white, its anterior edge blackish and the jaws deep black.

As the moth into which this worm changes possesses no jaws or other implements by which it is possible for it to perforate the wood, it is necessary for the worm to prepare a way for its future escape from the tree; and the provisions which it makes for this end are truly interesting, indicating that the worm has a clear perception of what its future condition and requirements will be, both in its pupa and its perfect state. This is the more surprising when we recur to the fact that since its infancy this creature has been lying deeply bedded in the interior of the tree, the only act of its life having been to crawl lazily around in its cell and gnaw the wood there when impelled by hunger. How does it now come to do anything different from what it has been doing for months and years before? But, having got its growth and the time drawing near to have it change into a pupa or chrysalis, we see it engaging in a new work. It now bores a passage from the upper end of its cell, outward through the wood and bark till only a thin scale of the brittle dead outer bark remains. It is usually at the bottom of one of the large cracks or furrows in the bark that this passage ends, whereby the hole inside is less liable to be discovered by birds. The worm then diligently lines the walls of this hole with silken threads interspersed with its chips and forming a rough surface resembling felt, as it withdraws itself backwards for a distance of about three inches, thus placing itself beyond the reach of any bird or other

enemy outside of the tree, should its retreat be discovered; and it here incloses itself in a cocoon which it spins of silk, of a long oval form, having the end towards the outer opening much thinner and its threads more loosely woven. In this cocoon it throws off its larva skin and then appears in its nymph or pupa form.

The pupa is an inch and three-quarters long and half an inch thick, of a dull chestnut color, the rings of its abdomen paler, and on the back near the anterior edge of each ring is a row of angular teeth, resembling those of a saw, of a dark brown color and all of them inclining backward, these rows of teeth extending downwards upon each side below the breathing pores or about two-thirds of the distance around the body. On the middle of each ring is also a much shorter row of little tubercular points. Finally, upon the under side of the last segment are about four stouter conical teeth, the tips of which are drawn out into sharp points which are curved forward, so that when this last segment, which is tapering and smaller than the others, is bent downwards, these curved points will catch and hold the body from moving forward.

The pupa lies perfectly dormant in its cocoon probably a fortnight or longer. It then awakes from its slumbers and begins to writhe and bend itself from side to side. By this motion the rows of little teeth upon the rings of its abdomen, which incline backward as above described, catch in the threads of the cocoon, first upon one side and then upon the other, and thus move the body forward, whereby its head presses upon the loosely woven end of the cocoon, more and more firmly, until it forces its way through it, and the pupa works itself forward out of its cocoon. And the same writhing motion being continued, the teeth now catch in the threads with which the sides of the hole are lined, and thus, though destitute of feet, the pupa moves itself along till it reaches and breaks through the thin scale of bark which hitherto has closed the mouth of its burrow, and pushes itself onward till about three-fourths of its length protrude from the tree, when by curving the tip of its body downward the four little hooks thereon catch in some of the threads and hold it from advancing further and falling to the ground. By so much motion of the pupa the connections of the inclosed insect with its shell become sundered and the sutures of the shell are probably cracked open, so that the moth readily presses them apart and crawls out therefrom, leaving the empty and now lifeless shell projecting out from the mouth of the hole, with a small mass of worm-dust surrounding it.

The male moth is of a gray color from white scales intermixed with black ones. The *head* is furnished upon the crown, or vertex, with longer or hair-like scales. The antennæ are tapering and many-jointed, their basal joint thickest and covered with black and gray scales, the remaining joints being naked, shining, coal-black, each joint bearing two branches on its front side, forming two rows of coarse teeth like those of a comb, the teeth being six or more times as long as thick, and all of the same length except at the base and tip, where they become shorter, all of them ciliated with fine hairs. The feelers are appressed to the face and reach as high as to the middle of the eyes, and are cylindric, clothed with short appressed scales, the separation of the terminal joint being slightly perceptible. The *thorax* has the shoulder-covers black, forming a stripe of this color along each side, which anteriorly curves downwards and is continued backward upon the upper side of the breast. Its base is clothed with larger scales, forming tufts upon each side. The *abdomen* is conic and equals the tips of the wings in its length, and is but slightly covered with scales except along each side, where they form a broad stripe, the under side being entirely denuded; it is black and shining, with the sutures dull yellowish. At its tip are three appendages, longer than the last rings of the abdomen. The two lower ones are broad, thick, flattened processes of a dull brownish yellow color, with their tips rounded and slightly bent inwards towards each other. The upper one is a slender, black, shining hook or claw of the same length, its tip sharp-pointed and curved downward. Above these appendages and hiding them from view is a brush of black hairs, forming a conical tuft at the end of the abdomen, blunt at its apex. The *legs* are more or less denuded of scales, black and shining, with the hind shanks thicker towards their tips

and with two pairs of spurs, the forward shanks having only a single spine, which is placed on the middle of their inner sides, the same as in other moths; and the feet are compressed, and five-jointed, with the basal joint longest and the following ones successively shorter. The *fore wings* are black, with groups of whitish scales forming gray spots or clouds which are netted with black lines, varying greatly in different individuals. Often a transverse gray spot is situated towards the base and another on the anal angle, the outer and hind margins being gray alternated with black. The *hind wings* are black, with their posterior half of a rich marigold yellow color bordered with a black line upon the hind margin, the yellow color being irregularly notched on its anterior side and narrowed to the inner angle, and not extended to the outer angle, the two outer cells being black. The outer or anterior margin, except at its base and tip, is usually gray alternated with transverse black streaks and blotches, and inside of this is a large ash-gray spot occupying the outer anterior part of the disk. The under sides of both wings is similar to their upper surface.

The female would not be supposed to pertain to the same species with the male, her size is so much larger, her colors so much paler gray, and her hind wings being wholly destitute of the bright yellow coloring which forms so conspicuous a mark in the other sex. The branches of her antennæ are also shorter, being but about four times as long as thick. The ground color of her fore wings is gray, variously netted with black lines dividing the gray in places into small roundish spots and into rings having black centers. The black color usually forms a broad irregular band across the middle of the wings parallel with the hind margin, and another between this and the hind edge, chiefly on the outer half of the wing, the hind edge and fringe being whitish alternated with black spots placed on the tips of the veins. The hind wings are dusky gray and towards their bases blackish, their posterior half being freely transparent and faintly netted with darker lines. The body is densely coated with gray scales, its under side hoary white; and the legs are gray, with black bands on the shanks, and black feet, with gray rings at their articulations.

Remedies.—We have but a single suggestion to make upon the subject of remedies against this truly formidable though fortunately rare enemy. It is probable that soft scap applied the fore part of June to the bodies of trees will be equally efficacious against this and other borers as it is against that of the apple tree. This remedy may well be resorted to, to protect the locusts and oaks which we value as ornamental trees; and scarce and valuable as timber is becoming in all the older settled sections of our country, I doubt not it will be found to be good economy to bestow similar attention upon the more valuable trees standing in our forests.

It should also be observed that whenever a hole made by a borer is discovered in the trunk of a tree, it should be immediately closed by inserting a plug therein, to exclude the wet which will otherwise be admitted hereby to the interior of the tree and produce a decay of the surrounding wood.

2. The oak cossus.

Xyleutes (*Cossus*) *querciperda* Fitch.

Order Lepidoptera; Family Bombycidæ.

Another and rather smaller borer, but belonging to a closely allied species, was found by Mr. J. A. Lintner resting upon the trunk of an oaktree in Schoharie, N. Y. It probably ranges all over the Eastern States and Mississippi Valley, since a species, either this or closely allied, is reported to us by Mr. G. W. Belfrage to inhabit Central Texas. Dr. Fitch thinks it probable that it bores into the oak. He describes it as a moth smaller in size than *X. robiniæ*, with thin and slight transparent

wings which are crossed by numerous black lines, the outer margin only of the forward pair being opaque and of a gray color; the hind wings of the male are colorless, with the inner margin broadly blackish and the hind edge coal-black.

3. The red-oak flat-headed borer.

Chrysobothris dentipes Germar.

Order Coleoptera; Family Buprestidæ.

Eating a slender, winding, broad, shallow burrow between the bark and sap-wood of newly-felled oak trees; a white, footless grub, with the fore part of the body enormously large, circular, and flattened, inclosing the small head in front.

This singularly-shaped borer is often found under the bark of newly-felled oaks, or those which have been prostrate for a longer time. The one here roughly figured occurred with others under the bark of the red oak at Salem, Mass., early in May, in company with more numerous individuals of *Magdalis olyra*, a small weevil also common in the Northern States, under the loosened, partly decayed bark of the oak.

It will be seen by the form of this singular borer that it is adapted for a life under or next to the bark of diseased trees, as it is quite unfitted, by reason of the enormously swollen front rings of the body, for boring very far into the living fresh wood, as is the case with the oak-boring caterpillar of *Xyleutes robiniæ*, or the oak pruner (*Stenocorus putator*). With its short, powerful jaws it can eat its way on either side in front of it, after hatching from the egg which is probably laid by the parent beetle in some crack in the bark. Its head is rather small and partly sunken within the segment next behind the head. This segment, destined to be the prothorax of the beetle, is remarkably broad, nearly three times as much so as the hinder segments, and fully as broad again as it is long, while the surface above is flat and more or less rough or pitted in the middle. With this unusual form it can eat its way in a serpentine course under the bark, deriving its nourishment from the sap-wood next to the bark. Owing to the form of its body in front, the burrow is shallow and broad, in transverse outline oval cylindrical. The body of this as well as most other borers is provided with fine, delicate, scattered hairs, projecting on each side of each segment. Judging by analogy, these hairs are probably provided each with a fine nerve (though this remains to be proved), and probably are endowed with a delicate sense of touch, useful to the insect as it moves to and fro in its gallery. The Buprestid larvæ are blind, without simple eyes, since living as they do in total darkness and never coming to the light they do not need even the simple eyes present in many other larvæ, and which are probably chiefly of use in enabling the insect to distinguish light from darkness.

Fig. 1. Supposed larva of *C. dentipes*, enlarged. —From Packard.

The larvæ of the *Buprestidæ* and the breeding habits of the beetles

have not as yet been carefully studied in America, and for any exact knowledge we have to go to French and German authors.

According to Perris, the Buprestids couple in the usual manner, the male mounting upon the back of the female, the act of copulation not being of long duration.

The form of the eggs and their size in our species are unknown, or have not been stated in print. It is most probable that the female lays them in the bottom of cracks in the bark, or under the partly loosened bark at least, where the larva upon hatching may find itself next to or immediately in contact with the bast or the sap-wood, which probably forms the greater part of its food, though Ratzeburg has found that the "frass" or excrement is colored by the bark, which indicates that the larvæ feed both on the bast and bark. As to the number of eggs laid by the female we have no information. The eggs are deposited in fissures or cracks by means of the extensile end of the body. As Westwood states, "The abdomen appears to be composed of only five segments. The remainder are, however, internal, and constitute in the female a retractile, corneous, conical plate, employed for depositing the eggs in the chinks of the bark of trees within which the larvæ feed." Perris, however, says that "the eggs are deposited in the interior of the bark, the outer layers of which the ovipositor of the female penetrates."

It has been claimed by Ratzeburg and also by Reifsig* that the European larvæ of Buprestis and the numerous allied genera, such as Chrysobothris, Chalcophora, &c., attain their full size in two years; but according to Perris the time required for transformation is but a single year, as may be seen by the extracts from his work further on.

As regards the habits of the larvæ we have no direct observation on the young of this family in this country, though much needed in connection with the use of remedial measures.

Mr. E. Perris, in his invaluable work, entitled "Insectes du Pin maritime," says of the larva of the European *Ancylocheira flavomaculata*:

> The larva of the *A. flavomaculata* lives in the wood of old pines recently dead, and especially in the larger branches and the large twigs (*pieux*). It is, indeed, under these two last conditions that they oftenest occur. It does not stop in the bark, because it is in the interior of the bark that the female lays its eggs, by means of its oviduct, and after its birth it plunges into the wood to the depth of about a centimeter [nearly two-fifths of an inch]. It follows the longitudinal fibers of the sap-wood while making a gallery elliptical in section, which it leaves behind it completely filled and packed with excrement and detritus. When the time of its metamorphosis approaches it goes towards the surface of the sap-wood, perforates it to the bark, sometimes makes a small incision into the latter, stops up the gallery with a plug made entirely of small, compacted chips; then it retires backward a little into a cell scooped out in the wood, and this is where it transforms into a pupa.

The following extract from Perris refers to the habits of *Chrysobothris solieri*, which also lives on the maritime pine in France. The habits of

*Ratzeburg's Die Waldverderbniss, &c., ii, p. 360.

our *C. dentipes* of the oak, and *C. femorata* of the oak and different fruit trees, and *C. harrisii* of the white pine are probably quite similar.

According to my observations the Chrysobothris only lays its eggs on the trunks of pines from five to fifteen centimeters in diameter at the base, and on the branches of old trees. I have never found it on an old trunk, and when a large prostrate pine is deprived of its branches it is on them that it lives, and not on the trunk. I have already said that the larva lives at first under the bark; it there busies itself, sometimes attacking very plainly the sap-wood, sometimes boring a sinuous gallery, which it leaves behind it filled with white chips and excrements of a brownish red; but at the approach of winter it burrows into the wood, where it gouges out a gallery elliptical in section, the dimensions of which increase as its body grows larger. When the moment of transformation has arrived it returns into its gallery, and undergoes its metamorphosis sometimes more than two centimeters from the surface, because I have found some pupæ and perfect insects at this depth.

Perris calls attention to the fact that though the Buprestid beetles stand quite high in the Coleopterous series, yet their larvæ have an organization inferior to that of all other Coleopterous larvæ known. Thus, they have neither feet nor eyes, and there are no other Coleopterous larvæ which, as in the Buprestids, have very rudimentary labial palpi, and which consist of less than two joints.

The burrows of the Buprestid larvæ may nearly always be distinguished, says Perris, by their tortuous course, and by the fact that the excrement and detritus, instead of being accumulated in the gallery without order, are there disposed in small layers forming concentric arcs, whose opening is turned away from the larva, and of a regularity not less remarkable than characteristic.

This symmetrical arrangement has as its primary cause the dimensions of the gallery, which are out of proportion with the abdomen of the larva. The latter, because of the size of the anterior portion of its body, is obliged to give to its gallery a size sufficient for the posterior part to execute freely movements of advance and retreat, which have as their natural result the disposition *en arc* of the rejected material behind. On the other hand, the larva, in consequence of the dimensions of its gallery, in order to have points of support is obliged to bend the posterior part of the body on itself. It is, indeed, ordinarily found in this attitude, which allows it to press against the walls, so as to push itself ahead; but in this condition the abdomen forms an arc which, propping itself from the convex side on the detritus, causes the concavity of the successive beds. * * *

We have seen that some Buprestid larvæ undergo their metamorphoses in the interior of the bark, others in the thickness of the wood. It is, moreover, in this that the wisdom of nature is revealed, for it is not capriciously and without motive that things happen as I have described. We know, indeed, that if those larvæ which do not attack the young trees, as those of *Ancylocheira 8-guttata*, of *Chysobothris solieri*, and of *Anthaxia morio* and of several species of *Agrilus*, should live under the bark they would not be sufficiently protected, because the bark is not thick enough and would easily separate from the wood. When, however, on the contrary, they live under the hard and thick bark of old trees, as *Melanophila tarda*, *Chrysobothris affinis*, *Agrilus biguttatus*, and *4-guttatus*, and others, they do not hesitate to take refuge in the bark, because they are there well sheltered, and because they save the beetle from making a long and difficult journey in order to make its exit. * * *

What is the duration of the life of the larvæ of the *Buprestidæ?* Ratzeburg is

inclined to believe that it is two years. M. Levaillant, whose observations are reproduced by M. Lucas in his notice of Chalcophora, is also disposed to think that those of this insect pass two years in the wood. The reason which he gives, and which is drawn from the size of the larvæ found from December to August, does not seem to me conclusive, because the female of Chalcophora is capable of laying eggs during almost the entire year. As to M. Ratzeburg, he has not, apparently, made careful observations in this respect.

As to myself, numerous facts authorize me to say that, in general, these larvæ only live one year. For example, some pines, poplars, and willows which I have cut down in the spring time with the design of obtaining Buprestids, have afforded me often very numerous perfect insects in May and June of the year following.

Some logs of oak, cut in January, 1847, and which lay during a whole year in the open air, furnished me in June and July, 1848, more than three hundred *Chrysobothris affinis*. The trunks of some large, very rigorous pines, cut down at the beginning of one year, contained pupæ of Ancylocheira in the following May. Finally, as regards all the species that I have here described, and for a number of others, I have, from my own experience, the certainty that the larvæ live only one year.

I admit that, without doubt, among these larvæ there are some which, not placed in conditions sufficiently favorable to complete during this period all the phases of their existence, and which, from one cause or another, may be retarded some months, for a year, even. I moreover accept the more willingly this fact, because I have had good occasions for observing this in larvæ which I have raised in my cabinet; but this is the exception, and the rule is that a single year suffices, in our country, for the development of the larvæ of the Buprestidæ.

The Buprestids in the perfect state love the daylight and sunshine. Before storms, when the air is calm and heavy and the sun is hot, they have an extraordinary activity; and when the weather gradually becomes cloudy and the wind rises they disappear from our sight. We know but little as to the nature of their food. *Chalcophora mariana* devours the young shoots of pines, *Anthaxia morio* and *chevrierii* eat, the first the petals of buttercups, the second those of *Cissus alyssoides*. Other Anthaxiæ, also, as well as Trachys, frequent different flowers. *Aphanisticus emarginatus* occurs on rushes (*joncs*), and I have sometimes taken *Acmæodera taniata* on the flowers of carrots. All these facts lead me to think that the Buprestids are phytophagous; but it appears that certain species are, accidentally at least, carniverous. This appears from a communication made by M. Léon Fairmaire to the Société Entomologique, in its session of January 10, 1849, relative to the subject of *Chrysobothris solieri*.

Regarding our oak borer (*C. dentipes*), Harris states that it completes its transformations and comes out of the trees between the end of May and the first of July. This applies to Maine and Massachusetts. In New York, according to Dr. Fitch, the beetles are "often found basking in the sunshine on the bark of the trees in June and July."

We have found the mines of a Buprestid borer under the bark of the hemlock, with exactly the arrangement in concentric arcs of the castings described on p. 14.

The beetle.—This insect is so named from the little tooth on the under side of the thick fore legs. It is oblong, oval, and flattened, of a bronzed brownish or purplish-black color above, copper-colored beneath, and roughlike shagreen, with numerous punctures; the thorax is not so wide as the hinder part of the body; its hinder margin is hollowed on both sides to receive the rounded base of each wing-cover, and there are two smooth elevated lines on the middle; on each wing-cover there are three irregular, smooth, elevated lines, which are divided and interrupted by large thickly-punctured impressed spots, two of which are oblique; the tips are rounded. Length from $\frac{1}{2}$ to $\frac{5}{6}$ of an inch. (Harris.)

4. The apple flat-headed borer.

Chrysobothris femorata Fabricius.

Order Coleoptera; Family Buprestidæ.

Boring under the bark and in the sap-wood of the white oak, and in the Gulf States, the pin oak; a pale-yellow flat-headed grub, closely resembling the preceding species

This pernicious borer of the apple tree, as stated both by Harris and Fitch, originally infested the white oak, but since the settlement of the country has abounded in the apple and sometimes in the peach, though it may still be found to injure the white oak.

Fig. 3 will fairly represent the "mine" or gallery made under the bark of a stump of the white oak, as it occurred at Providence, R. I. The worm soon after hatching made the mine as is seen on the right of the figure, where after a sinuous course it opens into a broad shallow cell, and then after pursuing an irregular direction dilates on the left into a broad shallow cell two-thirds of an inch wide, the oval black spot in the upper right corner representing the hole made by the larva for the exit of the beetle. In this hole the beetle was found. The large cell is for the repose of the pupa.

At Houston, Texas, I found the larva and pupa in abundance, April 2, 1881, under the bark of large pin oak stumps, and of dead trees. The burrows were like those represented in Fig. 3, being irregular winding shallow burrows, not nearly so definite in outline as those made by longicorn borers. The mine is about $\frac{1}{5}$ inch wide, and terminates in a broad irregular oval cell $1\frac{1}{2}$ inches long and $\frac{1}{4}$ to $\frac{2}{3}$ inch wide. In this cell the pupa spends the winter and early spring. One end of this cell lies toward the outer side of the bark, so that even if there is not a clearly defined oval opening as in Fig. 3, the beetle on emerging from the pupa state can with little difficulty extricate itself from its cell and make its way out of doors by pushing aside a thin barrier of bark. In the case of one mine in the pin oak there was a quite regular oval cell built up by the larva between the wood and the bark, the partition consisting of a composition of fine bark dust, thus forming a rude cocoon. The insect occurred at Providence in the larva, pupa, and beetle states May 20, though the larvæ were the most abundant.

Harris says of it from his observations in Eastern Massachusetts:

> Its time of appearance is from the end of May to the middle of July, during which it may often be seen, in the middle of the day, resting upon or flying round the trunks of white-oak trees and recently-cut timber of the same kind of wood. I have repeatedly taken it upon and under the bark of peach trees also. The grubs or larvæ bore into the trunks of these trees.

The following extracts from Dr. Fitch's first report will further serve to characterize the habits and appearance of this formidable pest of our most valuable forest, shade, and fruit trees. It will appear that Dr. Fitch has been the first to discover an ichneumon parasite in the larva

of this beetle, no European Buprestid beetle being, so far as we know, infested by internal parasites:

Another insect, which has not heretofore been noticed in our country as a borer in the apple tree, pertains to the family *Buprestidæ*, or the brilliant snapping beetles. Mr. P. Barry, of the Mount Hope nurseries, Rochester, has forwarded to us sections of the body of some young apple trees, which were sent to him from a correspondent in Hillsborough, in Southern Ohio, who states that in that vicinity the borer, which is contained in the specimens sent, is doing great damage to the apple trees, and that he has had peach trees also killed by this same worm. From an examination of these specimens, it appears that this insect is quite similar to the common apple-tree borer in its habits. The parent insect deposits its eggs on the bark, from which a worm hatches, which passes through the bark and during the first periods of its life consumes the soft sap-wood immediately under the bark. But when the worm approaches maturity and has become stronger and more robust, it gnaws into the more solid heart-wood, forming a flattish, and not a cylindrical hole such as is formed by most other borers, the burrow which it excavates being twice as broad as it is high, the height measuring the tenth of an inch or slightly over. It is the latter part of summer when these worms thus sink themselves into the solid heart-wood of the tree, their burrow extending upwards from the spot under the bark where they had previously dwelt. On laying open one of these burrows I find it is more than an inch in length, and all its lower part is filled and blocked up with the fine sawdust-like castings of the worm. Thus, when the worm is destined to lay torpid and inactive during the long months of winter, it has the forethought, so to speak, to place itself in a safe and secure retreat, within the solid wood of the tree, with the hole leading to its cell plugged up so as effectually to prevent any enemy from gaining admission to it.

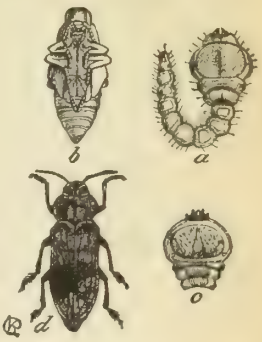

FIG. 2.—*a*, The apple flat-headed borer; *b*, pupa; *c*, under side of head and thoracic rings; *d*, beetle.—After Riley.

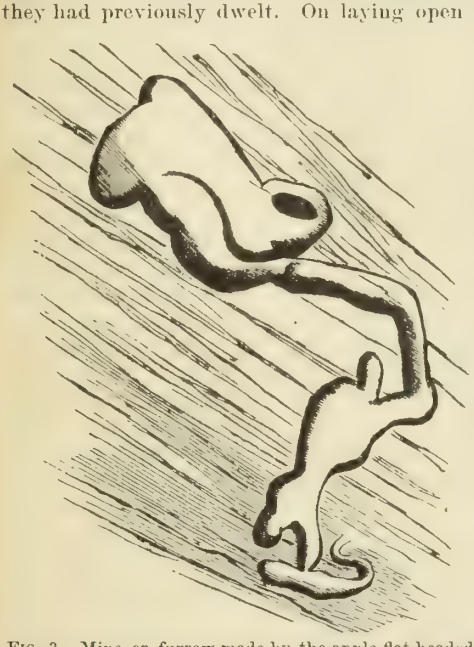

FIG. 3.—Mine or furrow made by the apple flat-headed borer, (C. femorata), nat. size.—Packard del.

Still, this worm is not able to secure itself entirely from those parasitic insects which are the destroyers of so many other species of its race, and which, as is currently remarked, appear to have been created for the express purpose of preying upon those species, in order to prevent their becoming excessively multiplied. We should expect that this and other borers, lying as they do beneath the bark or within the wood of trees, were so securely shielded that it would be impossible for any insect enemy to discover and gain access to them, to molest or destroy them. But among the specimens sent me by Mr. Barry is one where the worm has been entirely devoured, nothing but its shriveled skin remaining, within and upon which are several minute maggots or footless little grubs, soft, dull white, shining, of a long egg-shaped form, pointed at the tip and blunt in front, their bodies divided into

segments by very fine transverse impressed lines or sutures. They are about one-tenth of an inch long and 0.035 broad at the widest part. These are evidently the larvæ of some small Hymenopterous or bee-like insect, pertaining, there can be little doubt, to the family Chalcididæ, the female of which has the instinct to discover these borers, probably in the earlier periods of their life when they are lying directly beneath the bark, and piercing through the bark with her ovipositor, and puncturing the skin of the borer, drops her eggs therein, which subsequently hatch and subsist upon the borer, eventually destroying it. These minute larvæ were forwarded to me under the supposition that they were injurious to the apple tree, whereas, by destroying these pernicious borers, it is evident they must be regarded as our best friends. This fact illustrates how important it is for us to be acquainted with our insects in the different stages of their lives, that we may be able to discriminate friends from foes, and know which to destroy and which to cherish.

The larva.—The form of this borer is quite singular, and bears some resemblance to that of a tadpole or a battledoor. It consists of a very large, round, flattened portion, anteriorly, which is suddenly tapered into a long cylindrical tail or handle-like portion. The broad anterior part of this worm is about two-tenths of an inch in diameter and the narrow posterior part is but half as wide. Its length is about 0.65. It is soft, flesh-like, and of a pale-yellow color. In front two short robust jaws of a deep black color and highly polished are slightly protruded. When these are spread apart the tips of the feelers and between them the lips are perceptible. The head is blackish-brown and polished, and is deeply sunk into the second segment. Near each outer angle of the head is a small, pale-yellow, bead-like protuberance, which is probably the antenna. In Dr. Ratzeburg's figure, above alluded to, this slight protuberance is represented, probably incorrectly, as arising from the second segment. The second segment is deeply sunk into the third, and like all the remaining segments is pale-yellow and clothed with short minute hairs. The third or large segment is rather more broad than long, and is round and flattened above and beneath. Its upper side is occupied by a large, callous-like, transverse-oval elevation, the surface of which is flat and covered with numerous brown raised points, and in the middle are two smooth impressed lines, which diverge from the anterior to the posterior margin. Between these, on the middle of the basal edge, is a more faintly-impressed line, running forward, but becoming effaced before it reaches the center. On the under side is also a callous-like elevation, similar in all respects to that on the upper side, except that in place of the impressed lines it has in its middle a single channel or furrow, which does not extend to the posterior nor quite to the anterior margin. The fourth segment is a third narrower than the preceding, and has an impressed transverse line in its middle. In the deeply-impressed suture which divides this from the third segment, on each side is a smooth, crescent-shaped, elevated spot of a chestnut-brown color, resembling a little tick adhering in the fold of the skin. The nine remaining segments are of nearly equal length and diameter, except the two last, which are successively narrower. They are separated from each other by sutures which are strongly constricted. Along the middle of the back is a smoothish faintly-marked line, and on each side of each segment is an irregular triangular indentation, from the inner angle of which a faint impressed line extends inwards. On each side, beneath, is an impressed, longitudinal line. There are no conical projecting points at the apex of the last segment.

These borers, sent to me as above stated, have not yet completed their transformations; but they will in all probability remain in their present cells in the wood and be changed to pupæ the coming spring, from which the perfect insects will issue the latter part of May and during the month of June. And there can be little doubt that they will prove to be the species named by Fabricius *Buprestis femorata*, which species pertains to the modern genus *Chrysobothris*. This insect may be met with in all parts of our country. The natural place for its larva is in the white oak, and it is probable that, being deprived of a sufficient supply of this wood in which to deposit its eggs, in consequence of our forests being so rapidly and extensively cut down, this insect

has been obliged to resort to the apple and peach trees. Dr. Harris speaks of meeting with it upon and under the bark of peach trees, and I have captured it upon the apple tree. Professor Kirtland, of Cleveland, Ohio, doubtless alludes to this species (Downing's Horticulturist, vol. ii, p. 544), when he says, "Our apple trees are often injured by the larvæ of the *Buprestis*, which will girdle out extensive portions of the bark and young wood." This, moreover, is in all probability the beetle of which a wood-cut illustration is given in the Ohio Cultivator, vol. x, page 242. Although no description of the insect or its larvæ is given, the figure presents more points of resemblance to *C. femorata* than to any other common American species. The following interesting particulars there stated sufficiently indicate that this beetle will be liable to do great damage in our orchards. The editor says, "The late Dr. Barker, of McConnellsville (Morgan County, Ohio), called our attention to the injury done to his apple trees, by the beetle represented above, several years ago. It was in the month of July, and large numbers of these beetles were seen running up and down the trunks and branches of the trees, while beneath the bark extensive ravages of the larvæ were found. We observed, however, that these injuries seemed in nearly or quite all cases to have commenced where the bark had previously been killed from some other cause, and were almost invariably on the south side of the trees. We have since found occasional marks of these insects in other orchards, but never where the trees appeared to have been in perfect health previous to their attacks." This beetle, however, is by no means limited to old and decaying trees, as the observations of the editor of the Ohio Cultivator leads him to infer. The sections of wood sent me by Mr. Barry are from young and thrifty apple trees, and it occurs in oaks also of this character, as well as those which are aged and perishing.

The beetle.—Like other species of its family, the thick-legged Buprestis is variable in size, measuring from four to five-tenths of an inch in length, and about two-thirds in width. It is of a black or greenish-black color, polished and shining, with the surface rough and uneven. The head, and sometimes the thorax, and the depressed portions of the elytra are of a dull coppery color. The head is sunk into the thorax to the eyes, is densely punctured, and is clothed in front with fine white hairs, which are directed downwards. Upon the middle of the top of the head is a smooth raised black line, with a narrow impressed line through its middle, a mark which serves to distinguish this from some of the other species which are closely related to it. The thorax is much more broad than long, and is widest forward of the middle. Its surface is covered with dense, coarsish punctures, which run into each other in a somewhat transverse direction. It is also somewhat uneven, with slight elevations and hollows, but has not two smooth raised lines on its middle and anterior part, which are met with in another species very similar to this, the tooth-legged snapping-beetle (*Chrysobothris dentipes* Germar). The elytra or wing-covers present a much more rough and unequal surface than any other part of the insect. Three smooth and polished raised lines extend lengthwise of each wing-cover, and the intervals between them are in places occupied by smaller raised lines, which form a kind of net-work, and two impressed transverse spots may also be discerned more or less distinctly, dividing each wing-cover into three nearly equal portions. These spots reach from the inner one of the three raised lines nearly to the outer margin, crossing the two other raised lines, and interrupting them more or less. They are commonly of a cupreous tinge, and densely punctured, but are smoother than the other portions of the surface. A smaller and more deeply impressed spot may commonly be found in the space next to the suture and forward of the anterior spot, of which it is, as it were, a continuation. The wing-covers are rounded at their tips, so as to present a slight notch at the suture when they are closed, and the outer margin towards the tip has several very minute projecting teeth. When the wing-covers are parted the back is discovered to be of a brilliant bluish-green color, and thickly punctured, with a row of large impressed spots along the middle, one on each segment, and half way between these and the outer margin is another row of smaller impressed dots, having

their centers black. The under side of the body and the legs are brilliant coppery, the feet being deep shining green, their last joint and the hooks at its end black. Here also the surface is everywhere thickly punctured, the punctures on the venter or hind part of the body opening backwards. The last segment has an elevated line in the middle at its base, and its apex is cut off by a straight line, in the middle of which s commonly a small projecting tooth. The anterior thighs are remarkably large, from which circumstance this species has received its name, and they have an angular projection on their inner sides, beyond the middle. The tibiæ, or shanks, of these legs are slightly curved. (Fitch.)

Remedies.—We extract the following suggestions from Fitch:

The remedies for destroying this borer must necessarily be much the same with those already stated for the common borer or striped Saperda. They consist essentially of three measures: First, coating or impregnating the bark with some substance repulsive to the insect; second, destroying the beetle by hand-picking; and third, destroying the larva by cutting into and extracting it from its burrow.

As it is during the month of June and fore part of July that the beetle frequents the trees for the purpose of depositing its eggs in the bark, it is probable that whitewashing the trunk and large limbs or rubbing them over with soft soap early in June will secure them from molestation from this enemy. And in districts where this borer is known to infest the apple trees the trees should be repeatedly inspected during this part of the year, and any of these beetles that are found upon them should be captured and destroyed. It is at midday of warm, sunshiny days that the search for them will be most successful, as they are then most active and show themselves abroad. The larvæ, when young, appear to have the same habit with most other borers, of keeping their burrow clean by throwing their castings out of it through a small orifice in the bark. They can, therefore, be discovered probably by the new sawdust-like powder which will be found adhering to the outer surface of the bark. In August or September, whilst the worms are yet young, and before they have penetrated the heart-wood, the trees should be carefully examined for these worms. Wherever, from any particles of the sawdust-like powder appearing externally upon the bark, one of these worms is suspected, it will be easy, at least in young trees, where the bark is thin and smooth, to ascertain by puncturing it with a stiff pin whether there is any hollow cavity beneath, and if one is discovered, the bark should be cut away with a knife until the worm is found and destroyed. After it has penetrated the solid wood it ceases to eject its castings, and, consequently, we are then left without any clew by which to discover it. Hence the importance of searching for it seasonably.

5. The green-headed buprestis.

Buprestis chlorocephala.

Order Coleoptera; family Buprestidæ.

Probably boring under the bark of the white oak, with habits similar to those of other flat-headed borers of the oak, a Buprestid beetle.

(Observed by Mr. George Hunt laying its eggs on the bark of the white oak at Providence, in June).

6. The northern brenthian.

Eupsalis minuta Drury.

Order Coleoptera; family Brenthidæ.

Boring into the solid wood of the white oak, forming a cylindrical passage, a slender grub ¾ inch long and not quite 0.05 inch thick, changing to a weevil with a large, very thick snout.

The habits and transformations of this beetle were first described by Mr. Riley, the original account given by Dr. Harris proving erroneous,

his larva being that of a Tenebrionid beetle, as stated by Riley. This interesting weevil may be found on the trunk and under the bark of the white oak in June and July in New England, or in May and June in New York and Missouri, having then assumed the imago or beetle condition. Riley states that it is equally common on the black, red, and post oaks, that it bores in all directions through the heart-wood, and is found most commonly in stumps or in felled trees the year after they are cut.

The beetle differs from other weevils in that the snout projects straight out in front, not being curved downwards as in weevils in general. In the male the snout is much broader and flatter than in the female, but varies considerably, especially in the males, both in length and breadth. It is of a mahogany brown, the thorax smooth and highly polished, and the wing-covers strongly furrowed, shaded with deeper brown, and marked with narrow tawny-yellow spots. It is from ¼ to a little over ½ an inch in length. The males are, contrary to the general rule in insects, almost invariably the larger. The males of the Brenthians are known to fight desperately for the female, and as has been remarked by Mr. A. R. Wallace,* it is interesting "as bearing on the question of sexual selection, that in this case, as in the stag beetles, when the males fight together, they should be not only better armed, but also much larger than the females." (Riely.)

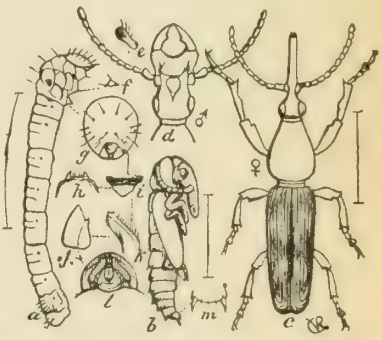

FIG. 4.—Northern Brenthian: *a*, larva; *b*, pupa; *c*, beetle, female; *d*, head of male; *e*, 4th antennal joint; *f*, leg; *g–l*, parts of larval head.†—After Riley.

According to Riley, in Missouri the eggs are deposited during the months of May and June. The female bores a cylindrical hole in the bark with her slender snout, and pushes an egg to the bottom of the hole.

It requires about a day to make a puncture and deposit the egg. During the time the puncture is being made the male stands guard, occasionally assisting the female in extracting her beak; this he does by stationing himself at a right angle with her body, and by pressing his heavy prosternum against the tip of her abdomen; her stout fore-legs serving as a fulcrum and her long body as a lever. When the beak is extracted, the female uses her antennæ for freeing the pincers or jaws of bits of wood or dust, the antennæ being furnished with stiff hairs and forming an excellent brush. Should a strange male approach, a heavy contest at once ensues, and continues until one or the other is thrown from the tree. The successful party then takes his station as guard. (W. R. Howard, in Riley's 6th Report.)

* The Malay Archipelago, p. 482.

† The line by the side of the insect in this and other cuts indicates the length of the insect, most of the sketches being enlarged views.

Riley thinks that the larva lives but a single year, although larvæ of different sizes occur in midwinter with the beetles.

The larva.—Length, 0.55–0.75 inch; diameter in middle of body, 0.05 inch. Body almost straight, cylindrical, 12-jointed, with a few faint hairs only on prothorax and around anus; thoracic joints short, bent a little forward, swollen and broadly and deeply wrinkled, with two especially prominent swellings on top of joints 2 and 3, converging towards head, and having each a granulated rufous spot; the other joints with about three dorsal transverse wrinkles; joints 5–9 subequal, as long as 1–3 together, twice as long as 4; 10–12 diminishing in length, slightly swollen, the anus retracted; 6 very small 3-jointed thoracic legs, the terminal joint being a mere bristle; stigmata quite distinct and brown, the first pair much the largest, between the fold of joints 2 and 3; the others on anterior fifth of joints 4–11, the last pair more dorsal than the rest. Head pale yellow, darker around mouth; rounded, more or less bent over the breast, with sparse, stiff, pale hairs springing from elevated points; ocelli, none; antennæ not visible, unless a dusky prominence lying close between mandibles and maxillæ be called such; labium small, with two depressions and other inequalities, the margins slightly angular, allowing jaws to closely fit around it; jaws stout, triangular, the inner margin produced at middle into a larger and smaller tooth, and with a slight excavation near tip; maxillæ long, with but a short, horny cardinal piece, the palpi apparently 2-jointed and with difficulty resolved, on account of three or four other prominences around them; garnished on the inside with a close row of stiff hairs and on the outside with two stouter hairs; labium large, oboval, the palpi placed in front and 2-jointed.

Pupa.—Average length 0.40 inch, with the antennæ curled back over the thorax, the seven or eight terminal joints each with a more or less distinct, forwardly-directed, brown thorn; the snout lying on the breast and varying according to sex; abdominal joints with a more or less distinct row of small thorns on the posterior dorsal edge, the last joint with a more prominent thorn directed backwards in a line with the body. (Riley.)

7. The gray-sided oak weevil.

Pandeletius hilaris Herbst.

Order Coleoptera; family Curculionidæ.

Making a smaller burrow than that of the Northern Brenthian, a worm like that of the plum weevil and changing to a gray weevil found on the leaves from May to September.

Beyond the fact stated by Harris that the larva lives in the trunks of white oaks, on which the beetles occur from late in May to September, we know nothing of this insect.

The beetle.—A little pale-brown beetle, variegated with gray upon the sides. Its snout is short, broad, and slightly furrowed in the middle; there are three blackish stripes on the thorax, between which are two of a light-gray color; the wing-covers have a broad stripe of light gray on the outer side, edged within by a slender blackish line, and sending two short oblique branches almost across each wing-cover; and the fore legs are larger than the others. Length from $\frac{1}{8}$ to $\frac{1}{5}$ of an inch. (Harris.)

8. The quercitron bark-borer.

Graphisurus fasciatus De Geer.

Order Coleoptera; family Cerambycidæ.

Feeding upon and destroying the quercitron bark of newly-felled trees, forming large tracks filled with worm-dust, a white, footless grub about 0.60 inch long, and with a transverse oval tawny-yellow spot on the middle of each wing above and be-

low; in June transforming to a long-horned beetle about ½ inch long, of an ash-gray color sprinkled with blackish spots and punctures, and back of the middle of its wing-covers an irregular oblique black band; the female with a straight awl-like ovipositor nearly ¾ inch in length. (Fitch.)

The bark called quercitron, of the *Quercus tinctoria*, is highly valued as a dye, and is much worm-eaten by this insect.

The parent of the worm differs remarkably from all the other beetles of this group in that the female is furnished with a straight awl-like ovipositor nearly a quarter of an inch in length, projecting horizontally backwards from the end of her body. The importance of this implement becomes manifest when we observe the thickness of the bark of the black oak, with its outer layers so dry and hard that they form, as it were, a coat of mail, protecting the trunk of the tree against the attacks of its enemies. Equipped as she is, however, the female of this beetle is able to perforate this hard outer bark and sink her eggs through it, placing them where her young will find themselves surrounded with their appropriate food. The worms from these eggs mine their burrows mostly lengthwise of the grain or fibers of the bark, and the channels which they excavate are so numerous and so filled with worm-dust of the same color with the bark, that it is difficult to trace them. The eggs are deposited the latter part of June, and the worms grow to their full size by the close of the season, and will be found during the winter and spring, lying in the inner layers of the bark, in a small oval flattened cavity about an inch in length, which is usually at the larger end of the track they have traveled.

The larva is divided by transverse constrictions into twelve rings, the last one being double. The head is small and retracted more or less into the neck, its base white and shining, and its anterior part deep tawny yellow, and along each side black. The neck or first ring is much longer as well as thicker than any of the others, the two rings next to it being shortest. From the neck the body of the worm is slightly tapered backwards to the middle, from whence it has nearly the same diameter to the tip, where it is bluntly rounded. Upon the upper side of the neck, occupying the basal half of this ring, is a large transverse tawny-yellow spot, rounded upon its forward side, but no corresponding spot appears on the under side of this ring. On the middle of all the other rings, except the two last, both above and below, is an elevated, rough, transverse, oval spot of a tawny-yellow color.

The beetle, like other species of the family to which it pertains, varies greatly in its size, specimens before me being of all lengths, from 0.35 to 0.58. It is of an ash-gray color from short incumbent hairs or scales, which have a faint tinge of tawny yellow except along the suture of the wing-covers. It is also bearded with fine erect blackish hairs which arise from coarsish black punctures which are sprinkled over the thorax and wing-covers, several of which punctures are in the centre of small black dots, which in places are confluent into small irregular spots. The head is of the same width as the anterior end of the thorax, and has a deep narrow furrow along its middle its whole length, and on the crown is an oval blackish spot on each side of this furrow. The face is dark gray, and the antennæ are black with an ash-gray band occupying the basal half of each of the joints. The thorax is narrower than the wing-covers, more broad than long, and thickest across its middle. Upon each side slightly back of the middle is an angular projection or short broad spine, blunt at its tip. On the middle of the back, between the centre and the base, is a short impressed line, and on each side of this, extending the whole length of the thorax, is a wavy blackish stripe, which is suddenly widened towards its hind end, and is sometimes interrupted in its middle. Often, also, there is a blackish spot between the anterior ends of these stripes, extending from the centre of the thorax to its forward end. The scutel is ash-gray in its middle and black upon each side. The wing-covers almost always show a large oblique and irregular triangular spot of black on their outer side forward of the middle, and always behind the middle is an irregular black oblique band, which seldom reaches to the suture, and which has a notch in the mid-

dle of its anterior side, and opposite to this on its hind side a large angular projection extending backward. Immediately back of this band is an irregular spot of a paler black color, which is sometimes confluent with the band; and there is also a small blackish spot on the outer side of the tips. The tips are cut off, sometimes transversely in a straight line, but usually concavely, and sometimes presenting a slight tooth-like projection on each side. The legs are ash-gray, the thighs with two black spots on their upper side, and the shanks with a black band at their base and another at their tip, these bands being more broad on the hind pair.

On elevating the loose bark of fallen trees the fore part of June, these insects will be found therein, lying in the cavities already mentioned, some of them being still in their pupa state, whilst others are changed to their perfect form, ready with the stout jaws and sharp teeth with which they are furnished to gnaw their way through the bark and come abroad.

This species occurs throughout the United States and Canada. Different specimens of it, however, vary greatly in their aspect. Even when newly born, among the individuals in the bark of the same tree, considerable diversities in size and markings may be noticed. And the beetles found in this situation have their colors so much brighter and their spots and bands so much more distinct and clearly defined, that I supposed them to be a different species from *fasciatus* for several years, and until specimens came to hand showing a gradual transition from these to the older individuals which we usually capture abroad, and meet with preserved in cabinets, in which the colors have become faded and dim and the marks obscure and partially obliterated. In the shape of some of its parts, also, different specimens are liable to vary. (Fitch.)

9. The Oak Leiopus.

Leiopus querci (Fitch.)

Order Coleoptera; family Cerambycidæ.

A very small, long-horned beetle, which I am unable to refer to any of the described species, I am assured lives at the expense of the red and white oak, from meeting with it upon those trees standing apart from others in fields. As the larvæ of kindred species burrow in the bark of trees, this will probably be found in the same situation in oaks. The beetle is met with upon the leaves of these trees early in July. It is very closely related to the Facetious Leiopus.

It is 0.20 inch long, and black, with ash-gray wing-covers, which are punctured and marked with a large black spot on the base of their suture in the form of a cross, and a broad black band slightly back of their middle, which is angulated, somewhat resembling an inverted letter **W**, this band often having a small ash-gray spot placed in it near its outer ends. Forward of this band are two black dots or short lines on each wing-cover, and sometimes a third dot back of it. There is also a dusky spot, usually on the tips of the wing-covers, and their deflected outer margin is black. The wing-covers are rounded at their tips. The thorax sometimes shows three faint gray stripes above. It is narrowed anteriorly, and on each side slightly forward of the base is a short, broad, sharp-pointed spine, from the tip of which, forward, the sides are straight. The long, thread-like antennæ are dull yellow, with a slight duskiness at the end of each joint. The legs are blackish, with the bases of the thighs, and frequently of the shanks also, pale dull yellow, the hind thighs being less thickened towards their tips than the four forward ones. (Fitch.)

10. The Thunderbolt Beetle.

Arhopalus fulminans (Fabr.).

Order Coleoptera; family Cerambycidæ.

Excavating a burrow in the soft sap-wood, about three inches long and 0.20 inch in diameter, a worm like the apple-tree borer, which changes to a long-horned beetle.

This beetle is said by Fitch to infest the oak, excavating a burrow in

the soft sap-wood about three inches long and 0.20 inch in diameter, this burrow having the shape of a much bent bow or a letter U. It changes to a pupa in the same cell, the beetle appearing in July. We have also learned that it bores in the chestnut, and for a description and figure of the beetle would refer the reader to the account of insects infesting the chestnut.

11. The White Oak Phymatodes.

Phymatodes variabilis (Fabr.).

Order Coleoptera; family Cerambycidæ.

Boring the trunk and branches of the white oak, a narrow longicorn larva, changing to a reddish thick-bodied longicorn beetle.

Numerous specimens of this beetle were taken by Mr. Alfred Poor from a white-oak stick, June 20. It is undoubtedly closely similar in its habits and in the form of the larva to the grape Callidium figured in our first report on the injurious insects of Massachusetts. This is the *Phymatodes variabilis*, and is one of our more common species of the genus. It is closely allied to *P. amœnus*, but is larger, and less coarsely punctured, while the antennæ are more reddish; the scutellum is concolorous with the wing-covers. The body, legs, except the femora, which are blackish in the middle, and antennæ, are reddish, the tips of the joints of the latter dark, and on the back of the prothorax are two black spots, often confluent. The head is black. The wing-covers are Prussian blue, smooth, finely punctured, with rather thick, fine, black hairs, bent downwards. Specimens recently changed from the pupa state are brown, and the species is exposed to considerable variation, as its name indicates. The male is just half an inch long, the female .60 inch.

The foregoing description is taken from our second report on the injurious insects of Massachusetts. We add the following description of the larva of a closely allied species, *P. amœnus*, Fig. 5, which injures the trunk of the grape.

The larva of the Grape Phymatodes.—Several years ago I received from Dr. Shinfer, of Illinois, specimens of the larva, pupa, and adult of this pretty insect (*Callidium amœnum* of Say), which is not uncommon in our own State. So much alike are all the borers of this family of long-horned beetles, that long and prolix descriptions and carefully-drawn figures of the mouth parts (wherein most of the differences lie) are absolutely necessary for their identification.

The larva (Figs. 5, *a*; *b*, head seen from above; *c*, seen from beneath) has a small head, which is a little more than half as wide as the prothoracic segment. This latter, being the segment immediately succeeding the head, is half as long as broad, with a distinct median suture and four chitinous patches; the two middle ones transverse and irregularly oblong, being about twice as broad as long, the outer spots being longitudinal to the segment, and oblong in form, or about twice as long as broad. The three segments succeeding are of nearly equal length and width, being about half as long as the prothoracic segment, and not much narrower. The body decreases in width toward the posterior half, which is of equal width throughout, the end sud-

denly rounding off; the terminal three segments are indicated by very slightly marked sutures, and together form a straight cylindrical portion nearly as long as the three segments in advance of it taken collectively. The body is slightly hairy, with a few fine, pale hairs on the top of the segment next behind the head. The basal portion of the head (epicranium) is broad and smooth, with a few hairs on the edge. The eyes are two small black dots, each situated a little behind the base of the antennæ, and in a line with them. The frontal piece (clypeus) is very small, about three times as broad as long, while the minute upper lip (labrum) is two-thirds as long as broad; they together form a somewhat triangular portion resting on the inner edge of the mandibles, which are broad and short, the ends broad and square, and blackish in color. The antennæ are not quite so large or as long as the maxillary palpi; they are four-jointed; the first joint being thick, the second joint a third shorter than the third, while the fourth joint is filiform, and about as long as the second joint. The under side of the head is chitinous, with a mesial subtriangular fleshy area. The chin (mentum) is square, not much longer than broad. The under lip (labium) is one-half as long as broad. The labial palpi are three-jointed, the basal joint being one-half as long as the second; the third joint is minute, short and hairy. The maxillary palpi are four-jointed, the first joint being twice as thick as the third, the second and third are of nearly equal length, while the fourth is slender and nearly as long as the second or third. The maxillary lobe is large and broad, reaching out to the labial palpi and as far as the end of third joint of the maxillary palpi; there are a few hairs on the end of it.

FIG. 5.—Grape Phymatodes: *a*, larva; *b*, upper side, *c*, under side of head of larva much enlarged.—From Packard.

On the upper side of the segments behind the prothoracic is a faint, transverse impressed line, with two or three short creases radiating from each end. On the eighth, ninth, and tenth rings these creases become much longer and are parallel to the median line of the body, while the transverse crease disappears.

There are nine pairs of stigmata, one pair on the mesothorax, the remainder on the first eight abdominal segments. There are three pairs of rudimentary thoracic feet, represented by very minute two-jointed tubercles, the basal joint consisting of a simple chitinous ring. The under side of the body is more hairy than above. On the under side of the prothoracic segment is a pair of round, smooth, very slightly chitinous spots, which are succeeded on each of the other rings by a pair of short, impressed oblique lines.

It is nearly half an inch (.45) in length.

It may be readily recognized by the four chitinous patches on the prothorax, and by the very minute clypeus and labrum. The upper side of the prothorax is inclined downward towards the head, but not so much as in Clytus.

The pupa.—It is white, with the wing-covers reaching to the end of the second abdominal segment. The antennæ are not much curved, reaching to the end of the third abdominal segment, and resting above the legs. The prothorax is swollen just behind the middle, and is just as long as broad. The maxillary palpi are long, reaching nearly to the end of the coxæ. The labial palpi reach a little beyond the middle of the maxillary palpi. The two anterior pairs of legs are folded at right angles to the body, the third pair obliquely. The first pair of tarsi reach to the base of the second tarsi; the second pair of tarsi reach to the coxæ of the third pair of legs. It is a third of an inch (.33) in length.

The beetle.—Ph. amœnus has a reddish body, with Prussian-blue wing-covers. The prothorax is just as long as broad, with the sides moderately convex, and broadest just behind the middle. The antennæ and tibiæ are blackish brown, the tarsi being dull red, the hind pair being darker than the others, and the femora are reddish. The prothorax is distinctly punctured, while the elytra are very coarsely punctured. The scutellum is pale reddish. It is a quarter of an inch in length. A single specimen received from Illinois.

12. The White-banded Phymatodes.

Phymatodes varius (Fabricius).

Order Coleoptera; family Cerambycidæ.

A black long-horned beetle, 0.25 in length, or slightly less, and about a third as broad, somewhat flattened, clothed with fine erect gray hairs: its wing-covers with two distinct slender white bands which do not reach the suture, the anterior one more slender than the hind one and curved; the antennæ and slender portions of the legs usually chestnut colored.

Several specimens of this beetle were met with a few years since, the last of May, on the trunk of a black oak, in which, it is probable, their younger state had been passed. It is closely related to the black varieties of *P. varius* Fab., but is a third smaller, with the white bands much more slender, and the surface of the wing-covers are perceptibly more rough than in my specimens of that insect, notwithstanding their smaller size. Its thorax is densely punctured, with a short smooth stripe between the center and the base. One of the specimens varies in having the posterior white band wholly wanting. (Fitch.)

I have found near Providence several of these beetles, of both sexes, running in and out of a pile of oak cord-wood in the forest, May 30, which was cut the previous winter.

13. The common oak clytus.

Clytus colonus.

Order Coleoptera; family Cerambycidæ.

Mining between the bark and the wood of the oak, up and down the trunk, and making a broad, shallow, irregular groove about 5^{mm} wide; the larva, pupa, and beetle occurring late in May and early in June.

I have found, in company with Mr. Calder, the larvæ of this pretty beetle in abundance mining under the bark of a fallen (probably white) oak, near Providence, May 26; several pupæ also occurred, one transforming to a beetle May 27. The mine extends up and down the trunk, and is of the usual form of longicorn mines, being a broad, shallow, irregularly sinuous burrow, and extending part of the way around the trunk, the diameter near the end of the burrow being 5^{mm}.

Mr. George Hunt has found the beetle under the bark of an old sugar maple tree in Northern New York, among the Adirondacks.

Larva.—Head broad; prothoracic segment large and broad, much wider than long, with two transverse chitinous portions in front, and one continuous band behind. Body behind rather stout and broad: no callous or fleshy bunches either above or below. Length, 13^{mm}; diameter of head across the thorax, 4½^{mm}.*

* This description, to be of much value, should be comparative, but I have at present no other larvæ of the genus with which to compare those of this species.

Pupa.—Prothorax well rounded as in Clytus beetles; antennæ slender, curving backwards, and reaching to the distal end of the middle femora. Femora much swollen, but the legs beyond slender, as in the beetle. (It will not be difficult to distinguish the genus from the peculiar form of the thorax, the swollen femora, and the slender legs and antennæ.) Abdomen short; end of hind femora extending to the third segment from the end of the abdomen. Length, 12–13½mm.

14. Smodicum cucujiforme (Say).

Order Coleoptera; family Cerambycidæ.

Boring in the larval stage under the dry bark of the live oak (Florida), the beech in Michigan, and the hackberry in Texas. (E. A. Schwarz.)

15. The Horn-tail Borer.

T remex columba (Linnæus).

Order Hymenoptera; family Urocerida.

This insect is known to infest the oak, but oftener bores into the maple, under which head the insect will be described.

16. Mallodon dasystomus (Say).

Order Coleoptera; family Cerambycidæ.

Boring in live oak, hackberry, pecan; attacking trees in healthy condition, and often greatly injuring them, but preferring trees which have already suffered from some cause; the beetle issuing from April till August, in Florida and Texas. (E. A. Schwarz.)

17. Mallodon melanopus (Linn.).

Boring in the box elder (*Acer negundo*) in Texas, and boring in the roots of oak shrubs at Cedar Keys, Fla., the beetle appearing in June; boring in *Celtis texana*, near Columbus, Texas. (E. A. Schwarz.)

18. The Oak-bark weevil.

Magdalis olyra (Herbst).

Order Coleoptera; family Curculionidæ.

Boring under the bark of the oak, probably after it has been loosened by the flat-headed borers, a curved fat footless grub, with the head freer from the body than in the larval pine weevil; occurring in all stages under the bark in May, and probably producing a radiating track, as in Fig. 7; transforming into a black weevil with the surface of the body punctured, the thorax with a lateral tubercle on the front edge, while the tarsi are brown, with whitish hairs; ¼ inch long. (Fig. 6).

Fig. 7 represents the mines probably made by this weevil. The original specimen of the bark was taken from the same tree, as numerous individuals of the beetle occurred in different stages of growth, and no other weevils or Scolytidæ were present. The beetle which makes the burrow must have been a weevil by the shape of the burrow, which is long, narrow, and deep, being about four inches long. It will be seen by reference to the illustration that the parent weevil laid at least seven eggs in an opening in the bark; when the larva hatched they mined

the bark and scored the wood in directions radiating on one side of the place of oviposition; in one case a mine went directly across the one next to it.

The following beetles are not known with certainty, but supposed by Harris and also by Fitch, from their frequent occurrence on the oak, to injure that tree:

19. The Silky Timber-beetle.

Lymexylon sericeum (Harris).

Order Coleoptera; family Lymexylonidæ.

Boring small long cylindrical burrows in the wood of the oak, probably, and other trees; a slender odd-looking worm with six legs placed on its breast, a prominent hump upon its neck, and a leaf-like fleshy appendage at the end of its back; changing into a long narrow chestnut-brown beetle, 0.50 long, bearded with short, shining, yellowish hairs, giving it a silky luster; its eyes large and almost meeting together above and below, and its wing-covers tapering and shorter than the body. See Harris' Treatise, p. 51. (Fitch.)

20. The American Timber-beetle.

Hylecœtus americanus (Harris).

Order Coleoptera; family Lymexylonidæ.

A worm very similar to the preceding, but with a straight sharp-pointed horn at the end of its

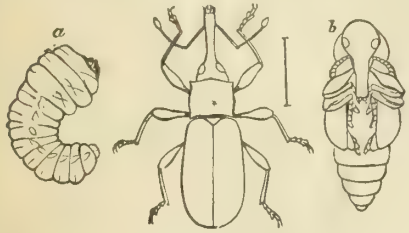

Fig. 6.—*a*, larva; *a*, pupa, and adult of the oak bark weevil, *M. olyra* (from Packard).

Fig. 7.—Track probably made by *Magdalis olyra* (from Packard).

back in place of a leaf-like appendage; changing into a pale brownish red beetle 0 40 long; its wing covers, except at their base and its breast, black, its eyes small, and a glassy dot on the middle of its forehead resembling a small eyelet. (See Harris' Treatise, p. 51.)

This and the preceding are very rare insects, and their larvæ have never been detected, but are inferred by Dr. Harris to inhabit oaks and to have the singular forms above indicated, from the analogy of the perfect insects to two European species. Foreign writers, I see, are misled by Dr. Harris's account, into supposing that it is authentically ascertained that our insects coincide in their larva state with the European species. (Fitch).

21. The Feeble Oak-borer.

Goes debilis (Leconte).

Order Coleoptera; family Cerambycidæ.

A cylindrical long-horned beetle, which has recently been described by Dr. Le Conte, under the above name, is so uniformly found upon white oak trees in July and August, that I doubt not its larva is a borer in the trunks of these trees, perforating the wood, probably, in a manner similar to that of the marked pine borer, and the worm resembling that in its appearance. This beetle is half an inch long and scarcely a third as broad, of a black color, its wing-covers chestnut red, its surface having a marbled appearance, produced by short prostrate hairs of a dull ochre yellow color, except on the anterior half of the wing-covers, where they are gray, and are here followed by a tawny brown spot destitute of these paler hairs. It has only been found, as yet, in the State of New York, in the northern sections of which it is not rare. (Fitch.)

22. The Brown Prionus.

Orthosoma brunneum.

Order Coleoptera; family Cerambycidæ.

The larvæ of this beetle has been found in rotten walnut and oak stumps by Mr. Hunt near Providence, but as it is more commonly met with in pine logs the reader is referred to the account of it given under pine insects.

AFFECTING THE LIMBS AND TWIGS.

23. The Oak Pruner.

Elaphidion villosum (Fabr.).

Order Coleoptera; family Cerambycidæ.

Cutting off the branches of the white and black oak (each containing a larva, which fall late in summer to the ground), longicorn larvæ, which become beetles in the next midsummer, and lay their eggs near the axilla of a leaf stalk or small stem.

In walking under oak trees in the autumn one's attention is often directed to the large number of oak limbs and twigs lying on the ground. Upon examination they will be found to have been partially gnawn off

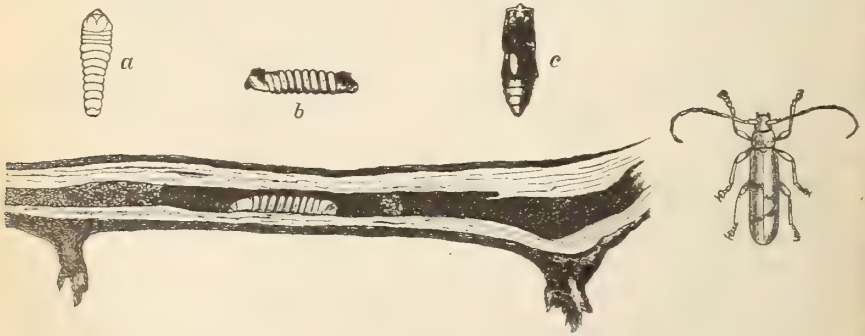

Fig. 8. Oak Pruner: *a*, larva; *b*, side view of the same; *c*, pupa.—From Packard.

by worms, the wind having further broken them off. This is the work of the grub of the oak pruner. The insect's purpose in cutting off the

limb, whether conscious or not of any design in the matter, is probably, as Peck first suggested, to afford the grub a sufficiently moist retreat to live in during the winter. He supposed that the limb thus wounded would become too dry for the maintenance of the soft-bodied larva, hence it must be felled to the ground, where in the wet and under the snows of winter it would remain sufficiently moist for the existence of the insect, which completes its transformation within.

Mr. C. A. Walker has brought us the insect in its different stages cut out of oak branches, which occurred in abundance at Chelsea, Mass., but, as seen by the following extracts, we are indebted to Dr. Fitch for the most detailed information regarding this curious longicorn.

The severed limbs are usually but eighteen inches or two feet in length, but Professor Peck states that limbs an inch in thickness and five feet in length are sometimes found. I have seen a limb cut off by this insect which was ten feet in length and an inch and a tenth in thickness, and have repeatedly met with them seven and eight feet long and usually an inch, but in one instance an inch and a quarter, in thickness.

The parent beetle seems aware that her progeny in their infancy will be too feeble to masticate the hard woody fibers of the limb. She, therefore, selects one of the small twigs which branch off from it, which is not thicker than a goose quill, with its base composed of soft wood, the growth of the last year, all the remainder of the twig being the green succulent growth of the present year. She places her egg near the tip of this twig, in the angle where one of the leaf-stalks branch off from it. The young worm which hatches therefrom sinks himself into the center of the twig and feeds upon the soft pulpy tissue around him until it is all consumed, leaving only the green outer bark, which is so thin and tender that it withers and dries up, and ere long becomes broken. By the time this green tender end of the twig is consumed the worm has acquired sufficient size and strength to attack the more solid woody portion forming its lower end. He accordingly eats his way downward in the center of the twig, consuming the pith, to its base, and onward into the main limb from which this twig grows, extending his burrow obliquely downward to the center of the limb, to a distance of half an inch or an inch below the point where the lateral twig is given off.

The worm being about half grown, is now ready to cut the limb asunder. But this is a most nice and critical operation, requiring much skill and calculation; for the limb must not break and fall while he is in the act of gnawing it apart, or he will be crushed by being at the point where it bends and tears asunder, or will fall from the cavity there when it breaks open and separates. To avoid such casualties, therefore, he must after severing it have time to withdraw himself back into his hole in the limb and plug the opening behind him before the limb breaks and falls. And this little creature accordingly appears to be so much of a philosopher as to understand the force of the winds and their action upon the limbs of the tree, so that he can bring them into his service. He accordingly severs the limb so far that it will remain in its position until a strong gust of wind strikes it, whereupon it will break off and fall.

But the most astonishing part of this feat remains to be noticed. The limb which he cuts off is sometimes only a foot in length and is consequently quite light; sometimes ten feet long, loaded with leaves, and very heavy. A man by carefully inspecting the length of the limb, the size of its branches, and the amount of foliage growing upon them could judge how far it should be severed to insure its being afterwards broken by the winds. But this worm is imprisoned in a dark cell only an inch or two long in the interior of the limb. How is it possible for this creature, therefore, to know the length and weight of the limb and how far it should be cut asunder? A man, moreover, on cutting a number of limbs of different lengths, so far that they will be broken by the winds, will find that he has often miscalculated, and that several of the limbs do not break off as he designed they should. This little worm, however, never

makes a mistake of this kind. If the limb be short it severs all the woody fibers, leaving it hanging only by the outer bark. If it be longer a few of the woody fibers on its upper side are left uncut in addition to the bark. If it be very long and heavy not more than three-fourths of the wood will be severed. The annexed figures represent the several ends of limbs of different sizes, the coarsely dotted parts of the two first indicating the ragged broken ends of the woody fibers, the remainder being the smooth surface cut by the worms, and the large black dot representing the perforation leading up the limb to where the worm lies. The first of these figures was taken from the limb already spoken of as ten feet in length, and here it will be noticed that a portion of the stouter wood towards the center of the limb was preserved, as though the worm had been aware that the weaker sappy fibers outside next to the bark could not be relied upon for sustaining a limb of this size, as they are where the limb is smaller. With such consummate skill and seemingly superterrestrial intelligence does this philosophical little carpenter vary his proceedings to meet the circumstances of his situation in each particular case! But by tracing the next stage of his life we shall be able to see how it is that he probably performs these feats which appear so much beyond his sphere.

Having cut the limb asunder so far that he supposes it will break with the next wind which arises, the worm withdraws himself into his burrow, and that he may not be stunned and drop therefrom should the limb strike the earth with violence when it falls, he closes the opening behind him by inserting therein a wad formed of elastic fibers of wood. He now feeds at his leisure upon the pith of the main limb, hereby extending his burrow up this limb six or twelve inches or more, until he attains his full growth—quietly awaiting the fall of the limb, and his descent therein to the ground. It is quite probable that he does not always sever the limb sufficiently, in the first instance, for it to break and fall. Having cut it so much as he deems prudent, he withdraws and commences feeding upon the pith of the limb above the place where it is partially severed, until a high wind occurs. If the limb is not hereby broken, as soon as the weather becomes calm he very probably returns and gnaws off an additional portion of the wood, repeating this act again and again, it may be, until a wind comes which accomplishes the desired result. And this serves to explain to us why it is that the worm severs the limbs at such an early period of his life. For the formidable undertaking of cutting asunder such an extent of hard woody substance, we should expect he would await till he was almost grown and had attained his full strength and vigor. But by entering upon this task when he is but half grown he has ample opportunity to watch the result, and to return and perfect the work if he discovers his first essay fails to accomplish the end he has in view.

Thus the first part of the life of this worm is passed in a small twig branching off from the main limb. This is so slender and delicate that on being mined as it is by the worm and all its green outer end consumed, it dies and becomes so decayed and brittle that it is usually broken off when the limb falls, whereby it has escaped the notice of writers, hitherto. The remainder of his larva life is passed in the main limb, first cutting off this limb sufficiently for it to break with the force of the winds, and then excavating a burrow upwards in the center of the limb, both before and after it has fallen to the ground, feeding hereon until he has grown to his full size.

It is most frequently the limbs of the red and the black oak that I have met with, severed by the oak pruner, though it is not rare to find those of the scarlet oak (*Q. coccinea*) and of the white oak lopped off in the same manner. Limbs of the beech and chestnut not unfrequently, and those of the birch, the apple, and probably of other trees, are sometimes similarly severed. Mr. P. Weter, of Tirade, Walworth County, Wisconsin, informs me that the peach in his vicinity suffers in a similar manner, and to such an extent some years, that the severed limbs, varying from a few inches to two feet in length, are seen lying under almost every tree. We have in our country several species of beetles very closely related to the oak pruner, but no attempts have yet been made to ascertain their mode of life. It is very probable that

they all have this same habit of cutting off the limbs of trees, one perhaps preferring the wood of one kind of tree, another, another. This is the more probable, since there is considerable diversity in their operations, as shown by an examination of the fallen limbs. Thus the scarlet oak, instead of having a hole bored in the severed end of its limbs, commonly has half the wood ate away on one side of the limb for the length of an inch or more, with the cavity thus formed under the bark packed with worm dust, and a cylindrical burrow from the upper end of this cavity running upwards in the center of the limb, the same as in other cases.

It further appears that the female, when ready to drop an egg, is not always able to find a small twig with a green succulent end adapted to her wants. She then consigns her progeny to the bark of the main limb, and the young worm subsists on the soft pulpy matter between the bark and the wood, excavating a shallow irregular cavity which is packed with worm dust, till it has acquired sufficient strength to gnaw the wood, when it cuts off the limb as in other cases. It may, however, be a different species from the common oak pruner, which cradles its young thus beneath the bark instead of in a lateral twig. It is usually in the fallen limbs of the beech, though sometimes in those of the oaks also, that I have met with these worm tracks under the bark.

The bark of the beech, it will be recollected, is quite thin and very brittle, so that it will illy serve to hold the limb in its place if the wood underneath is cut off in the usual manner. And accordingly a remarkable modification of this operation will be noticed in the amputated limbs of this tree. The worm eats its way down the limb beneath the bark until it has acquired sufficient strength to sever the woody fibers. It then passes transversely around the limb beneath the bark, girdling it by cutting off all the softer outer fibers and leaving the harder ones in the middle of the limb uncut, whereby the limb is sustained until the wind strikes it. How surprising that these little creatures have such intelligence given them as enables them to vary their operations to such an extent, according to the circumstances of their situation in each particular case! I should be inclined to think the beech pruner a different species from that of the oak, as it dwells beneath the bark instead of in a lateral twig, and cuts off the outer instead of the inner wood of the limb; but the worm is identical with that of the oak in its external appearance, and one of these worms which I placed in a cage, falling from its fractured burrow in the beech limb, forsook this wood and commenced boring into an oak limb lying beside it.

Not only the limbs but small young trees, at least of the white oak, are sometimes felled by these insects; in which cases the worm, instead of cutting the wood off transversely, severs it in a slanting or oblique direction, as though it were aware the winds would prostrate a perpendicular shoot more readily by its being cut in this manner.

The larva grows to a length of 0.60, and is then 0.15 thick across its neck, where it is broadest. It tapers slightly from its neck backwards, the hind part of its body being nearly cylindrical. It is a soft or fleshy grub, somewhat shining and of a white color, often slightly tinged with yellow, its head, which is small and retracted into the neck, being black in front. It is divided into twelve rings by very deep, wide, transverse grooves. The neck or first ring is much the largest, and shows two very pale tawny yellow bands on its upper side, the anterior one slightly broken asunder in its middle, and on each side beyond the ends of these bands is a spot of the same color The two or three rings next to the neck are shorter than the others, and less widely separated from each other. A faint stripe of a darker color may be discerned along the middle of the back, widely broken apart at each of the sutures. The last ring is much narrower and more shining than the others, and is cut across by a fine transverse line, dividing it into two parts, of which the hinder one or tip is bearded with small blackish hairs, and a few fine hairs are perceptible upon the other rings. The two last rings are retracted into the ring which precedes them, at the pleasure of the animal, whereby this ring becomes humped and swollen; and it appears to be chiefly

by thus enlarging the end of its body that the worm holds and moves itself about in its cell, its feet being so weak and minute that they are scarcely perceptible and can be of little service. It has three pairs of soft conical jointed feet, resembling its antennæ in their size and shape. The first pair is placed on an elevated wrinkle of the skin in the suture between the first and second segments of the thorax, more distant from each other than are those of the second and third pairs, which are situated on the middle of the elevation of the second and third segments.

Some of the worms enter their pupa state the last of autumn, and others not till the following spring. Hence in examining the fallen limbs in the winter, a larva may be found in one, a pupa in another. Preparatory to entering its pupa state, the larva places a small wad of woody fibers, sometimes intermingled with worm-dust, below it, in its burrow, and sometimes another wad above it if the burrow runs far up the limb, thus partitioning off a room one or two inches in length in which to lie during its pupa state. The shriveled cast skin of the larva will be found at the upper end of this cell, after it has changed to a pupa.

Usually those insects which undergo a complete metamorphosis, remain at rest, lying dormant and motionless during their pupa state. The oak pruner, however, is a remarkable exception to this. Whenever its cell is opened it will be seen moving from one end of it to the other with quite as much agility as it shows in its larva state. The sutures of its abdomen have the same deep transverse grooves as in the larvæ, admitting the same amount of motion to this part of its body that it previously had. And lying on its back, it uses the tip of its abdomen as though it were furnished with a proleg, the little sharp points with which it is covered being pressed against the rough walls of the cell, and the body pushed forward or drawn backward hereby, step after step, at the will of the animal.

The pupa is of much the same size with the larva and of a yellowish white color. Its eyes are sometimes white, sometimes blackish brown. The antenna-sheaths arise in the notch upon the inner side of the eyes and, passing directly across the surface of these organs, extend down along each side of the back above the sheath of the fore and middle pairs of legs, then curving inward they pass back to the eye along the inner side of the same legs, their ends being placed upon the eye slightly inside of their origin. The knees of the hind legs protrude far out from under the upper sides of the wing-sheaths forward of their tips, whilst the feet of these legs occupy the space between the tips of the wing-sheaths. The back of the abdomen shows a distinct pale brown stripe along the middle, on each side of which the surface of the segments is furnished with numerous small erect sharp points of a dark brown color, those on the apical segment being double the length of the others.

The beetle.—They are usually from 0.50 to 0.55 in length and 0.12 broad, of a slender cylindrical form, of a dull black color, tinged more or less with brown on the wing-covers, more evidently so towards their tips, whilst the antennæ are paler brown, and the under side and legs chestnut colored, sometimes bright, sometimes dark and blackish. The surface is everywhere clothed with shortish prostrate gray hairs, and on the wing-covers these are in places more dense, forming small gray spots, and on each side of the thorax, in the middle, is a whitish dot, formed in the same manner. Sometimes also on the base of the thorax, on each side of its middle, a short gray stripe formed by these hairs, is very obvious, whilst in other individuals no traces of these stripes can be discerned.

The scutel also is densely covered and gray from these hairs. The surface, above, is occupied by numerous coarse round punctures, those on the thorax being of the same size with those on the wing-covers, but more crowded, many of them running into each other. Towards the tips of the wing-covers these punctures become perceptibly smaller.

In at least three-fourths of the fallen limbs no worm is to be found; and an examination of them shows that the insect perished at the time the limb was severed, and before it had excavated any burrow upward in its center, no perforation being present

except that leading into the lateral twig. It is probable that in many of these instances the limb broke when the worm was in the act of gnawing it asunder, either from its own weight or from a wind arising whilst the work was in progress. And even though the worm may have withdrawn into its hole and plugged the opening behind it, it is frequently discovered here, probably, and devoured by birds. After a violent wind in the summer season, some of our insect-eating birds may always be noticed actively in search of limbs and trees that have thereby been broken, their instinct teaching them that this breakage usually occurs from the wood being weakened by the mining operations of worms therein, whose lurking places are now opened to them. And they will be seen industriously occupied in picking around the fractured ends of the wood, and feasting upon the grubs which they there find. Numbers of our wood-boring larvæ are thus destroyed, and the oak pruner, notwithstanding the precautions it takes to secret itself, doubtless frequently falls a prey to these sagacious foragers.

Remedies.—These insects will undoubtedly at times occur in such numbers as to render it important that they be destroyed, at least where they resort to the peach or other valuable trees. And this may readily be effected by gathering and burning the fallen limbs in the winter or the early part of spring.

24. The seventeen-year locust.

Cicada septemdecim Linn.

Order Hemiptera; family Cicadariæ.

Stinging the terminal twigs of the oak and other forest trees and of various fruit-trees, the seventeen-year locust, which deposits its long slender eggs in a broken line along the twig.

Without attempting to recapitulate the history of this famous insect, we would only say that the eggs are deposited from the end of May through June (Fig. 9, *d*, *e*,) in pairs in the terminal twigs of the oak, &c. The larvæ (Fig. 9, *f*,) hatch out in about six weeks after they are deposited, and drop to the ground, in which they live, sucking the roots of trees, &c., for nearly seventeen years, the pupa state (Fig. 9, *a*, *b*) lasting but a few days.

The following remarks on the habits of this insect are taken from our Third Report on the injurious Insects of Massachusetts:

As regards the kinds of trees stung by the Cicada I may quote from a communication from William Kite in the American Naturalist, vol. ii, p. 442, as confirming and adding somewhat to Dr. Harris's statements: "Seeing in the July number of the Naturalist a request for twigs of oak which had been stung by the so-called seventeen-year locust, I take the liberty of sending you twigs from eleven different varieties of trees in which the females have deposited their eggs. I do this to show that the insect seems indifferent to the kind of wood made use of as a depository of her eggs. These were gathered July 1, in about an hour's time, on the south hills of the 'Great Chester Valley,' Chester County, Pa. No doubt the number of trees and bushes might be much increased. The female, in depositing her eggs, seems to prefer well-matured wood, rejecting the growing branch of this year, and using the last year's wood and frequently that of the year before, as some of the twigs inclosed will show. An orchard which I visited was so badly 'stung' that the apple trees will be seriously injured, and the peach trees will hardly survive their treatment. Instinct did not seem to caution the animal against using improper depositories, as I found many cherry trees had been used by them, the gum exuding from the wounds, in that case sealing the eggs in beyond escape.

"The males have begun to die, and are found in numbers under the trees; the females are yet busy with their peculiar office. The length of wood perforated on each branch varied from one to two and a half feet averaging probably eighteen inches: these seemed to be the work of one insect on each twig, showing a wonderful fecundity.

"The recurrence of three 'locust-years' is well remembered in this locality—1834, 1851 and 1868. There has been no variation from the usual time, establishing the regularity of their periodical appearance."

As regards the time and mode of hatching, Mr. S. S. Rathvon, of Lancaster, Pa., contributes to the same journal some new and valuable facts, which we quote: "With reference to the eggs and young of the seventeen-year cicada, your correspondent from Haverford College, Philadelphia, is not the only one who has failed to produce the young by keeping branches containing eggs in their studios. I so failed in 1834 and 1851, and indeed I have never heard that any one has succeeded in that way, who has kept them for any great length of time. In the brood of 1868, the first cicadas appeared here in a body, on the evening of the second day of June. The first pair *in coitu*, I observed on the 21st, and the first female depositing on the 26th of the same month. The first young were excluded on the 5th of August. All these dates are some ten days later than corresponding observations made by myself and others in former years. On the 15th of July I cut off some apple, pear, and chestnut twigs containing eggs, and stuck the ends into a bottle containing water, and set it in a broad, shallow dish also filled with water, the whole remaining out of doors exposed to the weather, whatever it might be. The young continued to drop out on the water in the dish for a full week, after the date above mentioned. I could breed no cicadas from branches that were dead and on which the leaves were withered, nor from those that from any cause had fallen to the ground, and this was also the case with Mr. Vincent Bernard, of Kennet Square, Chester County, Pa. After the precise time was known, fresh branches were obtained, and then the young cicadas were seen coming forth in great numbers, by half a dozen observers in this county. As the fruitful eggs were at least a third larger than they were when first deposited, I infer that they require the moisture contained in living wood to preserve their vitality. When the proper time arrives and the proper conditions are preserved, they are easily bred, and indeed I have seen them evolve on the palm of my hand. The eyes of the young cicadas are seen through the egg-skin before it is broken."

Mr. Riley, in an interesting account of this cicada in his First Annual Report on Noxious, Beneficial, and Other Insects of Missouri for 1869, has shown that in the Southern States thirteen-year broods of this insect are found. He remarks: "It was my good fortune to observe that besides the seventeen-year broods, the appearance of one of which was recorded as long ago as 1633, there are also thirteen-year broods, and that, though both sometimes occur in the same States, yet, in general terms, the seventeen-year broods may be said to belong to the Northern and the thirteen-year broods to the Southern States, the dividing line being about latitude 38°, though in some places the seventeen-year brood extends below this line, while in Illinois the thirteen-year brood runs up considerably beyond it. It was also exceedingly gratifying to find, four months after I had published this fact, that the same discovery had been made years before by Dr. Smith, though it had never been given to the world."

Mr. Riley predicts that in Southern New England a brood will appear in 1877 and 1885. Probably the Plymouth brood, which appeared in 1872, will not appear again for seventeen years, namely, in 1889, the two broods noticed by Riley appearing west of this town. As regards its appearance in Plymouth, Mass., Harris states that it appeared there in 1633. The next date given is 1804, "but, if the exact period of seventeen years had been observed, they should have returned in 1803."

Mr. B. M. Watson informs me, from his personal observation, that it also appeared in 1838, 1855, and 1872. In Sandwich it appeared in 1787, 1804, and 1821. In Fall River it appeared in 1834, in Hadley in 1813, in Bristol County in 1784, so that, as re-

marked by Harris and others, it appears at different years in places not far from each other. So that while in Plymouth and Sandwich we may look for its reappearance in 1889, in Fall River it will come in 1885, or four years earlier.

There are three species of Cicada in the Northern States, and, in order that they may not be confounded in studying the times of appearance of the different broods of the seventeen-year species, I add a short description of each form, so that they may be readily recognized in the winged and immature states.

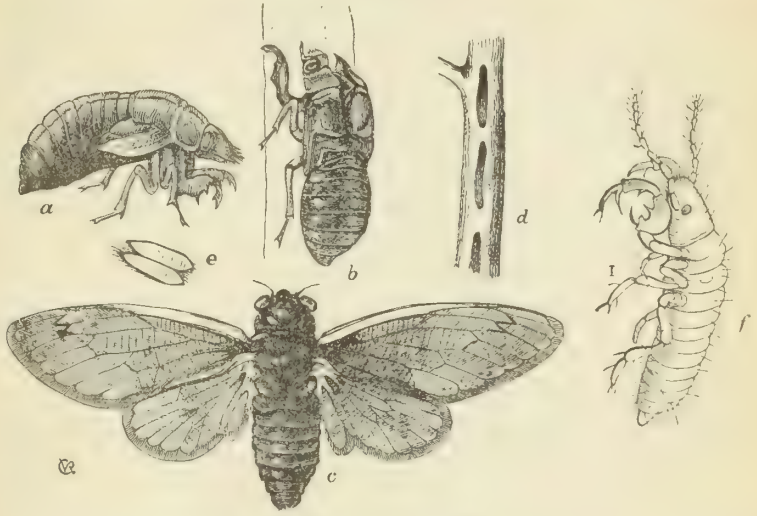

FIG. 9.—The seventeen-year Cicada and pupa; (*a*, *b*), *d*, position of eggs (*e*); *f*, larva.—After Riley.

The two larger species are the seventeen-year locust (*Cicada septendecim*) and the dog-day cicada (*C. pruinosa*). Fig. 9, copied from Riley's report, gives a good idea of the former species: *a* represents the pupa, *b* the same after the adult has escaped through the rent in the back, *c* the winged fly, *d* the holes in which the eggs *e* are inserted. Fig. 9, *f* represents the larva as soon as hatched. The adult may be known by its rather narrow head, the black body, and bright red veins of the wings. The wings expand from two and a half to three and a quarter inches.

The pupa is long and narrow, and compared with that of *C. pruinosa* the head is longer and narrower, the antennæ considerably longer, the separate joints being longer than those of the dog-day locust. The anterior thighs (femora) are very large and swollen, smaller than in *C. pruinosa*, though not quite so thick, with the basal spine shorter than in that species, while the snag or supplementary tooth is larger and nearer the end; the next spine, the basal one of the series of five, is three times as large as the next one, while in *C. pruinosa* it is of the same size, or, if anything, smaller. The toe joint (tarsus) projects over two-thirds of the length beyond the end of the shank (tibia), while in the other species it only projects half its length. The terminal segment of the body is rather larger than in *C. pruinosa*. The body is shining gum-color or honey-yellow, with the hinder edge of the abdominal segments thickened, but no darker than the rest of the body. Length, one inch (.90–1.00); width, about a third of an inch (.35), being rather smaller than that of *C. pruinosa* and much larger than that of *C. rimosa*.

25. THE WHITE-LINED TREE HOPPER.

Thelia univittata Harris.

Order HEMIPTERA; family MEMBRACIDÆ.

Common upon oak limbs and twigs, puncturing them and sucking their juices.

This tree hopper is found on the oak in July. It is about four-tenths

of an inch in length; the thorax is brown, has a short obtuse horn extending obliquely upwards from in front, and there is a white line on the back extending from the top of the horn to the hinder extremity. (Harris.)

26. The oak blight.

Eriosoma querci Fitch.

Order Hemiptera; family Aphidæ.

A species of blight, or a wooly aphis upon oak limbs, puncturing them and exhausting them of their sap.

This blight is very like a similar insect upon the basswood. The winged individuals are black throughout, and slightly dusted over with an ash-gray powder resembling mold. The fore wings are clear and glassy, with their stigma-spot dusky and feebly transparent, their rib-vein black, and their third oblique vein abortive nearly or quite to the fork. It is 0.16 long to the tips of its wings. (Fitch.)

27. The white oak scale-insect.

Lecanium quercifex Fitch.

Order Hemiptera; family Coccidæ.

Adhering to the smooth bark of the limbs of the white oak, in June, an oval, convex, brownish-black scale, about 0.30 inch long and 0.18 wide, its margin paler and dull yellowish. (Fitch.)

28. The quercitron scale-insect.

Lecanium quercitronis Fitch.

Order Hemiptera; family Coccidæ.

On the small limbs of the black oak, a scale like the preceding but smaller, and of a nearly hemispherical form; its color varying from brownish-black to dull reddish and pale dull yellow, with a more or less distinct stripe of paler yellow along the middle of its back, and the paler individuals usually mottled with black spots or stripes. Length, 0.20; width, 0.16 inch. (Fitch.)

These scales are parasitized by *Platygaster lecanii* Fitch.

29. The oak-tumor gall-fly.

Cynips quercus-tuber Fitch.

Order Hymenoptera; family Cynipidæ.

On or near the ends of the small limbs and twigs of the white oak, hard irregular swellings thrice as thick as the twig below them, the bark upon them of a brighter cherry-red color than elsewhere, and their substance internally corky and woody; produced by the stings of a small black gall-fly with dull pale yellow antennæ, mouth and legs, its hind shanks and its antennæ towards their tips being dusky, its length 0.08 and to the tips of its wings 0.13. (Fitch.)

30. The oak-tree gall-fly.

Cynips quercus-arbos Fitch.

Order Hymenoptera; family Cynipidæ.

Swellings similar to those above described, growing on the tips of the limbs of aged and large white-oak trees; producing a small black gall-fly having all its legs and

antennæ of a bright pale yellow color, and one more joint in the latter organs than in the preceding species in the males, which sex is 0.06 in length, and to the tips of its wings 0.10. (Fitch.)

31. The oak-potato gall-fly.

Cynips quercus-batatus Fitch.

Order Hymenoptera; family Cynipidæ.

A large, hard, uneven swelling, three-fourths of an inch thick and twice or thrice as long, resembling a potato in its shape, growing on white-oak twigs more distant from their ends than the oak-tumor; producing a small black gall-fly with the basal joints of its antennæ and its legs dull pale yellow, its thighs and hind shanks black, and its middle shanks often dusky, the antennæ in the female with thirteen joints, and the length of this sex 0.09. (Fitch.)

32. The oak-bullet gall-flies.

Callaspidia quercus-globulus Fitch, and *Cynips oneratus* Harris.

Order Hymenoptera; family Cynipidæ.

Smooth globular galls the size of a bullet, growing singly, or two, three or more in a cluster, upon white-oak twigs, internally of a corky texture, each containing in its center a single worm, lying in an oval whitish shell resembling a little egg 0.15 in length; producing sometimes a black gall-fly with tawny-red legs and the second veinlet of its wings elbowed or angularly bent backwards, its length 0.15; sometimes a smaller fly (*C. oneratus*) of a clear pale yellow color, almost white, with a broad black stripe the whole length of its back, which color in the males is more extended, reaching down upon the sides, its length 0.12. (Fitch.)

These species are parasitized by two chalcid flies, *Macroglenes quercigloburi* Fitch, and *Pteromalus onerati* Fitch.

33. The oak-fig gall-fly.

Cynips quercus-ficus Fitch.

Order Hymenoptera; family Cynipidæ.

Surrounding the twigs of white oaks in a dense cluster, resembling preserved figs packed in boxes, each molded to the shape of those pressing against its sides, hollow bladder-like galls of the pale dull yellow color of a faded oak leaf, each gall producing a small black fly with the lower half of its head, its antennæ and legs pale dull yellow, its hind shanks dusky and its abdomen beneath reddish-brown, its antennæ with fifteen and in the female thirteen joints. Length 0.06, females 0.10, and to the end of their wings 0.14. (Fitch.)

34. The wool-sower gall-fly.

Cynips seminator Harris.

Order Hymenoptera; family Cynipidæ.

A round mass resembling wool, from the size of a walnut to that of a goose egg, growing on the side of or surrounding white-oak twigs in June, of a pure white color, or tinged or speckled with rose-red, and in autumn the color of sponge; producing small shining black gall-flies with bright tawny yellow legs and antennæ, and in the female the head and thorax cinnamon-red; their antennæ of fifteen and fourteen joints; length 0.08, and females 0.11 inch. (Fitch.)

INJURING THE LEAVES.

35. The forest tent caterpillar.

Clisiocampa disstria Hübner; (*Clisiocampa sylvatica* Harris).

Order Lepidoptera; family Bombycidæ.

A caterpillar like the apple-tree tent-caterpillar, but differing from it in having a row of oval white spots instead of a white stripe along its back; the colony spinning a cobweb-like nest against the side of the tree; spinning a whitish cocoon, the moth appearing early in July.

The nests of this caterpillar, unlike the prominent tents of *C. americana*, so abundant in wild-cherry trees and neglected orchards, are seldom seen, as they are of so slight a texture and are so much less conspicuous objects than the tent-like whitish nests of *C. americana;* but the caterpillars are not infrequently met with. After spinning, about the middle of June in the Northern States, a dense oblong cocoon, the caterpillar lies in it about twenty days, the moth appearing the early part of July. It occurs in the Atlantic and Southern States. Fitch states that it also occurs on the apple and cherry, the walnut, and other trees. Mr. Riley informs me that this is as destructive as any caterpillar to the foliage of the oak in the Southern States, being far more injurious than stated by Fitch, who quotes with disapproval Abbot's statement (Insects of Georgia, p. 117) that they are "sometimes so plentiful in Virginia as to strip the oak trees bare."

The caterpillar.—Pale blue, sprinkled over with black points and dots. Along the middle of the back is a row of ten or eleven oval or diamond-shaped white spots; behind each of these spots is a much smaller white spot, occupying the middle of each segment. On the hinder part of each wing are three crinkled and more or less pale orange-yellow lines, which are edged with black. On each side also is a continuous and somewhat broader stripe of the same yellow color, similarly edged on each side with black. Lower down on each side of the body is a paler yellow or cream-colored stripe, the edges of which are more jagged and irregular than those of the one above it. Length 1.50 inches. (Fitch.)

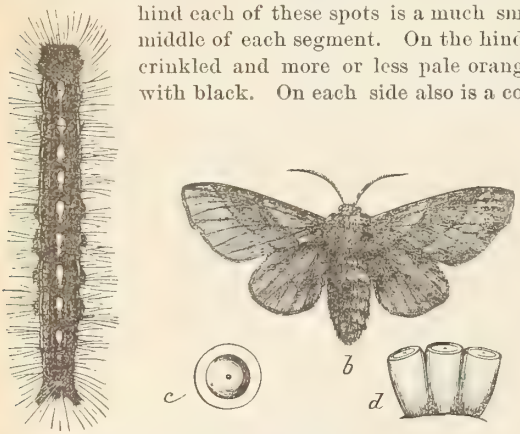

Fig. 10.—Caterpillar; *b*, female moth; *c*, *d*, egg of the oak tent-caterpillar.—After Riley.

The male moth usually measures 1.20 across its spread wings. Its thorax is densely coated with soft hairs of a nankin-yellow color. Its abdomen is covered with shorter hairs, which are light umber or cinnamon brown on the back and tip and paler or nankin yellow on the sides. The antennæ are gray, freckled with brown scales, and their branches are very dark brown. The face is brown with the tips of the feelers pale gray. The fore wings are gray, varied more or less with nankin yellow, and they are divided into three nearly equal portions by two straight dark brown lines, which cross them obliquely, parallel with each other and with the hind margin. The space between these lines is usually brownish and darker than the rest of the wing, being quite often

of the same dark brown color as the lines, whereby they become wholly lost. Sometimes the hind stripe is perceptibly margined on its hind side by a pale yellowish line. The fringe is of the same dark brown color with the oblique lines, with two whitish alternations towards its outer end. But sometimes it is of the same color with the wings and edged along its tip with whitish. The hind wings are of a uniform pale umber or cinnamon brown, sometimes broadly grayish on the outer margin, and across their middle a faint darker brown band is usually perceptible, its edges on each side indefinite. The fringe is of the same color with the wings or slightly darker and is tipped with whitish. The under side is paler umber brown, the hind wings often gray, and both pairs are sometimes crossed by a narrow dark brown band, which on the hind wings are curved outside of the middle. All back of this band on both wings is often paler, and more so near the band.

The female is 1.75 in width, and, in addition to the shortness of the branches of her antennæ, differs from the male in her fore wings, which are proportionally narrower and longer, with their hind margin cut off more obliquely and slightly wavy along its edge. Hence, also, the dark brown lines cross the wings more obliquely, the hind one in particular forming a much more acute angle with the outer margin. And all the wing back of this line is sometimes paler or of a brownish ashy color. And the fringe of these wings has not the two whitish alternations which are often so conspicuous in the male. The head and fore part of the thorax is cinnamon brown. The abdomen is black, clothed with brown hairs, though very thinly so on the anterior part of each segment, where these hairs are intermingled with silvery gray scales. (Fitch.)

36. The Californian tent caterpillar.

Clisiocampa californica Packard.

Feeding on the scrubby oak, in abundance near San Francisco, a tent-caterpillar with a black head and a double rusty black dorsal line, appearing from the middle of March till the middle of April.

"This species," says Mr. Stretch (in Papilio, vol. i, No. 5), "is exceedingly abundant in the neighborhood of San Francisco, and is probably widely distributed." Near San Francisco its favorite food-plant is a species of scrubby oak, *Q. agrifolia*, but it is sometimes found on the blackberry (*Rubus*) and other shrubby plants. Its depredations do not seem to have extended to the orchards. The nests may be seen in warm localities as early as the middle of March, while in those more exposed they are not seen till the middle of April; but both these dates are sufficiently early to protect the orchards. The larvæ pupate in about six weeks from the egg, and the imago appears in about a fortnight.

Larva.—Head black, legs black; abdominal feet pale testaceous. Body black, faintly dusted with rusty, which forms an exceedingly broken and indistinct lateral line, and a more complete double dorsal line. Each segment carries a lateral, transverse, very faint linear dot, above the lateral line. The dorsal and lateral hairs are all tawny. The general appearance of the larva is tawny brown. Length about 1.40 inches.

Cocoon.—Constructed in the crevices of bark or in the angles of masonry, where accessible, and consisting of a loose, white web, in which is suspended the long ovate cocoon of dense papery consistency, thickened with a yellowish powdery gum. (Stretch.)

37. The Pacific oak tent caterpillar.

Clisiocampa constricta Stretch.

Feeding on the leaves of the Sonoma oak of California, a tent-caterpillar, with an irregular black dorsal stripe and transforming at the end of May, the moth appearing late in June.

The following descriptions of larva, chrysalis, and cocoon of this moth is copied from Mr. Henry Edwards's account in the Proceedings of the California Academy of Sciences, vol. v, 1874, p. 368.

Larva.—Head slate-gray, with black spots; mouth-parts black, tipped with dull yellow. Body slate-gray, covered laterally with fine black speckles. Along the middle of the dorsal region is an irregular black stripe, marked on its sides with waved orange lines, and surmounted at the union of the segments by a double tuft of chestnut-brown hairs. On the second and third segments, in the middle of the notched black line, is a stripe of dull white. From the base of the orange-brown tufts spring a few scattered black hairs, longest anteriorly, and from the forepart of each segment arise lateral tufts of white hairs. The stigmata are orange, with black central points. Above the base of the feet is a black interrupted line, out of which spring other white hairs, irregularly disposed. Under side dull velvety black, with the anterior portion of each segment whitish. Feet and prolegs black, yellow at their tips. Length 1.85 inches. Food-plant, *Quercus sonomensis* Benth.

The larva is frequently attacked by a species of Ichneumon, the eggs of which are visible on the head and anterior segments.

Chrysalis.—Chestnut-brown, with few hairs along the base of each segment.

Cocoon.—Ovo-lanceolate, very silky, yellowish white, with some portions glued in compact mass, and whiter than the remainder. Chrysalis only imperfectly seen through the web. Larva May 22, changed to chrysalis May 29. Imago, June 16.

The caterpillar of a species of Clisiocampa, which differs from the two Californian species just described and from the eastern ones, the moth of which we did not obtain, was abundant at Virginia City and Helena, Mont., on the leaves of the wild rose so common near those towns, its conspicuous tents readily attracting the eye. A half-grown larva, found, June 16, at Virginia City, measuring 0.75 inch in length, had a blue-black head. The body was blue on the sides, with dark spots; a black subdorsal spot rudely resembling a St. George's cross occurred on each side of each ring. The median dorsal line is pale blue, interrupted by the sutures between the segments. On each side of the line is a brown ochreous patch. The hairs are ochreous brown; the long ones paler. When fully grown it is about the size of the Eastern tent-caterpillar (*C. americana*), *i. e.*, an inch and a half. The mature larva found at Helena, June 21, was described from life in my notes, as follows:

Head grayish brown; body pale, grayish-blue on the sides, speckled with black, with a large black squarish patch, extending above into the subdorsal broad longitudinal band, which is mottled with bright ochreous brown, short wavy lines. A pale bluish distinct longitudinal broad median dorsal stripe interrupted by the sutures between the segments. Hairs long, pale brown. Body blackish beneath.

At this date the caterpillars had begun to be full fed, and one caterpillar had spun a cocoon under a stone.

This caterpillar differs from that of *C. americana* in having a broad blue dorsal stripe instead of a white one, and there is no broad longitudinal black stripe, as in the Eastern caterpillar. The moth probably differs from any of the Pacific coast species, the larva being quite unlike that of *Clisiocampa californica* Pack., which is closely allied to *C. americana*. It also differs decidedly from the caterpillar of *C. constricta* Stretch, the dorsal stripe being blue instead of black.

38. The Californian lappet-moth.

Gastropacha californica Pack.

Order Lepidoptera; family Bombycidæ.

Feeding in California on the oak as well as apple and pear trees, and spinning thin and irregular webs over the branches.

The larva, and pupa and cocoon have as yet not been described. I extract the following notice of its habits, by Mr. Henry Edwards:

The moth lays its eggs in June, and they must remain unhatched until the following spring. Just when the young shoots of the oaks (*Quercus agrifolia* Nee) begin to appear, the larvæ make their appearance also, spinning thin and irregular webs over the branches of the trees. In these webs they house mostly during the heat of the day, but sally forth in the evening and at night for food. In this way they will soon strip a tree of its leaves, though it is well to say that the oaks do not seem to be permanently affected, as they soon send forth fresh shoots, and toward the time that the caterpillars undergo their change to the chrysalis they are green and gay again. The larvæ retain the shelter of their web until after the third molt, when they wander away singly, are found everywhere, becoming sometimes a complete nuisance in gardens and fields. They feed in their more mature stages upon many plants besides the oak, eating with avidity willows, ash, *Æsculus californica*, *Photinia arbutifolia*, *Arbutus menziesii*, as well as apple and pear trees. Toward the end of May they spin their cocoons, seeming to have no choice of locality, but fixing themselves wherever they may chance to be, either on walls, palings, trunks, or branches of trees, stems of grapes, or among the leaves of herbaceous plants. The time in the chrysalis state is about eighteen to twenty-one days, so that the moths emerge and are in the greatest abundance about the middle of June. They come very readily to light, and are a pest to the entomologist in his nocturnal rambles. I regret that I cannot now send you descriptions of the larva and chrysalis.

39. The Californian phryganidea.

Phryganidea californica Pack.

Order Lepidoptera; family Zygænidæ.

Very destructive to young oaks, a naked, yellowish-white caterpillar, striped with black and white, with a large head, wandering incessantly over the bushes and feeding very rapidly; spinning no cocoon, but the chrysalis, yellowish and black, attached by the tail to fences, &c.

This is, by its numbers and familiar habits, one of the best known and most destructive insects of California. The following account has been furnished me for Hayden's Report by Mr. Henry Edwards.*

This insect is also very destructive to our young oaks, the caterpillars, which are perfectly naked and with the head almost monstrous in size, making their appearance about the same time as those of *Gastropacha*. They are restless little creatures, wandering incessantly over the trees, and feeding very rapidly. They spin no cocoon, but hang by the tail, like the larva of *Vanessa*, &c. The change to the chrysalis is undergone in April and May, and the moths appear in about fifteen or sixteen days. There is a second brood of these insects, the imagos of the latter appearing in September and October. Indeed, fresh specimens are now upon the wing, though the second brood is by no means so abundant as the first. I have observed that *Phryganidea* and

Fig. 11.—Californian Phryganidea.—From Packard.

* A. S. Packard, jr., Report on the Rocky Mountain Locust, &c. Hayden's Report U. S. Geological Survey of the Territories for 1875.

Gastropacha never associate upon the same tree, and I think that the former has always the mastery. This is perhaps owing to some excretion from its body which is unpleasant to the *Gastropacha;* but of course I do not speak with certainty as to this fact. It is, however, sure that they are never found in large quantities on the same tree. I am inclined to think that *Phryganidea* is more destructive to the oaks than the other species, as it feeds solely upon *Quercus*, while the other, as I have said, is not so particular in the choice of its food. I inclose my published description of the eggs of *Phryganidea*. I quote Mr. Edwards's description of the egg and larva:

The egg is spherical, a little flattened above, shining, yellowish-white at exclusion, attached in clusters of about ten or twelve to the upper sides of the leaves. The third day the apex of the egg assumes a dull orange hue, afterwards changing to a bright reddish-purple and gradually to a duller shade as the young larvæ emerge. The eggs were laid by a female in my possession on July 5. In the young larva the head is very large, almost monstrous, pale olive-brown, with a narrow black line at base; body pale canary-yellow, with four rows of black spots arranged longitudinally in lines.

The larva is slender, with the head prominent, globose; last segment but one humped; head pale brown; body black above, dirty green below, with a broad dorsal line of dirty greenish, divided by three narrow black lines, and the sutures faintly marked with same color. There is also a narrow, broken, stigmatal line of dirty greenish, and a similar line above each of the abdominal legs. Tip of the last segment horny, the segment not being used to assist in progression, but usually slightly elevated; body smooth, transversely wrinkled. Younger specimens chiefly differ in the disproportionate size of the head. Length 0.90 to 1.00 inch.

Pupa, naked, suspended by the tail, greenish white, with black markings; all the sutures of the head, thorax, legs, and antennæ lined with black. The mesothorax has a central black line; the abdomen has a dorsal row of black points on the front edge of each segment, and a lateral row blending into each other towards the anal segment, which is black; below with two sublateral series of black transverse spots nearly blending into two longitudinal bands. Length 0.75 inch. (Stretch.)

Mr. Behrens, of San Francisco, writes me that three generations of the *Phryganidea* appear in a year. "In 1875 it, with the larva of the *Gastropacha californica*, ate our evergreen oaks to broomsticks. You could hear the caterpillars eat and their manure drop, the latter covering everything; it could be swept together by the bushelful. In the wake of both followed ichneumon parasites."

This singular insect was originally, from a study of the moth alone referred by me to the Psychinæ, but Mr. R. H. Stretch, with a knowledge of its transformations, has shown that I was in error, and has placed it very properly in the Zygaenidæ, in his valuable work entitled "Illustrations of the Zygaenidæ and Bombycidæ of North America" (1873). Having recently received specimens of the larvæ and pupæ from Mr. James Behrens, it was at once evident on a cursory examination that the early stages show all the characteristic features of Alypia and Eudryas and the other higher members of the Zygaenidæ. The venation of the moth is, however, aberrant, and this together with the dull-brown coloration and semi-hyaline wings misled me into placing it near Psyche.

40. THE ORANGE-STRIPED OAK-WORM.

Anisota senatoria Hübner.

Order LEPIDOPTERA; family BOMBYCIDÆ.

In August, sometimes stripping the trees, a spiny black caterpillar, with four orange-yellow stripes on the back and two along each side, with two black prickles above and two on each side, changing the following June to a large ocher-yellow moth, with a large white dot on the fore wings.

These prickly caterpillars, during certain years, as I have noticed at Amherst, Mass., so abound as to nearly strip large oak branches of their leaves, and is perhaps the most destructive of all our caterpillars to the foliage of the oak. The spines, if they happen to penetrate the skin, as Fitch and others have observed, sting like nettles. This species is the more injurious in the Northern States, while *A. stigma* is most destructive in the Southern, Mr. Riley informs me. According to Riley, Mr. Bassett has bred a small ichneumon fly (*Limneria* (Banchus) *fugitiva* Say) from this caterpillar. Riley has also bred it from the larva of *Anisota stigma*, as well as other caterpillars.

41. THE SPECKLED SPINY OAK-WORM.

Anisota stigma Hübner.

Eating the leaves in September, in the Southern States especially, a worm like the preceding, but of a bright tawny or orange color, with a dusky stripe along the back and dusky bands along the sides, and with its prickles lengthened into thorn-like points.

This worm is said by Mr. Riley to be nearly as destructive in the Southern States as *A. senatoria* is in the Northern.

Full-grown larva.—Average length, 50mm. General color pale tawny-red, inclining to orange. The whole surface covered with bright yellow, almost white papillæ of different sizes, giving a speckled appearance; the usual medio-dorsal narrow line; a broad subdorsal longitudinal stripe of a paler color and having a dingy carneous hue; a narrower sub-stigmatal stripe of the same hue. Horns and spines black and marked with white papillæ, and with a tendency to branch, especially toward the tips; the longer horns on joint 2 being blunt-pointed, and also with white papillæ at the base. Head uniformly gamboge-yellow; cervical shield, anal plate, and plates on anal prolegs of the same yellowish color as head. A pale medio-ventral line; the thoracic legs pale, the prolegs with pale papillæ outside on a dark ground.

The species is at once distinguished from the other species of the genus by the longer spines, their tendency to furcation and being speckled with white papillæ, and by the less distinct striping. (Riley.)

42. THE ROSEY-STRIPED OAK-WORM.

Anisota pellucida Hübner.

Order LEPIDOPTERA; family BOMBYCIDÆ.

Eating the leaves in July, in New York, a two-horned prickly worm of an obscure gray or greenish color, with dull brownish-yellow or rosy stripes, and its skin rough from white granules.

This species has been said by Fitch to have been common for many years in Salem, N. Y., where *A. stigma* has seldom been seen. The worms

mostly enter the ground to transform into the pupa early in August, though some remain on the trees as late as the middle of September.

The following description is copied from Prof. G. H. French's Report of the Curator of the Museum of the Southern Illinois Normal University, 1880. They occurred on different species of oak during the middle and last of September, most of them pupating by October 2d in the soil.

The caterpillar.—Length about 1.25 inches. General color pale dull green, striped with fine red substigmatal, subdorsal, and dorsal stripes, the last very pale, so as to be almost obsolete. Head with a slightly yellowish tinge. On each segment there are six short black thorns or sharp points, the two on the back of the second segment behind the head being about ¼ inch long, but the rest much shorter.

We add also the following description furnished by Mr. Riley, who has compared it with the caterpillar of *Anisota stigma:*

Pallucida comes nearest to *A. stigma* in general appearance, but the spines are shorter, more pointed, uniformly black; the color is darker, being almost black, so that the papillæ, which are rather denser, give the dark portion a bluish cast; the subdorsal and stigmatal lines are of a more intense red inclining to pink, and the stigmatal line is rather broader than the subdorsal. The average length is somewhat less and the larva more slender than in *stigma*; the shorter, blacker spines, deeper colors, and stronger contrast between the lines at once separating it from *stigma*. (Riley.)

43. The oak tussock caterpillar.

Halesidota maculata Harris.

Order Lepidoptera; family Bombycidæ.

Feeding in September, a black, very hairy caterpillar, with yellow and black tufts and yellow on the sides of the body; the worm spinning late in September a yellowish gray oval cocoon, constructed of silk, with the hairs of the caterpillar interwoven; the moth appearing the first week in June.

The larva.—Cylindrical; 1.30 inch long. Head large, slightly bilobed; black, with a faint white streak down the front as far as the middle, where it becomes forked. Body above black, thickly covered with tufts of bright yellow and black hairs. On the second, third, and fourth segments the hairs are mixed, yellow and black; those of the second and third segments, overhanging the head. From the fourth to the eleventh segments, inclusive, is a dorsal row of black tufts, the largest of which are on the tenth and eleventh segments; the fourth and eleventh segments have also a black tuft on each side near the base. The hairs on the sides of the body, from the fifth to the tenth segments, inclusive, are all bright yellow, while those on the sides of the twelfth and thirteenth are mixed with black. On the third, fourth, eleventh, and twelfth segments are a few long, spreading, yellow hairs, much longer than those elsewhere. (Saunders.)

The moth.—Light ocher-yellow, with large irregular light-brown spots on the fore wings, arranged almost in transverse bands. It expands nearly an inch and three-quarters. (Harris.)

44. The oak heterocampa.

Heterocampa pulverea Grote and Robinson.

Order Lepidoptera; family Bombycidæ.

Feeding on the red and scarlet oaks in southern Illinois a large bright-green caterpillar, the body deeper than broad, tapering a little from the middle to the head, but more behind, variously marked with purple and orange. (French.)

Professor French has reared this caterpillar, which occurred in Union County, Illinois, June 30th; July 6th it went into the dirt of the breeding-cage to pupate, the moth appearing August 6th.

The caterpillar.—Length, 1.25 inches. General color bright green, head gray, first segment behind the head with two dark purplish black dorsal warts; from these a purplish-brown line extends backward. This purple-brown color extends over the back part of the sixth segment, the whole of the seventh, and most of the eighth. On the third segment begins a dorsal orange-patch, which reaches back to the sixth segment, filling the space between the purple lines. On the ninth segment is another orange-patch. The tenth segment has no purple and only a little orange below the stigmata. There is also a faint yellowish dorsal line. The eleventh segment has purple-brown subdorsal lines with orange on the back. These lines unite on the twelfth segment and form a broad dorsal line. Feet and legs purple. (French.)

45. The six-flapped slug worm.

Phobetrum pithecium Smith and Abbot.

Order Lepidoptera; family Bombycidæ.

A singular dark-brown short, broad, ovate, flattened caterpillar, with six long, tongue-like, slender, fleshy lateral appendages, sometimes feeding on the oak.

This singular caterpillar, usually found on the plum, cherry, and apple; changes to a brown moth with very narrow wings. In the male the antennæ are very broadly pectinated, and the remarkably long narrow fore wings are partly transparent. Mr. Lintner has bred it from the oak.

46. *Cosmia orina* Guen.

Order Lepidoptera; family Noctuidæ.

A smooth yellowish-green larva, $\frac{7}{10}$ inch long, body cylindrical, above pale yellowish green, with a dorsal line of yellow, less distinct on the anterior segments, and covered with fine dots and short streaks of yellow, less numerous on the second and terminal segments. Head rather smooth, flattened in front, slightly bilobed, pale whitish-green. One specimen, which entered the chrysalis state on the 24th of June, produced the imago on the 18th of July. (Saunders.)

47. The Polyphemus silk-worm.

Telea polyphemus Hübner.

Feeding on the leaves in August and September, a large, fat, pale-green worm, as large as one's finger, with pearly red warts, with an oblique white line between the two lowermost warts; the head and feet brown, and a brown V-shaped line on the tail.

The American silk-worm, not uncommonly met with on the oak, may be artificially reared in great abundance on the oak, and the silk, reeled from the cocoons, can make a durable and useful cloth. The large, thick, oval cocoons are attached to the leaves and fall with them to the ground in autumn. The eggs are laid in June, when the moths may be seen

flying at night. It is one of our largest moths, expanding from five to six inches, and is dull ocherous-yellow, with a large transparent eye-

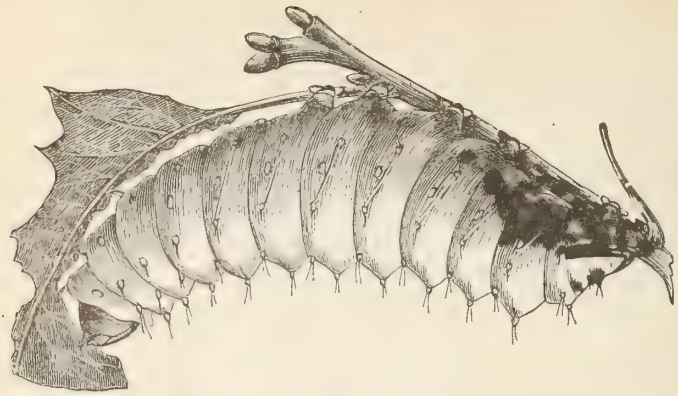

FIG. 12.—American silk worm, natural size.—From Packard.

like spot in the middle of each wing. It is not common enough to be destructive.

48. *Catocala fratercula* Grote and Robinson.

Order LEPIDOPTERA; family NOCTUIDÆ.

Living on the live oak in early spring in Florida, remaining in the pupa state two weeks. (A. Koebele, Bull. Brooklyn Ent. Soc. I, p. 44.)

49. THE SINGLE-DOTTED PARAPHIA.

Paraphia unipunctaria Haworth.

Order LEPIDOPTERA; family PHALÆNIDÆ.

Eating the leaves early in June, a gray span worm 1.40 inch long, sprinkled with blackish dots and short lines, its head and neck a little thicker than the body, each ring with a small squarish white spot above on its hind edge and with two blackish parallel lines on each side of this spot.

This moth ranges from New England to Texas; it is said by Fitch to feed on the oak, and by Abbot (in Guenée) to live on the "elm, oak, *cournouiller*," &c. The *Amilapis triplipunctata* of Fitch is undoubtedly synonymous with Haworth's species, originally described as an English species.

The moth.—Of a uniform clear fawn-color, without the usual spots and speckles present in other species of the genus; a basal, brown hair-line bent outward acutely on the median vein; a broad, diffuse, dark median band common to both wings. The extradiscal line is dark, finely scalloped, curved outward below the costa, and sweeping inward below the first median venule; beyond this line both wings are deeper fawn-color. At a little distance below the costa, and nearer the extradiscal line than the outer edge of the wing, is a conspicuous angular, clear, white spot. Fringe dark, the scallops filled with whitish scales. Hind wings like the anterior pair, though the extradiscal line is not sinuous, but curved regularly outward. Beneath, paler than above; the median band is distinct, and the extradiscal line more or less so; the tints are much as above. The wings expand 1.40 inches.

49. The harlequin oak geometer.

Aplodes mimosaria Guenée.

Order Lepidoptera; family Phalænidæ.

Feeding upon the leaves of the oak, a cylindrical brown geometric caterpillar, its back with singular curved lateral appendages, covered with short, velvety hairs, changing to a pale yellowish browner pupa, with a simple caudal spine, nearly ½ an inch long. (Walsh).

The moth.—Male antennæ moderately pectinated, body and wings pea green, the wings broad, the hinder pair well rounded, less angulated than usual, anal angle square; head and antennæ white; front of the head bright rose-colored, except along the front edge. Palpi white, end of second joint and under side of the third joint roseate. Both pairs of wings crossed by linear, slightly-waved white lines. Inner line on the fore wings very near the base, regularly curved; outer line straight, waved, parallel with outer edge. Costa narrowly edged with white. Fringe white on both wings. Outer side of the fore femora green, of tibiæ dull red; two posterior pairs of tibiæ white. Abdomen white, green above at base, with a conspicuous white spot at base. Expanse of wings, 1¼ inches. Ranges from New England to the Middle and Western States.

50. The large scalloped winged geometer moth.

Stenotrachelys approximaria Guenée.

In the Southern States feeding on the oak a large geometer whose body is ash gray, washed with brown, with a dorsal series of white lozenges, lined with black and traversed in their middle by a twin, interrupted black vascular line. Found in March and April, the moth remaining in the chrysalis.

This caterpillar, according to Abbot (in Guenée), lives in Georgia on *Similax rotundifolia* and *laurifolia*, and, according to Abbot, on Quercus. This species is known to inhabit North Carolina as well as Georgia.

The moth.—It may be recognized by the deeply scalloped wings, and the large head, which is rather swollen in front. It is whitish gray, the wings clear, not bordered with brown. The fore wings with two distinct, heavy, black lines, the inner very near the base of the wing, regularly curved, a little pointed on the costa. Outer line bent at right angles on the basal third of the first median vein, the line thence going straight to the costa, though zigzag in its course; from the rectangular bend, the line follows a course subparallel to the median line, where it again turns rectangularly, ending on the middle of the inner edge of the wing. An inner reddish-brown line is parallel and near it below the median vein, and above passes just within the faint discal dot. Beyond this line the wing is speckled with transverse short, linear spots. A scalloped marginal, distinct black line. Expanse of wings, 1.90 inches.

51. The two-lined oak geometer moth.

Endropia bilinearia Packard.

A geometric caterpillar feeding on the oak; becoming a chrysalis early in July, emerging as a moth two weeks later.

The moth.—Clear fawn-brown; wings much darker and less spotted than in the other species of Endropia. Body and wings concolorous; front edge of the fore wings paler than the rest of the wing and spotted finely, especially on the edge, with brown specks. Two brown hair-lines, the inner situated on the basal, and the outer on the outer third of the wing; the inner line bent on the front edge of the wing. Outer line a little curved outward in the middle of the wing. Half-way between this line and the outer edge of the wing is a diffuse, interrupted, faint grayish band with a few dark scales, often wanting, and connecting with an oblique apical patch, also concolorous with the front edge of the wing. Outer edge of the wing deeply notched,

the eight acute points (including the apex, which is very acute) tipped with a few black scales, the fringe being whitish between. Beneath, body and wings ocher-yellow, especially in the middle of the wings. Both wings marked alike with a basal diffuse, broad brown line, and an outer much curved brown hair-line. An outer row of dark patches forming a faint broken line. An apical, oblique, whitish patch. Hind edge of fore wings with darker spots and patches than elsewhere. Expanse of wings, 1.30–1.65 inches. This fine moth occurs all over the United States and on the Pacific coast from California to Oregon.

52. THE THREE-TOOTHED OAK GEOMETER MOTH.

Endropia pectinaria Guenée.

Living on the oak and other trees a large gray measuring worm, transforming to a large Endropia, with three sharp teeth in the hind wings.

The transformations of this moth have been observed by Abbot in Georgia, who found it living on the oak and poplar in April. It changes to a chrysalis at the beginning of May, and the moth appears at the end of the same month.

Larva.—Pale green, with the sutures and sides reddish, a double angle bordered with reddish on the second segment, another more salient on the sixth, and finally another on the tenth; the fifth has on each side a small pointed tubercle. Head and feet concolorous.

Moth.—The hind wings with a large tail and toothed; the fore wings angular, sickle-shaped. Body and wings pale whitish-ash. Wings thickly covered with fine speckles. Fore wings with three lines, the usual inner and outer line, and a third wavy submarginal hair-line. The two inner lines distinct, of even width, a little oblique, not waved; the innermost line situated exactly on the inner third, the outer line on the outer third of the wing. Front edge of the fore wings stained with reddish on the end of the outer line. Submarginal hair-line wavy, sinuate, reddish, situated half-way between the outer line and the edge of the wing, and disappearing below the second median venule, scalloped between each venule, much more distinct below than above. On the hind wings a single brown line, and traces of a submarginal wavy line. Beneath, paler than above, with the lines reproduced beneath, and dull colored: the third submarginal line on both wings partly obsolete, but clearer than above: fringe reddish. Expanse of wings 1.50 inches. Ranges from Maine to Missouri.

The parent of this caterpillar, which is found in the United States, north and south, and west as far as Kansas, may be known by the three well-marked teeth on the apical half of the hind wings, by the clear border of the wings, and the dark clear lines on the under side.

The caterpillar lives in Georgia on the oak and other trees, according to notes left after his death by Abbot, and is of a pale yellowish gray, with a dorsal lozenge-like mark. The 4th segment is darker, and on the back of the 8th, 9th, and 10th are also two obscure marks bifid anteriorly on the first, and carrying a blackish angle on each extremity of the second. The head and feet are concolorous. It is found in Georgia in May and June, and the moth is disclosed towards the end of this last month. A second generation enters the chrysalis state towards the middle of July to appear as moths in the beginning of August. In the Northern States the species is undoubtedly only single-brooded.

Besides these geometric caterpillars, that of *Metrocampa perlaria* Guenée should be looked for on the oak, as its closely allied European congener (*M. margaritata*) feeds on the elm, hornbeam, birch, and oak.

53. THE GREEN AND RED OAK SPAN WORM.

Metanema quercivoraria Guenée.

Feeding on the oak, a pale green span worm, marked with red, changing to a brownish gray chrysalis, from which a beautiful sickle-winged moth comes.

54. THE LEAF-ROLLING WEEVIL.

Attelabus bipustulatus Fabr.

Rolling up the leaves of the red, post, and laurel oak (*Q. imbricaria*), late in April, forming compact, cylindrical cases containing a single egg; the case dropping to the ground, the larva after hatching feeding on the food around it, and finally transforming into a long-snouted weevil. A second brood of larvæ in July. (Murtfeldt.)

This beetle has the curious habit of rolling up a leaf, trimming and tucking in the lower ends with her beak. The egg is first deposited near the tip of the leaf, and a little to one side; the blade of the leaf is then cut through on both sides of the midrib, about an inch and a half below; a row of punctures is made on each side of the midrib of the severed portion, which facilitates folding the leaf together, upper surface inside, after which the folded leaf is tightly rolled up from the apex to the transverse cut, bringing the egg in the center; the concluding operation is the tucking in and trimming off the irregularities of the ends. A few days after completion the cases, first observed the latter part of April, drop to the ground; by May 15 several larvæ hatched and fed on the dry substance of their nest, and by the end of May they pupate within the nest: this state lasted from five to seven days, the first beetles issuing by June 2, while a second brood of larvæ may be found early in July. (Murtfeldt.)

The larva.—Average dorsal length, 0.22 inch; diameter on abdominal segments, 0.06 inch, tapering anteriorly from fourth segment. Yellowish white; thoracic segments slightly depressed on the back and smaller beneath; abdominal segments convex above and flat beneath, each one divided into three irregular shallow transverse folds, lateral surfaces with a double row of smooth polished oval tubercles, most symmetrical in form and position from segments 4 to 11 inclusive; above the tubercles on each segment is a deep depression. Head horizontal, rounded, small, about half the diameter of segment next behind, into which it retreats; white, the mandibles and other mouth parts reddish brown, surrounded by long hairs.

The pupa is cream white, 0.12 inch long; abdominal segments sharply ridged; posterior extremity terminates in a pair of bristly points, white, tipped with brown.

The beetle is a small, highly polished black weevil, with two large orange-red spots at bases of the wing-cover. (Miss Murtfeldt.)

I have also found, May 30, on the leaves of the oak near Providence, the rolls made by a species of Attelabus, apparently, but they were slenderer than those of the Attelabus found upon the alder.

I have also found on the leaves of the oak at the end of May, near Providence, *Cryptorhynchus bisignatus* Say. It may prove to live at the expense of this tree.

55. THE WHITE BLOTCH OAK-LEAF MINER.

Lithocolletis hamadryadella Clemens.

Order LEPIDOPTERA; family TINEID.E.

Making a whitish blotch-like mine upon the upper surface of the leaves of different oaks, a minute, flat, horny, footless, active, brownish-yellow larva, which transforms within the mine in a delicate disc-like cocoon. (Comstock.)

Several species of oak are injured by this leaf miner, which ranges from New York to Washington. Sometimes each leaf will contain on an average four or five miners, and young shade trees are thus weakened by their attacks in June. There are in Washington five or six broods of moths. The best remedy is to collect and burn the fallen leaves in the spring, since they contain the worms in their final stage before transforming.

The moth has white front wings, with three broad irregular bronze bands across each one, each band being bordered with black on its inner side. The hind wings are silvery. The wings expand 0.28 inch. (Comstock.)

56. *Brachys æsosa* Melsheimer.

Order COLEOPTERA; family BUPRESTIDÆ.

I have found this small Buprestid upon the leaves of the oak early in summer in Maine, and late in May near Providence, R. I. It most probably mines the leaves of the oak, but its habits are not yet known.

(We introduce a cut of *B. æruginosa*, much enlarged, to illustrate a larva of this genus.)

57. FITCH'S OAK-LEAF MINER.

Lithocolletis fitchella Clemens.

Order LEPIDOPTERA; family TINEIDÆ.

Forming a tent-like mine on the under surface of the leaves of different species of oaks, a minute, nearly cylindrical, white larva. (Comstock.)

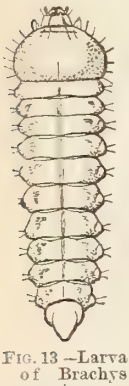

FIG. 13.—Larva of Brachys æruginosa.—From Packard.

The mine is visible on both sides of the leaf, while that of *L. hamadryadella* is to be seen only on the upper side. The insect hybernates in the pupa state within the leaves, so that the same general remedy of gathering and burning the leaves will apply to this as to the preceding leaf-miner.

The moth has pale reddish saffron fore wings, with a slight brassy hue. Along the front edge (costa) are five silvery-white costal streaks; on the inner margin are two conspicuous silvery dorsal streaks, while the hind wings are grayish fuscous. (Comstock.)

58. THE OAK-LEAF PHYLLOXERA.

Phylloxera rileyi Lichtenstein.

Forming a yellow circular spot on the under side of the leaf, but showing plainly above, of the white and post oak; the species of small size and unusually slender, and with long tubercles in the pupa. (Riley.)

INJURING THE SEED (ACORNS).

59. THE ACORN WORM.

Balaninus rectus Say.

Order COLEOPTERA; family CURCULIONIDÆ.

A grub like the chestnut borer, boring into the acorns and transforming into a similar beetle, which is "easily distinguished from *P. nasicus* by the finer, more rectilinear

rostrum, and it always differs from *B. nasicus* in having no bands or *vitta*, the elytra being uniformly spotted, as in *sparsus* Schoen. This is the species I breed from acorns, and I believe it also infests hazel-nuts." (Riley.)

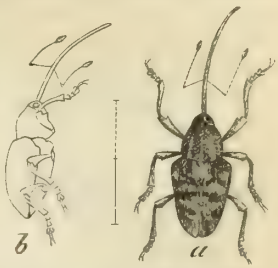

FIG. 14.—Acorn weevil. Balaninus rectus.—After Riley.

60. THE ACORN MOTH.

Holcocera glandulella Riley.

Order LEPIDOPTERA; family TINEID.E.

Occupying the deserted holes of the acorn weevil, a narrow-winged moth which drops an egg in the hole, from which hatches a slender grayish white or yellowish worm with 16 legs and blue black dorsal marks, with a light brown conical shield and dusky anal plate. The moth with silvery-gray fore wings, marked with dull reddish; two distinct dark discal spots; a pale transverse stripe across the basal third of wing, slightly bent inwards at the middle; this stripe is well relieved behind by a dark shade, which generally extends from the bend to the costa above the discal spots, forming a more or less distinct triangular shade in the anterior middle portion of the wing. Hind wings brownish gray. Expanse of wings, 0.50–0.80 inch. (Riley.)

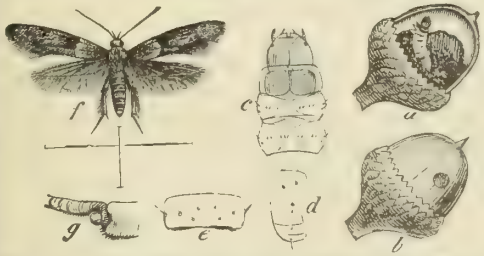

FIG. 15.—Acorn moth (f). *a*, *b*, acorns containing the worm; *c*, front end of the worm; *d* and *e* side and top view of a segment.—After Riley.

The following insects are also known to prey upon the oak:

LEPIDOPTERA.

61. The banded hair streak butterfly. *Thecla calamus* (Hübner).
62. Red spotted purple butterfly. *Basilarchia astyanax* (Fabr.).
63. Viceroy butterfly. *Basilarchia archippus* (Cramer).
64. Tiger swallow-tail. *Papilio glaucus* Linn.
65. Sleepy dusky-wing butterfly. *Thanaos brizo* Bard & Leconte.
66. Juvenal's dusky-wing. *Thanaos eunius* Scudd. Burgiss.
67. The oak tussock moth. *Halesidota tessellaris.* Basswood (Walsh).
68. The hickory tussock moth. *H. caryæ* Harris.
69. Clinton's tussock moth. *Parorgyia clintonii* G. & R. (Coquillet in Can. Ent., xii, 44).
70. The Io moth. *Hyperchiria io* (Fabr.).
71. The Maia moth. *Eucronia maia* (Drury).
72. *Heterocampa pulverea* G. & R. (French, Can. Ent., xii, 88.)
73. The oak slug worm. *Euclea monitor* Packard.
74. *Euclea querceti* (H. Sch.).
75. *Euclea quercicola* (H. Sch.). Allied to these is *Callochlora chloris* H. Sch., Fig. 16, the larva of which may be found on the oak.
76. *Edema albifrons* (Gm.-Abb.). (Harris' Correspondence, p. 304.)
77. *Nadata gibbosa* (Gm.-Abb.)? (Harris' Correspondence, p. 308.)

78. *Orgyia guloso* H. Edwards. (Edwards in Papilio, I, p. 61.)
79. *Catocala coccinata* Grote. (Coquillet in Papilio, I, p. 56.)
80. *Nematocampa filamentaria* Guenée. (Figured in Packard's Guide.
81. *Therina endropiaria* Packard. (Goodell, Can. Ent., xi, 194.)
82. *Dakruma pallida* Comstock.
83. Oak-leaf Tortrix. *Argyrolepia quercifoliana* Fitch, 5th Rep., p. 826.

Fig. 16.—Callochlora chloris. Nat. size.

84. *Psilocorsis quercicella* Clemens.
85. *Blastobasis coccivorella* Chambers.
86. *Exartema inornatana* Clemens.

The following *Tineidæ* are said by Chambers to live on various species of oak:

Leaf-miners of the upper surface.

87. *Lithocolletis cincinnatiella* Chamb. Yellowish blotch mine.
88. *Lithocolletis hamadryadella* Clem. Whitish blotch mine.
89. *Lithocolletis tuliferella* Clem. } Mines as to form somewhat like the
90. *Lithocolletis bifasciella* Chamb. } track made by a drop of water.
91. *Lithocolletis bicolorella* Chamb. Yellowish blotch mine, like that of *L. ulmella* in elm.
92. *Lithocolletis unifasciella* Chamb. } Irregular yellowish blotch mines,
93. *Lithocolletis bethaneella* Chamb. } smaller than that of *cincinnatiella*,
94. *Lithocolletis castaneæella* Chamb } and usually in red or black oaks
95. *Tischeria zelleriella* Clem.
96. *Tischeria pruinoseella* Chamb.
97. *Tischeria castaneæella* Chamb.
98. *Tischeria badiiella* Chamb.
99. *Tischeria quercivorella* Chamb.
100. *Tischeria quercitella* Clem.
101. *Tischeria citrinipennella* Clem.
102. *Tischeria complanoides* Frey & Boll. (Doubtful species.)
103. *Tischeria concolor* Zeller. (Food plant uncertain.)
104. *Tischeria tinctoriella* Chamb.
105. *Nepticula platea* Clem. } Imago unknown. Larvæ of both in crooked,
106. *Nepticula auguinella.* } linear mines.
107. *Nepticula quercipulchella* Cham.
108. *Nepticula quercicostanella* Chamb. } Larvæ in crooked, linear mines.
109. *Nepticula saginella* Clem.
110. *Coriscium* sp. Imago unknown.
111. *Coleophora querciella* Clem. Imago unknown. Larva lies in a case, which it attaches to the leaves.
112. *Catastega timidella* Clem. Imago unknown.

Leaf-miners of the under surface.

113. *Lithocolletis quercitorum* Frey & Boll. } Tentiform mines.
114. *Lithocolletis fitchella* Clem.

115. *Lithocolletis basistrigella* Clem.
116. *Lithocolletis æriferella* Clem.
117. *Lithocolletis quercipulchella* Chamb.
118. *Lithocolletis quercialbella* Chamb.
119. *Lithocolletis fuscocostella* Chamb. } Tentiform mines.
120. *Lithocolletis albanotella* Chamb.
121. *Lithocolletis obstrictella* Clem.
122. *Lithocolletis hageni* Frey & Boll.
123. *Lithocolletis argentifimbriella* Clem.
124. *Lithocolletis intermedia* Frey & Boll. Doubtful species.
125. *Lithocolletis mirifica* Frey & Boll. Doubtful species.
126. *Ornix quercifoliella* Chamb. Under edge of leaf turned down.
127. *Coriscium albanotella* Chamb. Large tentiform mine.

The following species either roll, fold, or sew the leaves together:

128. *Ypsolophus querciella* Chamb.
129. *Gelechia querciella* Chamb.
130. *Gelechia quercinigræella* Chamb.
131. *Gelechia quercivorella* Chamb.
132. *Gelechia quercifoliella* Chamb.
133. *Cryptolechia quercicella* Clem.
134. *Machimia tentorilerella* Clem. Larva in a web.

The following species feed in galls:

135. *Ypsolophus quercipomonella* Chamb.
136. *Gelechia gallægenitella* Clem.
137. *Hamadryas bassettella* Clem.

Coleoptera.

138. *Synchroa punctata* Newman. "They live in rotten oak stumps, thriving best in the white. The pupa requires about one week to perfect itself." (Horn.)
139. *Centronopus calcaratus* Fabr. "Inhabits black oak stumps. It remains in pupa two weeks." (Horn.)
140. *Centronopus anthracinus* Knoch. May be taken in company with the preceding species. (Horn.)
141. *Acanthoderes 4-gibbus* Say. Bores in dead twigs of oak. (Schwarz.)
142. *Bostrichus bicornis* Web. Under bark of white oak posts. (McBride.)
143. *Elaphidion atomarium* (Drury), according to Schwarz, bores in dry twigs of *Quercus virens* in Florida. (Riley.)
144. *Elaphidion mucronatum* Fabr., with the preceding. (Schwarz, in Riley.)
145. *Elaphidion parallelum* Newman. Boring in oak, etc. (Riley.)
146. *Tragidion fulvipenne* Say. Bores in oak. (Riley.)
147. *Arhopalus fulminans* Fabr. Red oak. (Fitch & Hadge.)
148. *Leptura zebra* Olivier. The larva and pupa inhabit the black oak. (Dr. Horn.)

149. The Dominican case-bearer, *Coscinoptera dominicana* (Fabr.), according to Riley.
150. *Mordella 8-punctata* Fabr. Found in old oak stumps. (Riley.)

HYMENOPTERA.

List of the species of North American Cynipidæ which live on the various species of oak, by R. Osten Sacken, 1865.

LIVING ON THE WHITE AND CHESTNUT OAKS.

151. *Cynips strobilana* O. S.
152. *Cynips globulus* Fitch.
153. *Cynips centricola* O. S.
154. *Cynips tubicola* O. S.
155. *Cynips clavula* Bassett.
156. *Cynips* (*Andricus*) *seminator* Harris.
157. *Cynips* (*Andricus*) *petiolicola* Bassett.
158. *Cynips* (*Andricus*) *fusiformis* O. S.
159. *Cynips* (*Andricus*) *futilis* O. S.
160. *Cynips* (*Andricus*) *papillata* O. S.
161. *Cynips* (*Andricus*) *flocci* Walsh.
162. *Cynips* (*Teras*) *pezomachoides* O. S.
163. *Cynips* (*Teras*) *forticornis* Walsh.
164. *Cynips* (*Teras*) *hirta* Bassett.
165. *Cynips* (*Teras*) *fulvicollis* Fitch.
166. *Cynips* (*Teras*) *nigricollis.*
167. *Cynips* (*Biorhiza*) *nigra* Fitch.
168. *Cynips* nov. gen. (allied to *Spathegaster* Hartig).
169. *Cynips irregularis* O. S.
170. *Cynips majalis* Bassett.
171. *Cynips batatus* Bassett.
172. *Cynips verrucarum* O. S.

LIVING IN THE RED, BLACK, AND WILLOW OAKS.

173. *Cynips* (nov. gen.) *spongifica* O. S. (*C. aciculata* O. S., and *C. confluens* Harris).
174. *Cynips* (nov. gen.) *quercus-coccineæ* O. S.
175. *Cynips* (nov. gen.) *inanis* O. S. (*C. confluens* Fitch, not Harris).
176. *Cynips* (nov. gen.) *coelebs* O. S.
177. *Cynips* (nov. gen.) *ilicifoliæ* Bassett.
178. *Cynips* (nov. gen.) *singularis* Bassett.
179. *Cynips* (nov. gen.) *ostensackenii* Bassett.
180. *Cynips* (nov. gen.) *formosa* Bassett.
181. *Cynips* (nov. gen.) *sculpta* Bassett.

GROUPS WHICH WILL PERHAPS CONSTITUTE AS MANY GENERA.

The following species may belong to new genera:

182. *Q. phellos* O. S.
183. *similis* Bassett.
* * * * *
184. *Q. nigræ* O. S.
185. *tumifica* O. S.
186. *nodesta* O. S.
* * * * *
187. *operator* O. S.
* * * * *
188. *ventricosa* Bassett.
* * * * *
189. *cornigera* O. S.
* * * * *
190. *punctata* Bassett.
191. *podagræ* Walsh.
192. *scitula* Bassett.
* * * * *
193. *Q. palustris* O. S.

The following additional species of Cynips living on the oak have been described by Mr. H. F. Bassett. (Canadian Entomologist, Vol. XIII, p. 92.)

194. *Cynips tenuicornis.* Arizona.
195. *Cynips bella.* Arizona.
196. *Cynips minuta.* On Quercus alba. Connecticut.
197. *Cynips vesicula.* On Quercus alba. Connecticut.
198. *Cynips pattoni.* On Quercus alba. Connecticut.
199. *Cynips polita.* On Quercus obtusiloba. New Jersey, Maryland.
200. *Cynips rugosa.* On Quercus prinoides. Connecticut.
201. *Cynips cicatricula.* On Quercus alba. Connecticut.
202. *Cynips capsula.* On Quercus bicolor. Connecticut.
203. *Cynips affinis.* On Quercus prinoides. Connecticut.
204. *Cynips gemula.* On Quercus prinoides. Connecticut.
205. *Cynips pigra.* On Quercus tinctoria. Connecticut.
206. *Cynips ignota.* On Quercus bicolor. Connecticut.
207. *Cynips papula.* On Quercus rubra and Q. tinctoria. Connecticut.
208. *Cynips noxiosa.* On Quercus bicolor. Connecticut.
209. *Cynips corrugis.* On Quercus prinoides. Connecticut.
210. *Cynips cinerosa.* Texas.
211. *Cynips floccosa.* On Quercus bicolor. Ohio.
212. *Cynips coxii.* On Quercus sp. Arizona.
213. *Cynips suttonii* Bassett. California.
214. *Cynips batatoides* Ashmead. Live oak in Florida.

INSECTS INJURIOUS TO THE ELM.

AFFECTING THE TRUNK.

1. The common elm-tree borer.

Saperda tridentata Olivier.

Order Coleoptera; family Cerambycidæ.

Perforating and loosening the bark and furrowing the surface of the wood with their irregular tracks, flat white longicorn borers, changing to beetles in June and July; the beetles flat, dark brown, with a longitudinal three-toothed red stripe on the outer edge of each wing-cover.

This is the most destructive borer of the elm in the Northern and Eastern States, often killing the trees by the wholesale. Great numbers of the larvæ of different sizes have been found boring in the inner bark and also furrowing with their irregular tracks the surface of the wood, the latter being, as it were, tattooed with sinuous grooves, and the tree completely girdled by them in some places. The elms on Boston Common have in former years been killed by this borer, and valuable trees, we have been informed, have been killed by them in Morristown, N. J. Fitch remarks that it consumes the inner bark of the slippery elm (*Ulmus fulva*), especially in dead and decaying trees. According to him, "the beetle deposits its eggs upon the bark in June, and the young larvæ therefrom nearly complete their growth before winter, and soon after warm weather arrives the following spring they pass into their pupa state." We have found the larvæ in abundance in the early spring in Providence in old dead elms.

The larva.—White, subcylindrical, a little flattened, with the lateral fold of the body rather prominent; end of the body flattened, obtuse, and nearly as wide at the end as at the first abdominal ring. The head is one-half as wide as the prothoracic ring, being rather large. The prothoracic segment, or that next to the head, is transversely oblong, being about twice as broad as long; there is a pale dorsal corneous transversely oblong shield, being about two-thirds as long as wide, and nearly as long as the four succeeding segments; this plate is smooth, except on the posterior half, which is rough, with the front edge irregular and not extending far down the sides. Fine hairs arise from the front edge and side of the plate, and similar hairs are scattered over the body and especially around the end. On the upper side of each segment is a transversely oblong ovate roughened area, with the front edge slightly convex, and behind slightly arcuate. On the under side of each segment are similar rough horny plates, but arcuate in front, with the hinder edge straight.

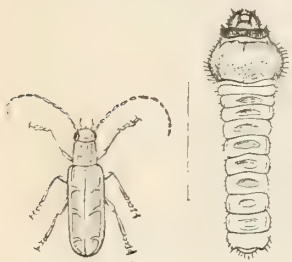

Fig. 17.—Larva (from life) and adult of the elm-tree borer.—From Packard.

It differs from the larva of *Saperda vestita* Say in the shorter body, which is broader, more hairy, with the tip of the abdomen flatter and more hairy. The prothoracic segment is broader and flatter, and the rough portion of the dorsal plates is larger and less transversely ovate. The structure of the head shows that its generic distinctness

from *Saperda*, originally insisted on by Mulsant, may be well founded, as the head is smaller and flatter, the clypeus being twice as large, and the labrum broad and short, while in *Saperda vestita* it is longer than broad. The mandibles are much longer and slenderer, and the antennæ are much smaller than in *Saperda vestita*.

The beetle is a rather flat-bodied, dark-brown beetle, with a rusty-red curved line behind the eyes, two stripes on the thorax, and with a long red stripe on the outer edge of each wing-cover, with three long points projecting inwards; 0.50 inch in length.

2. The lateral saperda-borer.

Saperda lateralis Fabricius.

Order Coleoptera; family Cerambycidæ.

Mining the inner bark of dead trees and logs of the common elm, a grub very similar to the foregoing, and about the 1st of June producing a similar beetle, but differing in wanting the transverse teeth or points arising from the marginal stripe on the wing-covers. (Fitch.)

3. The six-banded dryobius.

Dryobius sex-fasciatus Say.

Order Coleoptera; family Cerambycidæ.

A similar but larger grub than that of *Saperda tridentata*, but found with it, producing a black beetle of nearly similar form, with the edge of the thorax yellow, and also its scutel, with four yellow equidistant oblique bands on its wing-covers, the last one situated at the tip. Length 0.70 inch. (Fitch.) It also occurs on the beech according to C. G. Siemens.

4. The elm bark-borer.

Tomicus (*Phloiotribus*) *liminaris* Harris.

Order Coleoptera; family Scolytidae.

Making small perforations like pinholes, appearing in the bark, especially of diseased elms, from which, in August and September, issues a minute cylindrical bark-beetle of a dark-brown color: its wing-covers with deeply impressed punctured furrows and short hairs; its thorax also punctured. Length 0.10 or less. (Harris.)

5. The dark elm bark-borer.

Hylesinus opaculus Leconte.

Living under the dry bark of the elm and ash trees, a stout pitchy-black timber beetle. (Riley.)

The beetle.—Stout, opaque, when mature of a uniform piceous-black color. Head punctulate, not narrow in front, without transverse impressions in front of the eyes. Epistoma (Fig. 18, *b*) truncate or very slightly and broadly emarginate. Labrum visible. Antennal club very large, oblong-oval, the first two joints shining and pubescent only at apex. Thorax wider than long, very densely punctate; pubescence moderately thick and short. Elytral striæ (Fig. 18, *d*) evidently impressed and regularly, coarsely punctate; interstices very distinct, each with a regular row of small tubercles, which become more acute toward the apex and the sides. Pubescence very coarse and short. Tibiæ (Fig. 18, *c*) hardly dentate. (Riley's Rep. Ent. Dep. Ag. 1879, p. 45. The other figures illustrate *H. trifolii*.)

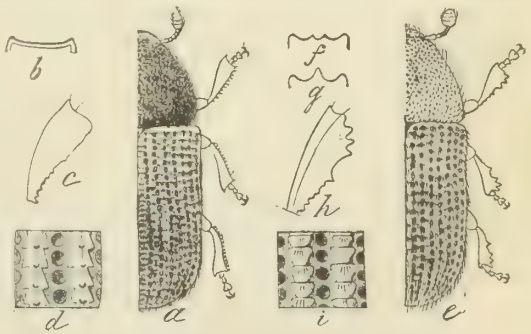

Fig. 18.—The dark elm bark-borer.—After Riley.

6. The short-lined dularius.

Dularius brevilineus Say.

Order Coleoptera; family Cerambycidæ.

Boring in partly dead or dry elms, the larva of a pretty longicorn, with deep purplish-blue wing-covers with three short white lines in the middle.

This beetle was first bred from the dry wood of the elm by Riley, the larvæ occurring in Ohio. It was also known, by the late Mr. G. D. Smith, to inhabit this tree, probably in the vicinity of Boston; it was noticed in our 2d Mass. Report, p. 18. Mr. George Hunt has observed this beetle on the bark of an elm at Plymouth, N. H., in the middle of July, inserting its eggs in the crevices of the bark. It is a singular-looking beetle, with a round, flattened prothorax, and wing-covers contracted in the middle, and not covering the tip of the abdomen, while the thighs are unusually swollen. The antennæ are about two-thirds the length of the body, flattened towards the end, and somewhat serrate. The body above is velvety black, and brown-black beneath. The head is black and coarsely punctured, and the prothorax is covered with short, dense, black hairs, like velvet. The wing-covers are Prussian blue in color, bent, corrugated, with an interrupted ridge just outside of the middle of each cover. They are covered with fine, black hairs, bent over. There is a pair of parallel, short honey-yellow lines in the middle of each wing-cover, with a third one a little in front, making in all six streaks. The legs and feet are black. It is a little over eight-tenths of an inch in length.

Fig. 19.—Elm-tree borer—From Packard.

6. *Neoclytus erythrocephalus* Fabricius.

Order Coleoptera; family Cerambycidæ.

Boring in dead elms in Michigan (Hubbard); also raised from hickory-wood (Horn).

7. The tree cricket.

Œcanthus niveus Serville.

Order Orthoptera; family Gryllidæ.

Boring into the corky bark of the elm in the Southern States, inserting its eggs irregularly, not in regular series as when it oviposits in the stems of the blackberry, raspberry, grape, &c.; a slender pale-green cricket, with white wings and a large ovipositor; the males shrilling loudly.

The eggs of the tree cricket begin to develop as soon as they are laid in the early autumn, and the embryo partially develops, so that the rudimentary limbs may be seen, as well as the mouthparts; the insect completes its development in the early part of the following summer, appearing early in August.

FIG. 20.—Male tree-cricket.—After Harris.

FIG. 21.—Female tree-cricket, natural size.—After Harris.

AFFECTING THE LEAVES.

8. THE CANKER WORM.

Anisopteryx vernata Peck.

Order LEPIDOPTERA; family PHALÆNIDÆ.

Very injurious to the elm in the Eastern States, stripping the trees; a dark-striped measuring worm varying in color to pale green, transforming from the middle to the last of June in the earth to a pupa, some appearing in the autumn but most abundantly in March; the female grub-like, the male winged.

Originally confined, as an injurious insect, to New England, it is now destructive in the Western States (Illinois and Missouri), and must originally have occurred all over the United States east of the Mississippi, as I have received it from Texas.

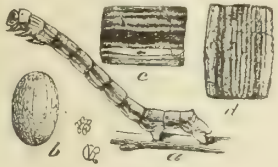

FIG. 22.—Canker worm: *b*, egg; *c*, side; *d*, back of a segment.—After Riley.

FIG. 23.—*a* female canker-worm moth; *b*, male; *c*, antennæ joints of female; *d*, one of female abdominal segments; *e*, ovipositor.—After Riley.

About the 1st of May, at the time when the leaves of the apple are unfolding, the young canker worms break through the eggs, which have been laid earlier in the season, in March and April, in patches on the bark of the trunk and limbs. They may be soon found clustering on the terminal buds and partly unfolded leaves, and are then about a line in length, and not much thicker than a bit of thick thread. Fortunately, owing to the want of wings, the female is exceedingly sedentary, and year after year the apple and elm trees of particular orchards and towns are defoliated and turned brown, while adjoining orchards and towns scarcely suffer. By the 20th of June, in Essex County, Massachusetts, the orchards or shades elms infested by them look as if a fire had run through them. At that date the worms are fully fed, and they then descend to the ground, letting themselves down by a silken thread. At this time I have destroyed thousands by jarring the tree and collecting those which fall down. I have watched old and young robins busily

engaged in eating them, and from the number of toads in my garden, gathered under the trees, I feel confident that they eat multitudes of them.

The worms at once enter the ground, change to chrysalids several inches below the surface, near the trunk of the tree, and there remain until the early days of March and April, when the wingless females ascend the trees, and the winged males may be seen fluttering about.

I took pains one spring, in the middle of April, to count the number of these moths on my apple trees, fourteen in number, averaging from six to seven inches in thickness, besides three elms. They were more abundant on the apple trees than on the elms. But on those seventeen trees there were counted, adhering mostly to the tarred paper, one thousand males and two hundred females. The spring of 1875 was cold and backward, and few moths were seen before this date. From these data we can ascertain approximately the relative numerical proportions between the sexes, which seems to approximate five males to one female.

The species I have referred to is the spring moth, the *Anisopteryx vernata* of Peck, but not of Harris. *A. autumnata* is much less abundant in the adult condition, and only appears in the autumn. The wings are thicker than those of *vernata*, and the caterpillar has an additional pair of prop-legs, though so short as to be useless. I find that most of the damage is done by the caterpillars of *vernata*. On June 15, 1875, I collected five hundred and fifty-seven caterpillars from the apple trees in my garden. Of these, five hundred and twenty were *vernata*, and twenty-seven were the young of the autumn species. Peck, in his account published in 1795, states that *vernata* does the principal damage.

Remedies.—The use of printer's ink laid on tarred paper is the cheapest, though the ink should be applied every day or two. The use of tin troughs of oil surrounding the tree is almost sure to stop the ascent of the females, while wooden troughs of oil built around the bottom of the trunk is almost equally efficacious. Care and attention, and, above all, co-operation among those suffering from these worms will enable us to check their ravages.

9. Unknown measuring worm.

Feeding on the leaves May 30 and June 1, at Providence, a reddish-green obscurely striped larva, much like the canker worm in form and size, but a little stouter.

10. The elm span-worm.

Eugonia subsignaria (Hübner).

Order Lepidoptera; family Phalænidæ.

Hatching from the eggs as soon as the leaves unfold and living unobserved for a week or two on young shoots in the tree tops, measuring or span worms, resembling the twigs of the elm in color, with a large red head, and the terminal ring of the body

bright red; pupating towards the end of June, and during July and August transforming into a snow-white moth.

Fig. 24.—Elm span-worm moth, natural size.—After Packard.

This insect is widely spread. I have observed it in the forests of Northern Maine in August, and it is common in the Middle States. It is very destructive to the elms in New York City and Philadelphia, though not known to be destructive in the country. The moth may at once be recognized by the snow-white body and wings, the anterior pair being angular and the hinder pair slightly notched. It is, according to Fitch, still more destructive to the linden than to the elm.

11. The November Moth.

Epirrita dilutata (Hübner).

Order Lepidoptera; family Phalænidæ.

Feeding on the leaves in spring: a dirty-green measure-worm, beneath paler bluish-white, its breathing pores forming a row of orange-red dots along each side, where is sometimes also a yellow line: entering the ground in summer, the moth appearing in November. (Fitch.)

In our monograph of the *Phalænidæ* we had overlooked the fact that Fitch had observed this moth in New York, flying slowly in forests in November. It appears to be more abundant in subarctic regions than in New England, as we have received numerous specimens of it from Newfoundland, and it has also been obtained in Labrador. It is probable that it will rarely occur in injurious numbers on elm trees in New England. In Europe, according to Newman, "it feeds on white-thorn, black-thorn, horn-beam, sloe, oak, and almost every forest tree, and is full-fed in June." Our species in British America, probably like *E. cambricaria*, will be found feeding on the mountain ash, a common tree in Labrador and Newfoundland.

The moth.—A much larger species than *E. cambricaria*, which is more common, and which also occurs in Northern Europe. It may always be distinguished from the other species of the genus by the simple not pectinated male antennæ. The body and wings are pale ash-gray; fore wings with eight well-defined sinuous or scalloped blackish lines, most distinct on the costa and veins; the basal line is heavy, and bent rectangularly between the subcostal and median veins; the next line, rather remote from the basal, curves inward on the subcostal vein, and outward on the median space; the two lines beyond are approximate, but less sinuous; the fourth line from the base of the wings is broad, diffuse, twice as broad on the costa as the three others; beyond this line is a clear median space, in the middle of which is the distinct discal dot; beyond are four more or less distinct lines, of which the outer (or submarginale is most distinct and regularly scalloped; a marginal row of twin black dots; fring. whitish. Hind wings with traces of four scalloped lines, the marginal one the heaviest. Expanse of wings, 1.60 inches.

12. The elm galeruca.

Galeruca calmariensis (Linnæus).

Order Coleoptera ; family Chrysomelidæ.

Thick, cylindrical, blackish, six-footed grubs, often wholly defoliating the trees, and changing into an oblong oval beetle a quarter of an inch long, of a grayish yellow color, with three small black spots on the prothorax, a broad black stripe on the outer edge of its wing-covers, and a small oblong spot near their base. (Fitch.)

13. The ladder chrysomela.

Chrysomela scalaris (Le Conte).

Order Coleoptera ; family Chrysomelidæ.

Feeding on the leaves throughout the season, a shining, hemispherical, bottle-green beetle, with silvery-white wing-covers, on which are several bottle-green spots, and a broad jagged stripe on their suture ; its wings rose-red and its antennæ and legs rusty yellow. Length, 0.30 to 0.40. More common on willows, and especially the alder. The larva is thick and fleshy, with a row of black spiracles along the side of the body and a dark prothoracic shield.

14. The American cimbex saw-fly.

Cimbex americana (Leach).

Order Hymenoptera ; amily Tfenthredinidæ.

A cylindrical, glaucous, yellowish-white worm, coiled and marked like a snail's shell, having a broad black line along the back ; when disturbed ejecting a watery fluid from pores situated above the spiracles ; transforming into the largest species of saw-fly we have, with stoutly-knobbed antennæ ; appearing early in summer. It also feeds on the birch, linden, and willow.

15. The antiopa butterfly.

Vanessa antiopa (Linnæus).

Order Lepidoptera ; family Papilionidæ.

Sometimes occurring on the elm, but more common on the willow ; a stoutly-spined caterpillar, with a black body spotted minutely with white, with a row of eight dark brick-red spots on the back ; changing to a dark brown chrysalis, with large tawny spots around the tubercles on the back. The butterfly purplish brown above, with a broad buff-yellow border in which is a row of pale blue spots. Flying from March till June, and again from the middle of August until late autumn.

16. The great elm-leaf beetle.

Monocesta coryli (Say).

Order Coleoptera ; family Chrysomelidæ.

Occasionally destructive to the red or slippery elm in the Middle States ; a pale yellowish beetle more than half an inch long, with the wing-covers twice spotted with blue ; laying its yellow eggs in a cluster on the under side of the leaf in June, the grub appearing a week later, being brown or yellowish brown, and eating the leaves

into rags; towards the end of July or early in August entering the ground, forming an oval cavity a few inches below the surface; assuming the pupa state a week before they appear as beetles in June. (Riley.)

FIG. 25.—The great elm-leaf beetle. *a*, *b*, eggs; *d*, larva; *g*, *h*, head and mouth parts of the same; *i*, pupa; *j*, beetle.—After Riley.*

15. THE INTERROGATION BUTTERFLY.

Grapta interrogationis (Fabricius).

Injuring the foliage of the elm as well as linden tree and hop-vine, a caterpillar, with reddish black, bilobed head, and black body covered thickly with streaks and dots

*This and several other cuts have been loaned by the permission of the Hon. George B. Loring, Commissioner of Agriculture.

of yellowish white, transforming into our largest species of Grapta, and marked on the under side of the dull hind wings with a golden semicolon.

The larva is an inch and a quarter long. The head is reddish black, flat in front and somewhat bilobed, each lobe tipped with a tubercle emitting five single black pointed spines. It is covered with many small white and several blackish tubercles. The body is cylindrical, black, thickly covered with streaks and dots of yellowish white; the second segment is without spines, but with a row of yellowish tubercles in their place; the third segment has four branching spines, all black, with a spot of dark yellow at their base; and on the fourth segment are four spines, as there are on all the others, excepting the terminal, which has two pairs, one posterior to the other. The spines are yellow, with blackish branches, excepting the terminal pair, which is black; and there is a row of reddish ones on each side. The under surface is yellowish gray, darker on the anterior segments, with a central line of blackish, and many small, black dots. (Saunders.)

FIG. 26. Grapta progne.—From Packard.

The chrysalis is ash brown, with the head deeply notched; and there are eight silvery spots on the back. The chrysalis state lasts from twelve to fourteen days.

16. THE SILVER-C GRAPTA.

Grapta progne (Cramer).

Late in June, eating the leaves, a more common spiny caterpillar than the preceding, being white mottled with gray, the butterfly smaller than the foregoing and marked with a reversed silver c or comma in the middle of the hinder wings; but one brood of butterflies appearing in July.

The larva is gray, mottled with whitish; head white, with two black prickles. The two upper long-branched prickles upon the second ring black; no spines on the prothoracic segments; those on the succeeding rings white, tipped with black; their branches white, toward the forward end of the body becoming more and more tipped with black. (Fitch.)

17. THE COMMA BUTTERFLY.

Grapta comma (Harris).

Another caterpillar closely resembling that of *G. progne*, but differing in being of a brownish-red color in front and white or pale yellow behind.

The half-grown larva is black, with a yellowish stripe along the side from the third segment to the tail, and with yellow stripes across the back, and spots of the same color at the base of the dorsal spines, which are yellow, tipped with black. The mature caterpillar is white, mottled or striped with gray or ashen, and with red spiracles (W. H. Edwards). It differs from the larva of *G. progne* in its brownish-red face, and in being more yellowish on the abdominal segments.

The chrysalis is brownish-gray or white, variegated with pale brown and ornamented with gold on the tubercles.

The butterfly differs from the Progne in the hind wings having a black spot on their center, as well as two others toward their base, and on their under sides a central silvery curved mark like the letter *c*. Expanse of wings about two inches. It appears in May, and a second brood in July, August, and September. This caterpillar is more common on the currant and hop.

18. THE FOUR-HORNED SPHINX CATERPILLAR.

Ceratomia quadricornis (Harris).

Order LEPIDOPTERA; family SPHINGIDÆ.

Occasionally eating the leaves, a stout green worm with a large horn on its tail and four shorter horns just behind the head, and seven oblique white lines on each side of the body.

This worm not unusually occurs from Maine southward on the elm, becoming fully fed early in September, when it descends into the ground and pupates, the moth appearing the following May and June. I have taken it in Maine as early as May 24. The moth is a large broad-winged sphinx, with gray or ashen body and wings, the anterior pair with a large white dot near the front edge.

19. THE FALL WEB WORM.

Hyphantria textor (Harris).

Order LEPIDOPTERA; family BOMBYCIDÆ.

Disfiguring in August and early in September the branches of the elm with their unsightly webs in which they live socially; slender, greenish-yellow caterpillars, dotted with black, with rather sparse, silken, whitish hairs, and transforming into a pure white moth.

The fall web worm should not be confounded with the American tent caterpillar, being about half the size of the latter, and appearing late in summer, when the tent caterpillar has disappeared. It is abundant and unwearying in its attacks on different fruit and shade trees. It is omnivorous in its taste and one of the most abundant pests in the Southern as well as Northern States, being abundant in Maine, and ranks with the canker-worm as a general nuisance. The webs can be removed by hand or by the use of mops dipped in a solution of carbolic acid or kerosene oil; or the branch with the web may be cut off. It occurs on fruit trees, as well as the hickory, black walnut, and sometimes the oak.

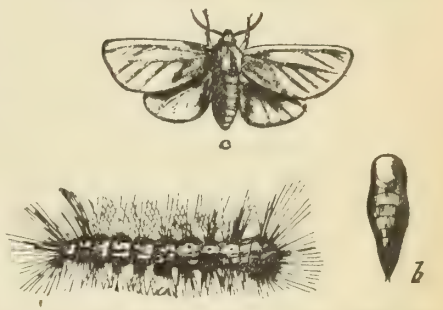

FIG. 27.—Fall web worm (*a*); *b*, pupa (a very poor figure); *c*, imago.—After Riley.

The larva when young is pale yellow, with the hairs quite sparse, and with two rows of black marks along the body; the head is black.

When fully grown it is pale yellowish or greenish, with a broad dusky stripe along the back and a yellow stripe along the sides. It is hairy, the rather long whitish hairs springing from black and orange-yellow warts. It is very variable as to depth of coloring and markings.

The moth is stout-bodied and entirely white. The female deposits her eggs in a cluster on a leaf generally near the end of a branch, the eggs hatching during the months of June, July, and August, earlier or later, according to the latitude. Each worm begins spinning the moment it is born, and by their united effort they soon cover the leaf with a web, under which they feed in company, devouring only the pulpy parts of the leaf. (Riley.)

20. The elm gall-louse.

Colopha ulmicola (Fitch).

Order Hemiptera; family Aphidæ.

Making in June a large excrescence like a cock's comb on the upper side of the leaf, the gall about an inch long and a quarter of an inch high, compressed, and its sides wrinkled perpendicularly, with its summit irregularly gashed and toothed, of a paler green color than the leaf and more or less red on the side exposed to the sun; opening on the under side of the leaf by a long slit-like orifice; inside wrinkled perpendicularly into deep plaits and occupied by one female and a number of her young, which are minute oval yellowish white lice 0.02 inch long, with blackish legs; the female more or less coated with white meal on her back, 0.07 long, oval and pale yellow, with blackish legs and antennæ. By midsummer the galls dry up. (Fitch.)

21. The wooly elm-tree louse.

Eriosoma Rileyi (Thomas).

Order Hemiptera; family Aphidæ.

Clustering on the limbs and trunks of the white elm, causing a knotty unnatural growth of the wood, small aphides covered with an intense white wool-like substance, the limbs at a distance appearing like snow. (Riley.)

In Illinois and Missouri, late in May and in June, the white elms in the larger cities are apt to become infested with these conspicuous and curious insects. Riley finds that by washing with a weak solution of cresylic acid soap they will be instantly killed.

The adult is dark blue, the wings clear, three times as long as wide, and more pointed at the ends than in *E. pyri*. Costal and subcostal veins, and that bounding the stigma behind robust and black. Length to tip of closed wings, exclusive of antennæ, 0.12 inch.

The young lice are narrower and usually lighter colored than the adults, varying from flesh to various shades of blue and purple. (Riley.)

The following insects also prey on the elm:

Hemiptera.

22. Common elm aphis. *Schizoneura americana* (Riley).
23. Yellow elm louse. *Callipterus ulmicola* Thomas. (VIII, 111).

Coleoptera.

24. The grape-vine flea beetle. *Graptodera chalybea* Illiger.
25. The goldsmith beetle. *Cotalpa lanigera* (Linn.).
26. *Magdalis armicollis* Say. (Inhabits the elm, Lebaron., 4th Rep).

Lepidoptera.

27. *Anthaxia viridicornis* Say. (Psyche II, 40.)
28. *Synchroa punctata* Newman. (Psyche II, 40.)
28. The American silk worm, *Telea polyphemus* Hübner.
29. The Emperor moth, *Hyperchiria io* (Fabricius).

31. The vaporer-moth caterpillar, *Orgyia leucostigma* Sm.-Abb.
32. *Tolype velleda* (Stoll).
33. *Acronycta ulmi* Harris. (Corr. 312.)
34. *Paraphia unipunctaria* (Haworth).
35. *Metanema quercivoraria* Guenée.
36. *Nephopteryx undulatella* Clemens.
37. *Nephopteryx? ulmi-arrosorella* Clemens.
38. *Bactra? argutana* Cl. (also on sumach, witch-hazel, and black-thorn).
39. *Lithocolletis argentinotella* Clem. Larva makes a tentiform mine in the under side of the leaves; rarely in the *upper* side. (Chambers.)
40. *Lithocolletis ulmella* Chamb. Larva makes a flat mine in the upper side of the leaf. (Chambers.)
41. *Argyresthia austerella* Zeller. This moth, "I am convinced, feeds in some way on it; and in latter May and in June the imago may be found about the trees." (Chambers.)

HYMENOPTERA.

42. The horn-tail borer, *Tremex columba* (Linn.).
43. Elm saw-fly, *Cimbex americana* var. *Cimbex laportei.*

INSECTS INJURIOUS TO THE HICKORY.

(*Carya alba* and *tomentosa.*)

INJURING THE TRUNK AND BRANCHES.

1. THE COMMON HICKORY BORER.

Goes tigrinus (De Geer).

Order COLEOPTERA; family CERAMBYCIDÆ.

Boring large holes lengthwise in the solid wood, a cream-colored grub, with the first segment behind the head flattened, pale tawny-yellowish, changing to a pupa in its burrow, and in summer appearing as a long-horned brown beetle an inch long, covered with a close gray pubescence, the wing-covers with a broad dark brown band beyond their middle and another on their base, the thorax with an erect blunt spine on each side; the antennæ pale yellowish, with their first joint dark brown. (Fitch.)

This is perhaps the most common borer in the hickory and walnut in the Northern States. According to Fitch the young worm lives at first upon the soft outer layers of the sap-wood, mining a shallow cavity all around the orifice in the bark, and the bark dies and turns black as far as this burrow extends. Its jaws having at length become sufficiently strong, it gnaws its way into the solid wood from the upper part of its burrow under the bark, boring obliquely inward and upward, all the lower part of its burrow being commonly packed with its sawdust-like chips. Finally, having completed its growth, it extends the upper end of its burrow outward again to the bark.

2. THE BEAUTIFUL HICKORY BORER.

Goes pulcher (Haldeman).

Similar to the preceding. "Scarce, but a few are found every season in the shagbark and pignut hickory, June and July." (Dr. T. Hadge, Buffalo, N. Y., Amer. Ent., iii, p. 270.)

3. The belted chion.

Chion cinctus (Drury).

Order Coleoptera; family Cerambycidæ.

A worm like the preceding and with similar habits, forming long galleries in the trunk in the direction of the fibers of the wood, producing a more flattened long-horned beetle from two-thirds to a little over an inch long, of a hazel-brown color, with a short dull straw-yellow band placed obliquely forward of the middle of each wing-cover, and with a small sharp spine on each side of the prothorax, and two slender ones on the tips of each wing-cover; the antennæ of the males more than twice the length of the body. (Harris.)

Fig. 29.—The belted Chion.

4. The discoidal saperda.

Saperda discoidea (Fabricius).

Order Coleoptera; family Cerambycidæ.

A similar but much smaller worm than the foregoing, changing to a cylindrical long-horned beetle of a black or blackish-brown color, clothed with ash-gray pubescence which is less dense above and commonly forms three gray stripes upon the thorax, and a band or crescent upon the middle of the wing-covers, its legs yellow or reddish. Length 0.40 to 0.60 inch. (Fitch.)

5. The common hickory borer.

Cyllene picta Drury.

Boring in the trunk of the hickory, a whitish worm, one-half an inch long, the beetle appearing in June. (See Locust-tree borer.)

We have received this insect in all its stages from Mr. H. Gillman, of Detroit, who several years ago found several of them in a hickory log March 10th. From these living specimens the following description was drawn up:

Larva.—Body thick; mouth-parts black; head reddish behind the antennæ. Prothoracic segment (first behind the head) large and broad, being one-half as long as broad; flat and broad above, the upper surface being lower than that of the succeeding segment; the anterior edge thickened, being slightly corneous; a mesial deeply impressed line, especially on the hinder two-thirds, where it becomes a broad, deep angular furrow, dividing the tergum into two quadrant-shaped halves; the outer edge of the segment rises above the flattened tergal portion, which is sparsely covered with hairs; the latter thicker along the sides of the body. The body contracts in width behind the 4th abdominal segment; the upper side of each of the first six abdominal segments (corresponding to those segments in the beetle) is raised into blister-like swellings, especially on the 5th and 6th segments, which are much narrower than the four preceding segments. These dorsal swellings are smooth and free from fine hairs. Abdominal segments 7–9 convex above, not swollen, and the abdomen is narrowest between the 5th and 6th segments. A pair of large spiracles on the mesothoracic segment, and a pair on each of the first eight abdominal segments.

Fig. 30.—Common hickory borer; male, nat. size; *a*, larva; *b*, pupa.—From Packard.

Antennæ 3-jointed; the two basal joints being of the same length; the basal one being one-third stouter than the 2d; the 3d joint filiform, and one-half as long as the

2d joint, and ending in two or three hairs. The thin membranous labrum is divided into two parts, the basal solid, the terminal portion forming a moveable flap, overlapping and reaching nearly to the end of the mandibles when closed; the basal portion is shorter than broad, being broadly trapezoidal and smooth; the outer division is broader than long, the edges being rounded, so that it is almost broadly ovate (transversely) and smooth, covered with long hairs. It is pale membranous, of a testaceous hue. Mandibles black, very thick and stout, with obtuse, rounded edges; they are almost as long as the base is broad. Maxillæ membranous, flattened; maxillary palpi 2-jointed. Labium membranous, with a transverse chitinous band near the insertion of the 2-jointed palpi; both joints short; second one-half as thick as the first; edge hairy, the hairs reaching to the ends of the palpi. Length of body 0.50 inch; breadth of prothoracic segment, 4.2mm; breadth of head, 3.2mm.

FIG. 31.—Larva injurious to hickory insects.

Fig. 31 represents a larva which probably preys on the young of this and other hickory insects, as it is not uncommon under the bark of the hickory in Massachusetts. It belongs to the family *Nitidulidæ*.

6. THE HICKORY TWIG GIRDLER.

Oncideres cingulatus (Say).

Order COLEOPTERA; family CERAMBYCIDÆ.

Girdling and occasionally cutting off the twigs and branches, a thick-bodied, longicorn, dark gray beetle 0.60 inch long, with its wing-covers sprinkled over with faint tawny yellow dots.

This singular beetle, which inhabits the Eastern United States, appears in Pennsylvania from the middle of August until the middle of September. Fig. 32 represents the beetle and the incision it makes, and Fig. 33, from a drawing sent us by the late Prof. Haldeman, shows how the beetle may injure several adjoining twigs. The editors of the American Entomologist (I, p. 76) state that they have counted in a persimmon branch not more than two feet long, as many as eight eggs, placed one under each successive side-shoot, while they have found seven eggs all crowded together in a small hickory branch only three inches long. Prof.

FIG. 32.—Hickory twig girdler.—After Riley.

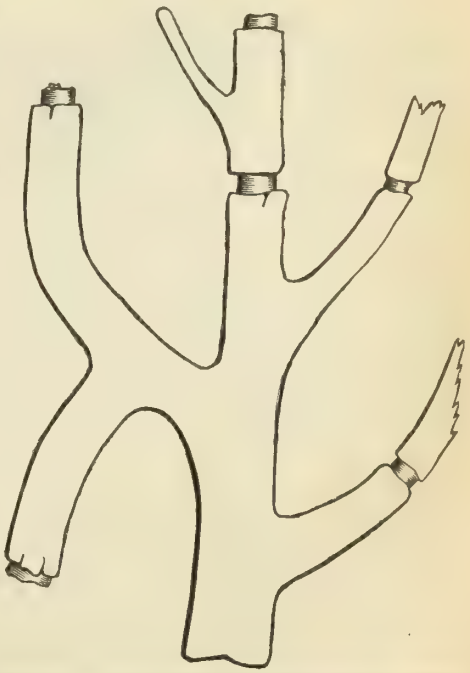

FIG. 33.—Tree cut by the twig girdler.—From Hayden's Report.

Haldeman states that "both sexes are rather rare, particularly the male, which is rather smaller than the female, but with longer antennæ. The female makes perforations (Fig. 32, *b*) in the branches of the tree upon which she lives, which are from half an inch to a quarter of an inch thick, in which she deposits her eggs (one of which is represented of the natural size at Fig. 32, *e*). She then proceeds to gnaw a groove, of about a tenth of an inch wide and deep, around the branch and below the place where the eggs are deposited, so that the exterior portion dies and the larva feeds upon the dead wood." In the case noticed by Prof. Haldeman, the tree attacked was the shag-bark hickory (*Carya alba*) and the incisions were so shallow as not to break off until after the larva had matured within it, or nearly a year after the girdling. But in most of the cases observed by Messrs. Walsh and Riley upon pear and persimmon trees, "the twig was girdled so deeply that it broke off and fell to the ground with the first wind, and while the eggs that had been laid in it by the mother-beetle were still unhatched. Even in a girdled hickory twig 0.35 inch in diameter, which we have now lying before us, but a third part of its diameter is left in the middle ungnawed away, so that in spite of the superior toughness of this timber the twig could scarcely have stood a high wind without breaking off and falling to the ground."

7. The slender-footed Dysphaga.

Dysphaga tenuipes (Haldeman).

A small grub, in the dead limb and twigs, producing in May a small black longicorn beetle with rough wing-covers but half as long as the abdomen and tinged with paler yellowish at their bases, its head having a furrow in the middle and its thorax cylindrical. Length 0.25 inch. (Fitch).

8. The lurid Dicerca.

Dicerca lurida (Fabricius).

Order Coleoptera; family Buprestidæ.

Boring in the trunks and limbs of the pig-nut hickory, a flat-headed grub of a yellowish-white color, changing to a flattened, hard-shelled beetle with short slender antennæ, of a lurid dull brassy color above, and bright copper beneath, with the wing-covers lengthened into diverging obtuse points.

The larva is of a yellowish-white color, very long, narrow, and depressed in form, but abruptly widened near the anterior extremity. The head is brownish, small, and sunk in the fore part of the first segment; the upper jaws are provided with three teeth, and are of a black color; and the antennæ are very short. The segment which receives the head is short and transverse; next to it is a large oval segment, broader than long, and depressed or flattened above and beneath. Behind this, the segments are very much narrowed and become gradually longer; but are still flattened, to the last, which is terminated by a rounded tubercle or wart. There are no legs, nor any apparatus which can serve as such, except two small warts on the under side of the second segment from the thorax. (Harris.)

The beetle is of a lurid or dull brassy color above, bright copper beneath, and thickly punctured all over; there are numerous irregular impressed lines, and several narrow elevated black spots on the wing-covers, the tips of each of which ends with two little points. Length 0.60–0.80 inch.

9. *Stenosphenus notatus* (Olivier).

Order COLEOPTERA; family CERAMBYCIDÆ.

Boring in the hickory tree, a specimen having been cut from a hickory tree in March. (C. V. Riley, Amer. Ent., vol. iii, p. 239.)

10. *Neoclytus erythrocephalus* (Fabricius).

Order COLEOPTERA; family CERAMBYCIDÆ.

Boring in hickory wood; nothing farther known regarding its habits.

This beetle has been raised from hickory wood by Dr. G. H. Horn. (Proceedings of the Entomological Society of Philadelphia, vol. 1, p. 29.) It has also been found boring in a dead elm by Mr. H. G. Hubbard, of Detroit, Mich., and a gravid female was found near the root of a rose-bush in Washington, D. C. (Riley).

11. *Dorcaschema nigrum* (Say).

Order COLEOPTERA; family CERAMBYCIDÆ.

Bores in the hickory, according to Dr. F. Hodge, Buffalo, N. Y.

12. THE HICKORY BARK-BORER.

Scolytus 4-spinosus (Say.)

Order COLEOPTERA; family SCOLYTIDÆ.

Undermining the bark and making long slender tracks radiating from a primary larger vertical chamber; a white footless grub, becoming a small cylindrical weevil-like beetle.

This very destructive bark-borer affects the bitter-nut, shell-bark, pig-nut hickory and probably the pecan (*Carya olivæformis*). According to Riley the beetle issues the latter part of June and early part of July. "Both sexes bore into the tree—the male for food, and the female mostly for the purpose of laying her eggs. In thus entering the tree they bore slantingly and upward, and do not confine themselves to the trunk, but penetrate the small branches and even the twigs. The entrance to the twig is usually made at the axil of a bud or leaf, and the channel often causes the leaf to wither and drop or the twig to die or break off.

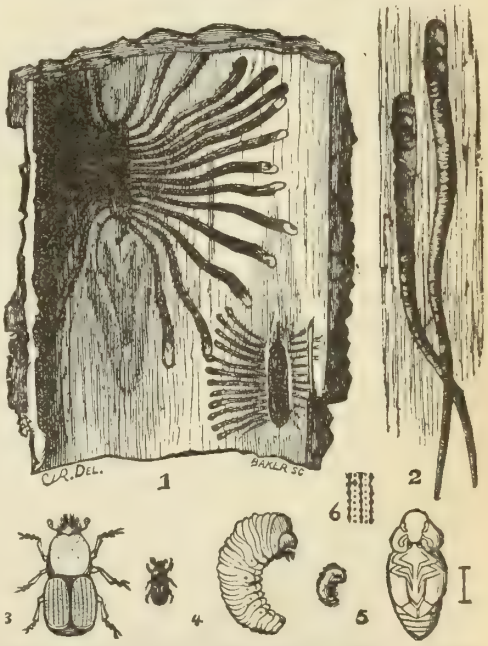

FIG. 34.—Hickory bark-borer. 1, 2, its "mine"; 3, the beetle; 4, larva; 5, pupa.—After Riley.

"The female, in depositing, confines herself to the trunk or larger limbs, placing her eggs each side of a vertical chamber, as described by

Mr. Bryant.* Here she frequently dies, and her remains may be found long after her progeny have commenced working. The larvæ bore their cylindrical channels, at first, transversely and diverging (Fig. 34, 1), but afterwards lengthwise along the bark (Fig. 34, 2), always crowding the widening burrows with their powdery excrement, which is of the same color as the bark. The full-grown larva (Fig. 34, 4, natural size and enlarged) is soft, yellowish and without traces of legs. The head is slightly darker, with brown jaws, and the stigmata so pale that they are with difficulty discerned. It remains torpid in the winter, and transforms to the pupa state about the end of the following May. The pupa (Fig. 34, 5) is smooth and unarmed, and shows no sexual differences. The perfect beetle issues through a hole made direct from the sap-wood, and a badly infested tree looks as though it had been peppered with No. 8 shot. The sexes differ widely from each other, the male having spines on the truncated portion of the abdomen, not possessed by the female. The eggs are deposited during the months of August and September, and the transformations are effected within one year, as no larvæ will be found remaining in the tree the latter part of July.

Two ichneumon parasites, according to Riley, prey upon this insect, and after killing the grub spin little pale cocoons. They are *Spathius trifasciatus* Riley, and *Bracon scolytivorus* Cresson.

The beetle.—Male entirely black, or black with brown wing-covers; the head above flat, concave towards tip; thorax very little longer than wide, and narrowing in front but slightly. Elytra with about 10 striæ confused at the sides, but regular above, and composed of small, deep, approximate punctures; interstitial spaces with a single row of minute and nearly obsolete punctures. The female differs in having the head rather shorter, more rounded, less hairy, and the venter unarmed. Length 0.15–0.20 inch. (Riley.)

13. *Sinoxylon basilare* (Say).

Order Coleoptera; family Ptinidæ.

Inhabits hickory wood, in which it bores to a considerable depth, preferring the hard central wood. Its borings are very fine, and firmly compressed. After full development is attained it makes its way out almost at a right angle and emerges through a circular opening in the bark of the hickory. (Horn.)

14. Red-shouldered apate.

Apate basilaris (Say).

Order Coleoptera; family Scolytidæ.

Boring deep, small, straight holes to the heart of the tree, which is entirely killed by this insect, and transforming at the bottom of the hole.

The beetle is deep black and punctured all over; thorax very convex and rough in front; the wing-covers not excavated at the tip, but sloping downward very sud-

* The mode of operation appears to be as follows: Boring through the bark, the insect forms a vertical chamber next to the wood, from half an inch to an inch in length, on each side of which it deposits its eggs, varying in number from twenty to forty or fifty in all. The larvæ, when hatched, feed on the inner bark, each one following a separate track, which is marked distinctly on the wood. Some trees contain them in such numbers that the bark is almost entirely separated from the wood. In many cases the upper part of the tree is killed a year or two before the lower part is attacked. (Riley's Fifth Annual Report Inj. Ins. Missouri, p. 104.

denly behind, as if obliquely cut off, the outer edge of the cut portion armed with three little teeth on each wing-cover, and on the base or shoulders a large red spot 0.20 inch in length. (Harris.)

The following *Coleoptera* are also said by Dr. J. L. Leconte to affect the trunks and branches of the common hickory (*Carya tomentosa*).*

15. *Lyctus striatus* Melsheimer. Family BITOMIDÆ.
16. *Anthaxia viridifrons* Gory. Appeared April 10. Family BUPRESTIDÆ.
17. *Agrilus egenus.* April 21. Family BUPRESTIDÆ.
18. ——— probably n. sp. April 8. Family BUPRESTIDÆ.
19. *Phyllobænus dislocatus.* Family CLERIDÆ.
20. *Chariessa pilosa.* April 16. Family CLERIDÆ.
Sinoxylon basilare. Family PTINIDÆ. (See p. 74.)
21. *Heterachthes quadrimaculatus.* Family CERAMBYCIDÆ.
22. *Phyton pallidum.* May 20. Family CERAMBYCIDÆ.
23. *Molorchus bimaculatus.* Family CERAMBYCIDÆ.
Cyllene picta. (See p. 70.) Family CERAMBYCIDÆ.
Neoclytus erythrocephalus. Family CERAMBYCIDÆ.
24. *Tillomorpha geminata.* Family CERAMBYCIDÆ.
25. *Acanthoderes quadrigibbus.* Family CERAMBYCIDÆ.
26. *Liopus cinereus.* April 24. Family CERAMBYCIDÆ.
27. *Ecyrus dasycerus.* April 21. Family CERAMBYCIDÆ.
Saperda discoidea. (See p. 70.) Family CERAMBYCIDÆ.
Oncideres cingulatus. (See p. 71.) Family CERAMBYCIDÆ.
28. *Tribolium*, n. sp. March. Family TENEBRIONIDÆ.
29. *Læmosaccus plagiatus.* April and August. Family CURCULIONIDÆ.
30. *Xyleborus celsus.* Family SCOLYTIDÆ.
31. *Thysanoës fimbricornis.* April and May. Family SCOLYTIDÆ.
32. *Chramesus hicoriæ.* April and May. Family SCOLYTIDÆ.
33. *Eupogonius vestitus* Say. Bred from hickory. (Riley.)

AFFECTING THE BARK.

34. THE HICKORY-BARK LOUSE.

Lecanium caryæ (Fitch).

Order HEMIPTERA; family COCCIDÆ.

Fixed to the bark of the small limbs, a large, very convex oval scale of a black color fading to chestnut brown, in May dusted over with a white powder. Length often 0.40 by 0.25 inch in width. (Fitch.)

35. THE HICKORY BLIGHT.

Eriosoma caryæ (Fitch).

Order HEMIPTERA; family APHIDÆ.

Forming a flocculent down coating the under side of the limbs, especially of bushes and young trees in shaded situations, multitudes of wooly plant lice.

The winged individuals are black, with the head, scutel, and abdomen covered with

* See American Entomologist, vol. iii, p. 236.

a white cotton-like substance, the fore wings with an oval salt-white spot near the tip of their outer margin; the veins being obsolete. Length to the tip of the wings 0.12 inch. On walnut bushes in Illinois. (Fitch.)

36. The hickory aphis.

Lachnus caryæ (Harris).

Order Hemiptera; family Aphidæ.

Living in clusters on the under side of limbs of the pig-nut hickory early in July, very large plant-lice ¼ inch long, with no terminal stylet and very short horney tubes; body covered with a bluish white bloom or down, with four rows of little transverse black spots on the back; top of thorax and veins of wings black, as are also the shanks, feet and antennæ, while the thighs are reddish brown. (Harris.)

AFFECTING THE LEAVES.

37. The luna silk moth.

Actias luna (Linnæus).

Order Lepidoptera; family Bombycidæ.

Devouring the leaves in August, a large thick-bodied caterpillar, about three inches long, apple green, each segment with six small bright rose-red elevated dots, and low down along each side a pale yellow line running lengthwise immediately above the lower row of dots, from which line at each of the sutures a pale yellow line extends upward upon the sides. Spinning a large oval cocoon, which is found among the fallen leaves; the moth, one of our largest insects, appearing late in May and during June; pale green, with eye-like spots in the center of each wing, the hinder pair pro longed into two long, broad "tails."

38. The regal walnut caterpillar.

Citheronia regalis (Hübner).

Order Lepidoptera; family Bombycidæ.

A spiny caterpillar five inches long, our largest species, green, with a red head and tail, and stout, sharp, black and red spines, and black and red feet; not spinning a cocoon, but the larva enters the ground in September to transform to a chrysalis, which in July changes to a very large bright orange-red moth, with the fore wings pale olive spotted with yellow, the veins stained reddish, and the hind wings orange-red.

This is our largest caterpillar; it is harmless, though so formidable in appearance, and easily recognized by its size and by the four long horns on the segments just behind the head. It feeds on the black walnut, butternut, hickory, persimmon, and sumach, and is very rare north of New York, and is scarce in the Middle and Southern States.

39. The hickory tussock moth.

Halesidota caryæ (Harris).

Order Lepidoptera; family Bombycidæ.

In July and August and early September, eating the tender leaves at the ends of the branches, snow-white caterpillars, over an inch long, with rows of round black

spots, and along the back 8 black tufts of converging hairs and two black pencils of longer hairs near each end of the body; spinning in sheltered corners and crevices ash-gray oval cocoons; the moth appearing the following June. (Fitch.)

In certain years this caterpillar may be quite numerous; it is quite social, feeding in companies and is a general feeder, and, while preferring the walnut, butternut, and sumach, is common on the elm and ash, and Fitch says he has seen clusters of the caterpillars upon the tamarack or larch; he adds, what has been observed by ourselves, that as they approach maturity they separate and stray off to other trees, and may then be seen on rose bushes, on the apple, oak, locust, &c., the same individual often remaining several days in one place. It ranges from Maine to the Southern States.

The moth is very light ochre yellow; the long narrow-pointed fore wings are thickly sprinkled with little brown dots, and have two oblique brownish streaks passing backwards from the front edge, with three rows of white semi-transparent spots parallel to the outer hind margin; hind wings very thin, semi-transparent, and without spots. The wings expand about two inches. (Harris.)

40. The skiff caterpillar.

Limacodes scapha Harris.

Order Lepidoptera; family Bombycidæ.

A singular boat-shaped triangular caterpillar, green, spotted above with brown pale beneath, the sides raised and the dorsal surface flattened; forming in the autumn a tough rounded oval cocoon, covered by an outer thin envelope.

The moth appears in June; it is light cinnamon brown; on the fore wings the costo-median region is filled in with a large tan-brown triangular spot, ending on the tip of the wing, and is lined externally with silver.

Fig. 35.—Limacodes scapha. Nat. size.

A number of other Bombycidæ allied to Limacodes, Notodanta, Halesidota, &c., also inhab it the hickory; besides these, the American silk worm sometimes occurs on the hickory, as well as the goldsmith beetle, which, according to Fitch, feeds on the leaves.

41. The walking stick.

Diapheromera femorata Say.

Order Orthoptera; family Phasmidæ.

Sometimes stripping the leaves of the hickory, white oak, locust, &c., causing the timber to appear seared and leafless, a singular insect which would be mistaken for the smaller twigs or leaf-stalks, as the body is very long and slender, wingless, nearly four inches long, cylindrical, and an eighth of an inch in diameter.

A large number of Hemiptera, such as gall-lice, tree-hoppers, &c.,

puncture the leaves, causing them to wither or raising galls upon them. The following species have been noticed by Fitch:

FIG. 36.—The walking stick. *a*, *b*, eggs; *c*, young just hatching; *d*, male; *e*, female.—From Riley.

42. THE HICKORY-STEM GALL-LOUSE.

Phylloxera caryœcaulis (Fitch).

Forming bullet-like galls, hollow, green, and of a leathery texture, upon the leaf-stalks and succulent young shoots, with the walls of the cavity inside covered with minute white and yellow lice.

43. HICKORY-VEIN GALL-LOUSE.

Phylloxera caryœvenæ (Fitch).

Forming plaits in the veins of the leaves, which project up from the surface in an abruptly elevated keel-like ridge upon the upper side of the leaf and with a mouth opening on the under side, the lips of which are woolly and closed. The wingless females minute, pale yellow, broad in front, and tapering behind to an acute point; antennæ and legs short and tinged with a dusky hue.

44. THE HICKORY LEAF-WITHERER.

Phylloxera caryœfoliæ Fitch.

Forming small conical elevations on the upper surface of the leaf of *Carya alba*, each having an orifice in its summit; a very small black plant-louse with a pale abdomen and legs and smoky wings laid flat on its back, and having only three veins in addition to the rib. Length, 0.06 inch. (Fitch.)

45. THE SEED-GALL HICKORY PHYLLOXERA.

Phylloxera caryœ-semen (Walsh).

Forming fuscous, minute, subglobular, seed-like galls on the leaves of *Carya glabra*, the galls opening in a small nipple on the under side. (Walsh.)

46. THE HICKORY ROUND-GALL.

Phylloxera caryœ-globuli Walsh.

Forming hemispherical galls about 0.25 inch diameter on the upper surface of the leaves of *carya glabra* and *alba*, the galls rather flat below, where they open in a slit. (Walsh.)

47. THE HICKORY SPINY GALL.

Phylloxera spinosa (Shimer).

Forming large, irregular galls, covered with spines, on the petiole of the leaf of *Carya amara*, the galls opening beneath in an irregular, sinuate slit. (Shimer.)

48. *Phylloxera caryæ-septa* (Shimer).

Forming flattened galls with a septum, on the leaves of *Carya alba*, the galls opening both above and below. (Shimer.) Probably, according to Riley, only an abnormal form of *P. caryæ-globulis*.

49. *Phylloxera forcata* (Shimer).

Forming galls much like those of *P. caryæ-semen*.

50. *Phylloxera depressa* (Shimer).

Forming depressed galls on leaves of *Carya alba*, the galls opening below with a constricted mouth fringed with filaments. *Daktylosphæra coniferum* Shimer is, in all probability, Riley claims, the same. (7th Rep. Ins. Mo., p. 118.)

51. *Phylloxera conica* (Shimer).

Forming galls similar to those of *P. depressa*, but without the fringe. (Probably the same, Riley claims.)

. *Phylloxera caryæ-gummosa* Riley.

Forming pedunculated ovoid or globular galls on the under side of *Carya alba;* the gall white, pubescent, and gummy or sticky, opening below in a fibrous point.

The eggs are almost spherical, pale, and translucent. Larva, mother-louse, and pupa quite pale, the red eyes and eyelets strongly contrasting. (Riley, 7th Rep. Ins. Mo., p. 118.)

53. *Phylloxera caryæ-ren* Riley.

Forming numerous more or less confluent mostly reniform galls on the petiole and leaf-stems of *Carya glabra;* the galls varying from 0.2 to 0.7 inch in diameter, pale green and densely pubescent, and opening in a slit the whole of their length, transversely with the axis of the petiole. (Riley.)

54. *Phylloxera caryæ-fallax* Riley.

Forming conical galls thickly crowded on the upper surface of the leaves of the *Carya alba*. Strongly resembling *P. caryæ-foliæ*, but the height one-third greater than the basal diameter, and opening below, instead of above, in a circular fuzzy mouth. (Riley.)

55. THE HICKORY GAY-LOUSE.

Callipterus? caryellus Fitch.

Scattered upon the under side of the leaves, a small pale-yellow plant-louse with white antennæ alternated with black rings and pellucid wings laid flat upon its back, its abdomen egg-shaped, somewhat flattened, and with only minute rudimentary honey-tubes. (Fitch.)

56. THE DOTTED-WINGED GAY-LOUSE.

Callipterus? punctatellus Fitch.

A plant-louse like the preceding, but with black feet and a black dot on the base and another on the apex of each of the veins of its fore wings. The stigma is salt-

white, with a brown streak at each end; the second vein is wavy, and at its tip is curved towards the tip of the first vein; the third vein arises from the basal extremity of the stigma, and forward of its furcation curves perceptibly towards the apex of the wing; the fourth vein is longer than the second fork. (Fitch.)

57. The spotted-winged gay-louse.

Callipterus? maculellus Fitch.

Differs from *C.? caryellus* in having only a slender black ring at each articulation of the antennæ, the feet and a band near the tips of the hind thighs blackish; the stigma salt-white, its base black; its apex dusky; fourth vein with a black dot on its base and a dusky one on its apex; the first vein, apical third of the second vein, and the first and second forks broadly margined with smoky brown; second vein wavy and parallel with the third vein till near its tip where it curves towards the first vein, its base a third nearer the third than it is to the first vein; third vein arising from the anterior extremity of the stigma, with a dusky spot on its apex. (Fitch.)

58. The smoky-winged gay-louse.

Callipterus fumipennellus Fitch.

Similar to the preceding, of a dull yellow color with blackish feet and the wings smoky with robust brown veins, the rib-vein much more distant from the margin of the first half of its length than in the other species, and from its middle to the stigma approaching the margin; the fourth vein equalling the stigma in length. (Fitch.)

59. The black-margined gay-louse.

Callipterus marginellus Fitch.

Pale yellow; antennæ white, their bases and the four bands black; a coal-black band in front between the eyes and continued along each side of the thorax to its base; fore wings pellucid, stigma with the outer margin and rib-vein coral black, first vein with a black dot on its base; fourth vein slender, black, the other veins colorless; outer margin of hind wings black. (Fitch.)

60. The freckled leaf-hopper.

Jassus inoratus Say.

A cylindrical oblong white leaf-hopper closely inscribed and reticulated with slender black lines and small dots which form irregular spots along the margins of the wing-covers; its legs white dotted with black. Length, 0.25 inch.

61. Four-striped leaf-hopper.

Diedrocephala quadrivittata (Say).

A flattened oblong leaf-hopper of a light-yellow color, varied on the thorax with orange, red or dusky; its fore wings olive green, each wing with two bright red or orange stripes, the tips margined with black. Length, 0.35 inch. (Fitch.)

62. The walnut sword-tail.

Uroxiphus caryæ Fitch.

A dull brown tree-hopper with the terminal portion of its fore wings obscure ash-gray; its abdomen and a ring on its shanks pale yellowish, and its breast mealy white. Length of male, 0.30; female, 0.37. (Fitch.)

63. The yellow tree-hopper.

Telamona unicolor Fitch.

A tree-hopper of a uniform dull ochre-yellow, somewhat like a beech-nut in shape and size, with a prominent hump jutting up on the middle of its back, highest anteriorly and descending with a slight curve to its hind angle, which is very obtusely rounded and but little prominent; its anterior angle also rounded and with only a slight concavity below it at the forward end of the hump, while at its posterior base is a strong one, the whole surface with close coarse punctures and showing a few elevated longitudinal lines low down on each side and towards the tip; the upper edge of the hump black and also the tip of the abdomen on its under side; fore wings glassy, with a black spot on their base and tip, and their veins margined with slender black lines. Length, 0.45 inch; height, 0.25 inch.

64. The banded tree-hopper.

Telamona fasciata Fitch.

Like the preceding species, but smaller and of a tawny yellow color, its head and the anterior edge of the thorax and the under side paler cream-yellow or straw-colored; with a single small black dot above each eye; its thorax in front and at tip blackish, and also an oblique band across the hind end of the dorsal hump longer than high, longer at its base than above, highest anteriorly, with a stronger concavity at its anterior end than at its posterior, and at its anterior base compressed and forming hereby a shallow indentation upon each side. Length, 0.38; height, 0.20 inch. (Fitch.)

65. The short-horned tree-hopper.

Ceresa brevicornis Fitch.

Very like *Ceresa bubalus* on the apple and wild thorn, but differing in having the horns much shorter, while the sides of the thorax, when viewed in front, are not gradually curved outwards, but are straight or rectilinear, with the horns abruptly projecting from the corner at the upper end of this line. The acute spine at the tip of the thorax is also longer and slenderer. The thorax between the horns is slightly convex. The dried specimen is of a pale dull yellow color speckled with faint pale green dots and with a paler straw-colored stripe, quite distinct, upon the angular sides of the thorax from each eye upward to the horn and from thence to the summit of the thorax. Length, 0.36 inch. (Fitch.)

66. The face-banded cixius.

Cixius cinctifrons Fitch.

A small four-winged hemipter of a white color, varied with blackish brown, and with three elevated lines upon the face and thorax; its face snow-white, crossed by two black bands, the outer raised lines dotted with white in these bands; the thorax black, tawny yellow on each side beyond the raised lines; neck white with a row of blackish dots upon each side; fore-wings smoky brown, their veins dotted with black in places, their basal edge, an oblique band and a spot in the middle of the outer margin white, their membranous tips white and somewhat hyaline, with a brown band across the transverse veinlets, and the hind margin blackish, interrupted by the snow-white tips of the veins; hind wings black and transparent; under side yellowish white with two blackish bands on each of the four forward shanks. Length, 0.18 inch.

67. The cloudy-tipped cixius.

Cixius colœpeum Fitch.

Rarely found on the leaves, a small four-winged homopter of a coal-black color, with clear, transparent wings having a large smoky-brown cloud on their tips; fore-

wings transparent, their veins dotted with black, the dots on the outer margin larger; an irregular and somewhat broken band of a smoky-brown color extending across forward of the middle and a broader one beyond the middle, having a black spot or stigma on the anterior corner of its outer end; between these bands a smoky-brown spot on the inner and a smaller one nearly opposite it on the outer margin; thorax with three raised lines; face black with the raised lines brown; legs dull whitish. Length, 0.22 inch. (Fitch.)

68. Amyot's otiocerus.

Otiocerus amyotii Fitch.

A light yellow homopter; the wing-covers pale sulphur-yellow, with a brown stripe from the base to the middle of the inner margin and thence to the outer tip; a row of blackish dots on the hind edge alternating with the ends of the apical veins, and about six dots forward of the innermost of these, placed on the tips of the subapical and on the bases of the apical veins; three brown stripes on the thorax; an orange-red stripe on each side of the head, from the eye to the forward edge below the apex. Length, 0.25; expanse of wings, 0.70 inch. (Fitch.)

69. The large green tree bug.

Rhaphigaster pensylvanicus (De Geer).

A large flattened grass-green bug (hempter) edged all around with a light yellow line, interrupted at each joint of the abdomen by a small black spot, its antennæ black beyond the middle of their third joint, with a pale yellow band on the first half of the two last joints. Length, 0.60 and 0.70 inch. (Fitch.)

70. The walnut leaf-roller.

Tortrix rileyana Grote.

Order Lepidoptera; family Tortricidæ.

Drawing together the leaves of the black walnut and hickory in May, a colony of small yellow caterpillars; late in the month changing to honey-yellow chrysalids, the moths escaping by the middle or last of June. The latter expands an inch, and is deep ochreous, the fore-wings broad, evenly washed with purplish, with dark velvety-brown small spots, of which there are three at the base, two in the middle of the wing, and one on the edge, while near the apex is a curved row of four or five spots. The hind wings clear bright deep ochreous yellow. (Riley.)

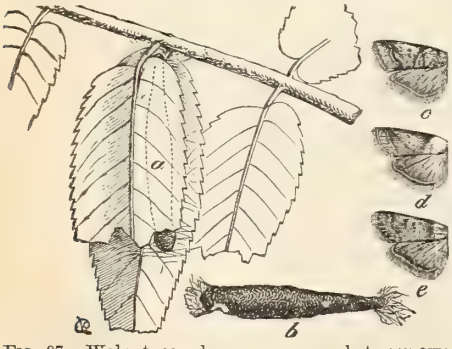

Fig. 37.—Walnut case-bearer; *a*, case between two leaves; *b*, case; *c*, *A nebulo*; *d*, *A. juglandis*; *e*, *juglandis* var.

71. The walnut case-bearer.

Acrobasis juglandis Le Baron.

Order Lepidoptera; family Pyralidæ.

Drawing two leaflets together and constructing a black case, a small dark greenish worm, changing to a gray narrow-winged small moth. (Fig. 20.—Riley IV, p. 42.)

We have observed at Providence, June 1st, between the folded leaves of *Carya porcina*, a similar case, but in the form of a long, slender black cone.

72. PIG-NUT LEAF WEEVIL.

Conotrachelus elegans Say.

Order COLEOPTERA; family CURCULIONIDÆ.

While engaged in laying its eggs sometimes cutting off the leaves of the pig-nut hickory, a weevil of moderate size, closely resembling the plum weevil.

We have observed this weevil at Providence, busily engaged the last of May laying its eggs in the partly rolled-up leaves of the pig-hickory (*Carya porcina*), and during the process cutting off the leaves, which hang down, wither, and turn black.

73. THE PIG-HICKORY SLUG-WORM.

Selandria sp.

A pale-green slug-worm, resembling in form the naked larva of *Selandria caryæ*, with several rows of short, forked white hairs; quite abundant at Providence May 30th, eating roundish holes in the leaves of the pig-nut hickory.

74. THE HICKORY SLUG CATERPILLAR.

Thecla calanus (Hübner).

Order LEPIDOPTERA; family PAPILIONIDÆ.

Feeding on the leaves of the pig-hickory at Providence May 30th and later, a pale-green, flattened, long, oval, cylindrical caterpillar, flat beneath; the body rounded above and covered with short hairs; changing to a delicate small butterfly, with the hind wings tailed.

AFFECTING THE FRUIT.

75. THE HICKORY-SHUCK WORM.

Ephippophora caryana Fitch.

Order LEPIDOPTERA; family TORTRICIDÆ.

Mining the shucks which envelope the nuts, causing them to be abortive and many to fall from the tree prematurely, a slender white sixteen-footed caterpillar about three-eighths of an inch in length.

The moth is sooty black, the fore-wings with reflections of tawny yellow, blue and purple; their outer edge black with oblique triangular whitish streaks placed at equal distances apart. A very oblique faint silvery blue streak extends inwards from the points of two of these white streaks, namely, the fourth and sixth ones from the tip of the wing; while the usual white spot on the inner margin of the wings is wanting. Expanse of wings, 0.60 inch. (Fitch.)

76. THE HICKORY-NUT WEEVIL.

Balaninus nasicus Say.

Order COLEOPTERA; family CURCULIONIDÆ.

A worm like the chestnut borer transforming into a long-snouted beetle closely like *B. rectus*, but with a darker, thicker, more curved rostrum, and with the antennæ springing from its middle in the male and from its basal third in the female. Two

thoracic paler bands are seen on the thorax, and there is always a pale transverse band behind the middle of the elytra, and a sutural band. In the male the beak is equal to three-fourths the length of the body; in the female to five-fourths. It breeds entirely on hickory nuts. (Riley.)

The following insects also occur on the hickory:

77. The Luna moth, *Actias luna.* (Linn.)
78. The hickory leaf roller, *Tortrix* (Lophoderus) *juglandana* Fernald. (Can. Ent. XI, 155.)
79. *Eburia quadrigemina* Say. Issuing from hickory trees in July, common. (McBride.)

The following Tineidæ feed on the hickory according to Chambers:

80. *Lithocolletis caryæfoliella* Clem.
81. *Lithocolletis caryævalbella* Chamb. Larva in a tentiform mine in the under surface of the leaves.
82. *Aspidisca lucifluella* Clem. Larva in a small blotch mine, from which it cuts out its pupal case.
83. *Coleophora caryæfoliella* Chamb. (and Clemens?). Larva feeds in a cylindrical case attached to the under surface of the leaves.
84. *Nepticula caryæfoliella* Clem. Imago unknown. Larva in a linear crooked mine on the upper side of the leaves.
85. *Ypsolophus caryæfoliella* Clem. Larva sews together the leaves.
86. *Gracilaria* sp. (probably *G. blandella* Clem.) Imago unknown. The larva when young makes a linear whitish mine in the upper surface of the leaves.
87. *Phycita nebulo* (juglandis). A pyralid living on the walnut.

INSECTS INJURIOUS TO THE BLACK WALNUT.

(*Juglans nigra.*)

AFFECTING THE TRUNK.

The chief enemy of this tree is the hickory and locust tree borer, (*Cyllene picta*). Fitch states that the beetles which are reared in this tree appear to constitute a distinct variety of a larger size than usual and with their yellow marks changed more or less to a white color.

AFFECTING THE LEAVES.

1. The black walnut sphinx.

Smerinthus juglandis Smith-Abbot.

Order Lepidoptera; family Sphingidæ.

A large pale blue-green caterpillar with a long caudal horn; head small, and the body attenuated before and behind, and with seven oblique white bands. When disturbed it makes a creaking noise by rubbing together the joints of the fore part of the body. It enters the earth to finish its transformations. (Harris.)

The moth is very gray, dark or dusky brown; wings indented on the outer edges; fore-wings with a dusky outer margin, a short brownish dash near the middle, and four transverse brown lines converging behind and enclosing a square dark brown

spot adjacent to the middle of the inner margin; hind wings with two narrow transverse brown lines between two brownish bands; thorax with a central brown line; abdominal segments plaited and prominent at the sides. The wings expand from 2¼ to 3 inches. The females are much larger and of a lighter brownish gray color than the males, with the square spot on the fore-wings less distinct. Ranges from Massachusetts to Florida and Georgia. (Harris.)

2. The red-tailed attelabus.

Attelabus analis Weber.

Order Coleoptera; family Curculionidæ.

Rolling up the leaves of the oak and black walnut, a weevil a quarter of an inch long, with a long, slender, cylindrical head and short, broad, thick body. The antennæ, legs, and middle of the breast deep blue-black; the thorax, wing-covers, and abdomen dull red; the wing-covers, taken together, nearly square and pitted in rows.

According to Harris, this pretty weevil is found on the leaves of oak trees in June and July. Mr. George Hunt has observed it on the walnut in May before the buds open, at Providence.

The following insects also occur on the black walnut:

3. Walnut leaf-roller, *Tortrix rileyana* Grote.
4. Walnut case-bearer, *Acrobasis juglandis* Le Baron.
5. The Luna moth, *actias luna* (Linn).
6. *Conotrachelus juglandis* (Lec). Larva taken from walnuts, Mt. Carmel, Illinois, H. Shimer, Mus. Peab. Acad. Science, Salem, Mass. (See Harris, p. 77.)

The following leaf-miners are enumerated by Mr. Chambers, with the notes appended:

7. *Lithocolletis caryæfoliella.* Larva in irregular blotch-mine in upper surface of leaves.
8. *Gracilaria blandella* Clem. Larva when small in a linear whitish mine in upper surface of leaves, afterwards feeding and pupating under the turned-down edge.
9. *Gracilaria juglandinigræella* Chamb. Larva at first mining the leaves beneath, afterwards feeding and pupating under the turned-up edge.
10. *Aspidisca juglandiella* Chamb. Larva in a very small blotch-mine, from which it cuts out a case in which it pupates.
11. *Nepticula juglandifoliella* Chamb. (and Clemens?) Larva in small, linear crooked mines; sometimes many in a leaf. Mine in upper surface.

INSECTS INJURIOUS TO THE BUTTERNUT.

(*Juglans cinerea.*)

AFFECTING THE TRUNK AND LIMBS.

1. The spotted leptostylus.

Leptostylus macula (Say).

Order Coleoptera; family Cerambycidæ.

Under the bark of old decaying trees a longicorn larva, changing to a pupa in its cell and early in July giving out a small thick long-horned beetle of a brown or chest-

nut color with the sides of its thorax and a band on its wing-covers ash-gray, the latter sprinkled over with coarse punctures and large blackish dots, the thorax on each side of its disk with a black stripe interrupted in its middle. Length, 0.25 inch.

Dr. Fitch, in his third report, states that the bark of old trees will sometimes be found everywhere filled with these grubs, which in the month of June may be seen changed to short thick pale-yellow pupæ, with a few perfect insects that are newly hatched and have not yet left the tree.

2. The muscle-shaped butternut bark-louse.

Aspidiotus (*Mytelapis*) *juglandis* Fitch.

Order Hemiptera; family Coccidæ.

Fixed to the bark of the twigs, minute pale brownish scales, like those of the apple bark-louse, but smaller and not curved; preyed upon by a minute chalcid fly. (Fitch.)

3. The hemispherical butternut scale insect.

Lecanium juglandifex Fitch.

Adhering to the bark on the under side of the limbs, a hemispherical dull yellowish or black scale about 0.22 inch long and 0.18 broad, notched at its hind end, frequently showing a paler stripe along its middle and a paler margin and transverse blackish bands. (Fitch.)

The males, according to Fitch, are long and narrow, delicate two-winged flies, measuring 0.05 inch to the tip of the abdomen and a third more to the ends of the wings. They are of a rusty reddish color, the thorax darker and the scutel and head blackish, this last being separated from the body by a narrow pale-red neck. The antennæ are slender and thread-like, half as long as the body and eight-jointed. Two slender white bristles as long as the body are appended to the tip of the abdomen. This description will apply to most of the males of other species of Lecanium.

AFFECTING THE LEAVES.

4. The butternut wooly worm.

Selandria caryæ Norton.

Order Hymenoptera; family Tenthredinidæ.

On the under side of the leaves companies of saw-fly larvæ covered with long dense snow-white wool standing up in flattened masses entirely concealing the green worm, eating the leaflets from the outer edge inward, often leaving nothing but the midribs.

These remarkable objects occasionally, though rarely, appear on the butternut in July. The worm presents the appearance (as described in our "Guide to the Study of Insects," from which the following description and figures are taken) of an animated white woolly or cottony mass nearly an inch long and two-thirds as high. The head of the larva is

rounded, pale whitish, and covered with a snow-white powdery secretion, with prominent black eyes. The body is cylindrical, with eight pairs of soft fleshy abdominal legs; the segments are transversely wrinkled, pale pea-green, with a powdery secretion low down on the sides, but above and on the back arise long flattened masses of flocculent matter (exactly resembling that produced by the wooly plant lice and other homopterous insects), forming an irregular dense cottony mass, reaching to a height equal to two-thirds the length of the worm, and concealing the head and tail. On the 27th and 28th of July the larvæ molted, leaving the cast skins on the leaf. They were then naked, a little thicker than before, of a pale-green color, and their bodies were curled upon the leaf. The worms eat out the edge of the leaf. Some time during August two cocoons were spun between the leaves, but I did not succeed in raising the saw-flies. On describing the larvæ in a letter to Mr. E. Norton, our best authority on this hymenopterous family, he kindly sent me alcoholic specimens of the larvæ (without the woolly substance, which dissolves and disappears in alcohol) found feeding on the hickory, which are, apparently, from the comparison of alcoholic specimens, identical with the butternut Selandria. The adult fly he named *Selandria carya*, and his descriptions are given below.

FIG. 38.—The butternut wooly worm and the same deprived of its coat.—From Packard.

Previously to this and without my knowledge, Dr. Fitch, under the name of *Selandria? juglandis*, had apparently briefly described in his third report the same insect, but he was unacquainted with the perfect insect, and was in doubt as to whether the larva was a Selandria or not. Under these circumstances we retain Mr. Norton's name. From his account it would appear that the insect also feeds on the hickory (*Juglans squamosa*).

Female.—Color shining black. The pro and meso-thorax and scutellum rufous, the apex of the latter black; the nasus and legs white, with their tarsi blackish; the base of coxæ and a line down the upper side of the legs black. Antennæ short; the second joint as long as the first; the four final joints together not longer than the two preceding. Nasus slightly incurved. Claws of tarsi apparently bifid. Wings subviolaceous; lanceolate cell petiolate, the first submedian cell above it with a distinct cross-vein. Under wings with one submarginal middle cell (all other species have this cell discoidal), the marginal cell with a cross-nervure, and all the outer cells closed by an outer nervure, which does not touch the margin. The submedian cell extended nearly to the margin. Length, 0.25 of an inch. Expanse of wings, 0.40 of an inch.

The male resembles the female, but the under wings are without middle cells.

The larva feeds upon the leaves of the hickory (*Juglans squamosa*). They are found upon the lower side of the leaf, sometimes fifteen or twenty upon one leaf, which they eat from the outer extremity inward, often leaving nothing but the strong midribs. They cover themselves wholly with white flocculent tufts, which are rubbed off on being touched, leaving a green twenty-two-legged worm, about 0.75 inch in length

when fully grown; darkest above, and with indistinct blackish spots upon the sides. The head is white, with a small black dot upon each side. Specimens were taken upon the leaves July 4. Went into the ground about the 20th of July. The cocoon is formed near the surface of the ground of a little earth or sand drawn together. Four specimens came forth about August 22, all seemingly very small for so large larvæ. (Norton in Packard's Guide to the Study of Insects.)

5. The two-marked tree-hopper.

Euchenopa binotata Say.

Order Hemiptera; family Membracidæ.

Puncturing the leaves and extracting their juices from July till the end of the season, a small rusty brown or black tree-hopper, with two bright pale yellow spots upon its back, which part is prolonged forward and upward into a compressed horn rounded at its tip and giving the insect a resemblance to a little bird with an outstretched neck, and the four forward shanks broad, thin, and leaf-like. Length, 0.25 to 0.30 inch. (Fitch.)

6. The butternut tree-hopper.

Ophiderma mera Say.

Belonging to the same family as the preceding, a greenish-gray tree-hopper, shaped like a half cone, with its apex bright chestnut-red, and behind its middle a black band which is sometimes interrupted on the summit of the back, and with a blackish spot on the tips of the hyaline fore wings. Length 0.36 inch. (Fitch.)

7. The obtuse clastoptera.

Clastoptera obtusa Say.

A short thick almost circular leaf-hopper of a gray color, with fine transverse wrinkles and three brown bands anteriorly, its fore wings clouded with tawny brown with streaks of white and a coal-black spot near their tips. Length 0.22 inch, (Fitch.)

8. The butternut tingis.

Tingis juglandis Fitch.

Puncturing the leaves and sucking their juices, a small singular bug, resembling a flake of white froth, its whole upper surface composed of a net-work of small cells, an inflated egg-shaped protuberance like a little bladder on the top of the thorax and head, the sides of the thorax and of the fore wings, except at their tips, minutely spinulose; the fore wings flat and square with their corners rounded, a large brown or blackish spot on the shoulder, and a broad band of the same color on their tips, with an irregular whitish hyaline spot on the inner hind corner; the body beneath, small and black, the antennæ and legs honey-yellow. Length 0.14 inch. (Fitch.)

Fitch remarks that this insect becomes common on the leaves of the butternut in May, and continues through the summer and autumn. It may sometimes be met with also on the birch, willows, and other trees. We have found it in abundance on the butternut at Brunswick, Me., late in August in all stages of growth.

9. The virginia tiger-moth.

Spilosoma virginica (Fabricius).

Order Lepidoptera; family Bombycidæ.

Occasionally devouring the leaves of the butternut, a very hairy, deep yellow caterpillar, with a black head and body, the latter mottled with black; changing to a thick chrysalis within a cocoon, where it remains until the following June, when it appears as a white moth.

This omnivorous caterpillar, commonly called "the yellow bear," is known to feed on the butternut, grape vine, current, gooseberry, grasses,

and various garden vegetables, and we have found it from the first to the middle of September in Maine feeding on the buckthorn and also the pitch-pine. According to Harris there seems to be two broods of caterpillars and two of the moths. The caterpillars, he states, "are to be found of different ages and sizes from the first of June till October. When fully grown they are about two inches long, and then creep into some convenient place of shelter, make their cocoons, in which they remain in the chrysalis state during the winter, and are changed to moths in the months of May or June following. Some of the first broods of these caterpillars appear to come to their growth early in summer, and are transformed to moths by the end of July or the beginning of August, at which time I have repeatedly taken them in the winged state; but the greater part pass through their last change in June." I have observed the full-grown caterpillar at Brunswick, Me., the first and second weeks in August; they spin from the middle of August till September. The following description of the caterpillar is taken from my notes:

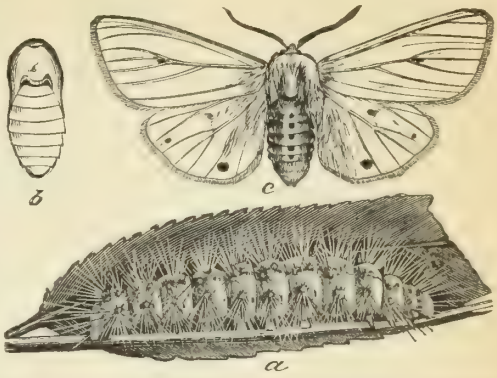

FIG. 39.—*c*, Virginia tiger-moth: *a*, its caterpillar; *b*, chrysalis, all nat. size.—After Riley.

The caterpillar.—Head of moderate size; body cylindrical, rather short and not very convex; each segment with four tubercles above, two smaller median ones being situated in front of and between two latero-dorsal larger ones; three tubercles on each side of each segment, all giving rise to dense verticils of long uneven fox-yellow hairs; most of the hairs are as long as the body is thick, while others on the back are twice as long, so that in outline the larva is an elongated ellipse, the head and tail being alike concealed by the spreading hairs. The body and head is black or yellowish mottled with black. The hairs are tawny yellow, while the short hairs on the sides of the thoracic rings are black.

The moth.—Snow white, with a black dot in the middle of the fore wings and two on the hind wings; a row of black spots along the back of the abdomen and a row along the sides, between the latter dots a longitudinal deep yellow stripe; the basal joints of the fore legs are yellow. The wings expand about two inches. The eggs are said by Harris to be golden-yellow, and to be laid in patches on the leaves of plants.

Besides this moth the following *Lepidoptera* occur at times on the butternut:

10. The hickory tussock moth, *Halesidota caryæ*, Brunswick, Maine.
11. The vaporer moth, *Orgyia leucostigma.*
12. The fall web-worm, *Hyphantria textor.* (See p. 67.)
13. The Luna moth, *Actias luna* (Linn.). (See p. 76.)
14. The Cecropia moth, *Samia cecropia.*

15. The American silk worm, *Telea polyphemus.* (See p. 47.)
16. The black walnut sphinx, *Smerinthus juglandis.* (See p. 84.)
17. The butternut leaf-miner, *Lithocolletis caryæfoliella* Clem.
18. The locust or hickory borer, *Cyllene picta* (Drury). (See p. 70, 95.)

INSECTS INJURIOUS TO THE CHESTNUT.

(*Castanea vesca.*)

AFFECTING THE TRUNK AND LIMBS.

1. The chestnut tree borer.

Making a zigzag burrow under the bark, and sometimes descending nearly 2 inches towards the heart of the tree where it may spend the winter, a longicorn larva nearly ¾ inch long, dirty white, of much the appearance of the hickory or locust tree borer, and transforming in its chamber into the beetle state.

Although the chestnut has been supposed to be remarkably free from borers, we have found that in Rhode Island the trunks are quite liable to the attacks of a borer, which we have not yet traced to the beetle, but which will probably prove to be the species next mentioned (*Arhopalus fulminans*), since this beetle, which is known to inhabit the chestnut, is closely allied to the locust borer in its form, while the larva is also closely like that of *Cyllene picta* and the different species of *Clytus.* The burrows in outline are flattened, cylindrical, being adapted to the broad flattened front part of the body of the larva. The burrows begin as small zigzag galleries about a line in width and 4 inches long, making about three turns at nearly right angles in this space; they are filled with the castings of the worm; as the larva grows larger it sinks deep in towards the heart of the tree, when the burrow in the deepest part becomes packed with large, long, curved chips, apparently bitten off by the grub for the purpose of forming a chamber, the partition of chips possibly serving to keep out the cold during its winter's sleep.

2. The brown chestnut beetle.

Arhopalus fulminans (Fabricius).

Order Coleoptera; family Cerambycidæ.

Boring into the trunk, a grub like the foregoing, if not the same insect, which transforms into a dark brown beetle with dark blue reflections, and the wing-covers crossed by four zigzag fine gray lines.

The following notice of this beetle is taken from my Second Report on the Injurious Insects of Massachusetts (1872):

My attention has been called by Mr. R. B. Grover, a student in the State Agricultural College, to the fact that the *Arhopalus fulminans* Fabr. (Fig. 40, enlarged twice), one of the family of longicorn beetles, bores in the trunk. I know nothing further concerning its habits nor of the appearance of its grub. The beetle itself is blackish brown, with slight dark-blue reflections; the legs and antennæ are of the same color,

the latter being scarcely longer than its body. The top of the head and the sides of the prothorax and under side of the body are covered with a pale-gray pile, while certain silver markings on the wing-covers are composed of similar close-set, fine hairs. The hairs on the sides of the prothorax inclose a conspicuous black spot, while the top is black, and more coarsely punctate than the wing-covers. The latter are each crossed by four acutely zigzag lines, composed of microscopic hairs, forming W-like bands on the elytra, the basal lines being less distinctly marked than the others. The ends of the wing-covers are also tipped with gray, especially on the inner side of the end. The legs are pitchy brown with light hairs, and with a reddish tinge on the terminal joints (tarsi). It is a little over half an inch long.

FIG. 40.—Chestnut Borer. —From Packard.

3. THE NOBLE CHESTNUT BORER.

Calloides nobilis (Say).

A longicorn borer, probably depredating upon the chestnut, and transforming to a large, handsome, black brown beetle, nearly an inch long, marked with three broken yellow lines and a pair of large round yellow dots on the wing-covers.

Mr. George Hunt informs us that he has found this noble Clytus under the bark of the chestnut at Providence; hence it occurs as a borer of this tree. Its food-tree has not heretofore been known.

4. THE TWO-TOOTHED SILVANUS.

Silvanus bidentatus (Fabricius).

Order COLEOPTERA; family ATOMARIIDÆ.

Under the bark of logs and decaying trees, probably loosening the bark from the wood, a minute, narrow, flattened beetle, of a light chestnut-brown or rust-color, its thorax longer than wide, slightly narrowed towards its base and with a small tooth projecting outwards at each of its anterior angles. Length, 0.10 to 0.12 inch. (Fitch.)

Fitch observes that this is an European insect, which, like a kindred species, the Surinam Silvanus, has now become perfectly naturalized and as common throughout the United States as it is in its native haunts. On stripping the bark from recently cut logs of chestnut and of oak, this minute beetle, which is so flattened and thin that it can creep into the slightest crevices, will be found frequently in considerable numbers.

The beetle.—The head and thorax often of a darker shade than the wing-covers; the latter with rows of close punctures with a slightly elevated line between each alternate row. Its thorax also is densely and confluently punctured, and commonly shows a very faint elevated longitudinal line in its center. The angles at its base on each side are obtuse, and from these angles forward to the projecting tooth the lateral edges are crenate-dentate, having sixteen little elevated tubercles or minute teeth jutting out at equal distances along the margin. The poinrt of the lage anterior tooth

forms a right angle. Upon each side of the head behind the eye is also a minute tooth of the same size with those along the sides of the thorax. The surface is slightly clothed with minute inclined bristles. (Fitch.)

5. The notched-winged geometer moth.

Eugonia alniaria Hübner.

Order Lepidoptera; family Phalænidæ.

Feeding on the chestnut, a bluish-green caterpillar, with wrinkles, and on the eleventh segment two little warts tipped with brown; transforming to a light ochre-yellow moth with wings deeply notched.

This caterpillar was found by Mr. L. W. Goodell on the chestnut at Amherst, Mass., August 20; on the 21st it drew a few leaves together, and spun a thin, silky, pear-shaped cocoon; became a chrysalis the 24th, and was transformed to a moth September 13.

Larva.—Body two and three-tenths inches long, the body largest near the tail, and tapering to the head; bluish green, with a thick wrinkle on each ring, those on the fifth and eighth thickest and light-brown; on the back of the eleventh ring two little warts tipped with brown. (L. W. Goodell.)

Pupa.—One and two-tenths inches in length, bluish-white, ending in a flattened tail, tipped with black, and on each edge three small black spines, each ending with a minute hook. (Goodell.)

Moth.—Short bodied, quite hairy; male antennæ heavily pectinated, wings deeply scalloped; delicate ochre-yellow, with a reddish tinge towards the edge of the wings, and on the head and front of the thorax. Fore wings with two lines, often interrupted, or only developed on the costa; inner line on the inner third of the wing; the curved outer line, beginning near the inner, diverges and follows a sinuate course, ending much nearer the apex than the inner line, the distance varying; both wings speckled, sometimes thickly, with unusually large spots; outer edge of both wings deeply excavated, especially opposite the second median venule. Hind wings with no lines, only an obscure discal dot. Expanse of wings two and two-tenths inches.

This moth ranges from Maine to Missouri. The larva is also described by Mr. S. H. Scudder as living on the black birch. But his description given in my Monograph of the Phalænidæ (p. 530) is so different from Mr. Goodell's that I fear it refers to a different insect.

AFFECTING THE LEAVES.

6. The chestnut tree-hopper.

Smilia castaneæ Fitch.

Order Hemiptera; family Membracidæ.

Puncturing the leaves and extracting their juices in July, a triangular tree-hopper, shaped much like a beechnut, of a blackish color, tinged with green more or less when alive, its head and the anterior edges of its thorax and all beneath bright yellow, its fore-wings clear and glassy, with a blackish spot on their tips and another on the base, which is often prolonged along the middle of the wing and united with the hind spot. Length of male, 0.25; female, 0.30 inch. (Fitch.)

7. The unadorned tree-hopper.

Smilia inornata Say.

A tree-hopper of the same size and shape as the preceding, but of a light green color fading to light yellow, with a slender black line along the upper edge of its back, and a very slight duskiness on the tips of its glassy wings. Common on chestnuts and oaks from July to the last of September. (Fitch.)

8. The chestnut gay-louse.

Callipterus castaneæ Fitch.

Order Hemiptera; family Aphidæ.

On the under sides of the leaves, puncturing them and sucking their juices in August and September, a small sulphur-yellow plant-louse, with black shanks and feet, its antennæ also black except at their bases and as long as the body, its wings pellucid, their first and second oblique veins and the tip of the rib-vein edged with coal-black, and its thighs straw yellow. Length, 0.09; expanse of wings, 0.15 inch. (Fitch.)

9. The chestnut phylloxera.

Phylloxera castaneæ (Ha d ma .

In August and September, on both sides of the leaves, puncturing them and extracting their juices and causing them to curl, a very small louse-like fly of a bright sulphur-yellow color, with a black thorax, breast, and eyes, its feet and antennæ tinged with blackish and its wings translucent. The wingless individuals associated with it are entirely yellow, with red eyes. (Haldeman.)

AFFECTING THE FRUIT.

10. The ch tnut weevil.

Balaninus caryatrypes (Boheman).

Eating large cavities in the meat of the chestnut; a soft, white, footless grub, attaining its full size when chestnuts are ripe, and remaining in the nuts through the winter; transforming into a weevil with an exceedingly long and slender beak.

The chestnut is often infested by a large white maggot (Fig. 10, larva of Balaninus and chestnut infested), with a yellowish head, which attains its full size at the time the nuts drop. It is found in nuts sent

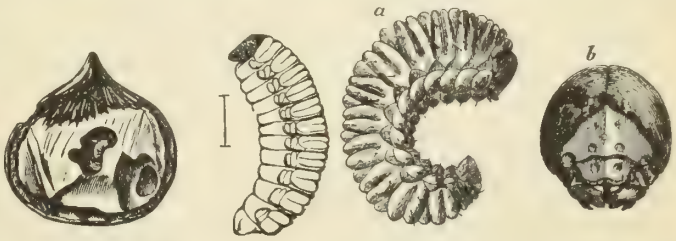

Fig. 41.—Chestnut Maggot. *a*, a second, better drawn, view; *b*, head.—From Packard.

to market, and it is probable that while some of the maggots gnaw their way out, and enter the ground in the autumn to transform, others delay until the spring. The worm devours nearly a third or one-half of the interior of the nut, part of the cavity being filled with the castings of

the worm. As the grub is white it is liable to be overlooked and eaten with the chestnut; it makes its exit through a round hole in the shell.

The larva is about a third of an inch long, cylindrical, and of nearly the same thickness from the head to the tail. It is completely footless as are nearly all nut-inhabiting larvæ. It is very difficult to rear this insect, as I have found after successive trials, and I am indebted to Mr. G. Mooney, of Providence, Rhode Island, for a fresh male and female beetle reared by him from chestnuts collected in Providence. On sending one of the specimens to Dr. G. H. Horn, he kindly identified it as *Balaninus caryatripes.*

Dr. LeConte, in his work on "The Rhynchophora of America," remarks that the beak of these weevils "attains in length and attenuation the greatest development; in the male it is rarely shorter than the body; in the female it is frequently twice the length, and is used to make the perforation into which the egg is subsequently introduced. The great thickness of the husks of the fruits (chestnuts, walnuts, hickory nuts, &c.) depredated on by these insects necessitates a very long perforating instrument to reach the kernel, upon which the larva feeds."

11. The chestnut caterpillar.

Devouring the inside of chestnuts the larva of a moth which grows to more than half an inch in length, and is cylindrical and thick, of a dirty white color, with a tawny yellow head, and sixteen feet. It eats the meat of the nut mostly at its tip and on its convex side, the cavity which it makes being filled with little brown and whitish grains; and a small hole is perforated upon one side of the nut at its tip, out of which a portion of these grains is protruded. (Fitch).

Besides the chestnut grub or weevil, Dr. Fitch gives an account of this larva of a moth which he has found in chestnuts, but which he did not rear.

The following insects also prey upon the chestnut:

12. The larva of the American maple moth, *Apatela americana* Harris.
13. The American white ant (*Termes frontalis* Haldeman) sometimes mines and wholly consumes the interior of chestnut fence posts and stakes, while the outer surface remains entire. It also mines old elm, pine, and other decaying trees, as well as the sills of houses.
14. *Lithocolletis castaneœella* Chamb. Larva in a blotch upper-surface mine in the leaves.
15. *Lithocolletis* sp. Image unknown. Larva in tentiform mine in under surface of leaves.
16. *Bucculatrix trifasciella* Clem. The larva *probably* feeds on it.
17. *Tischeria castaneœella* Chamb. Larva mines the upper surface of the leaves.
18. *Nepticula castaneæfoliella* Chamb. Larva in crooked, linear mines in the upper surface.

INSECTS INJURIOUS TO THE LOCUST.

(*Robinia pseudacacia.*)

AFFECTING THE TRUNK.

1. The locust borer.

Cyllene picta (Drury).

Order Coleoptera; family Cerambycidæ.

Boring a hole ¼ inch in diameter under the bark and upwards, deep into the wood, and ejecting the dust through the orifice in the bark, a longicorn larva, which transforms to a pupa in its burrow, and late in summer appears as a brown beetle, striped and banded with golden yellow, and with a W on its wing-covers; often abundant on the flowers of the golden rod early in September, when they lay their eggs in crevices in the bark of the locust.

This is by far the most destructive pest of the locust, one of the most beautiful and valuable of our shade trees. In New England there is scarcely a tree which does not show the marks of its attacks, and in many localities it has practically been exterminated. In the Western States it is also very destructive; but from observations we have made in Kentucky the noble locust trees in that State grow so luxuriously as to apparently escape or overcome the insidious attacks of this borer. It occurs throughout the United States east of the Plains.

The operations of the grub or larva may be detected by a mass of sawdust-like castings at the mouth of its gallery.

The beetles are abundant, feeding on the flowers of the golden rod (*Solidago*), early in September, when we have taken them in Cambridge, Mass., and Providence, R. I. So wide are the deep yellow spots and bands that the beetle is nearly all of the shade of deep golden yellow peculiar to the flowers of the golden rod, and thus the insect is an interesting case of "protective mimicry," being protected from the attacks of birds, &c., by its liability to be confounded with the yellow heads of the golden rod.

The best account of these insects has been given, as follows, by Harris:

In the month of September these beetles gather on the locust-trees, where they may be seen glittering in the sunbeams with their gorgeous livery of black velvet and gold, coursing up and down the trunks in pursuit of their mates, or to drive away their rivals, and stopping every now and then to salute those they meet with a rapid bowing of the shoulders, accompanied by a creaking sound, indicative of recognition or defiance. Having paired, the female, attended by her partner, creeps over the bark, searching the crevices with her antennæ, and dropping therein her snow-white eggs, in clusters of seven or eight together, and at intervals of five or six minutes, till her whole stock is safely stored. The eggs are soon hatched, and the grubs immediately burrow into the bark, devouring the soft inner substance that suffices for their nourishment till the approach of winter, during which they remain at rest in a torpid state. In the spring they bore through the sap-wood more or less deeply into the trunk, the general course of their winding and irregular passages being in an upward direction

from the place of their entrance. For a time they cast their chips out of their holes as fast as they are made, but after awhile the passage becomes clogged and the burrow more or less filled with the coarse and fibrous fragments of wood, to get rid of which the grubs are often obliged to open new holes through the bark. The seat of their operations is known by the oozing of the sap and the dropping of the sawdust from the holes. The bark around the part attacked begins to swell, and in a few years the trunk and limbs will become disfigured and weakened by large porous tumors, caused by the efforts of the trees to repair the injuries they have suffered. According to the observations of General H. A. S. Dearborn, who has given an excellent account* of this insect, the grubs attain their full size by the 20th of July, soon become pupæ, and are changed to beetles and leave the trees early in September. Thus the existence of this species is limited to one year.

As is well known, this species also attacks the walnut and hickory, and occasionally the honey-locust, but those individuals living in these trees, unlike the locust brood, evolve the beetle in June, according to Walsh, who has claimed that the males of the hickory-brood differ from those of the locust-brood in having "much longer and stouter legs and much longer and stouter antennæ, and in having [their bodies] tapered behind to a blunt point"; on the other hand the females are not distinguishable, nor the larvæ. On this account Mr. Walsh regarded the locust and hickory broods as representing two distinct species, a view not now entertained. He gives, however, some interesting facts in the *Practical Entomologist*, vol. i, p. 29, regarding the appearance of this insect in the Western States, as follows:

The history of this species is very curious, and as it has only recently been elucidated by myself, and some additional details can now be added, may be briefly summed up as follows: About a hundred years ago this insect was well known to Forster to inhabit the locust in the State of New York. Twenty years ago, although the best Illinois botanists agree that the locust grows wild in the Southern part of Illinois, it was still unknown in that State. Shortly afterwards it commenced attacking the locusts in the neighborhood of Chicago, and thence spread gradually in a south-southwest and west direction through the State, sweeping the locusts before it wherever it came. In 1860, it had pretty well destroyed all these trees in Central Illinois. Rock Island lies on the Mississippi River 180 miles south of west from Chicago. In 1862 it had reached a point 20 miles east of Rock Island. In 1863 it burst forth suddenly in great swarms from all the locusts in Rock Island, and the two following years about completed their destruction. It has now (1865) crossed the river into Iowa, and no doubt will continue its travels westward as long as it finds any locust trees to prey on.

Lest it should be supposed that, agreeably to the belief of all the older writers, the species that inhabit the hickory is identical with that which inhabits the locust, it is proper to add here, that I myself split the hickory insect out of a stick of hickory wood, as much as eight years ago in Rock Island; that abundance of hickory grows in the woods within half a mile of that city, and yet that our locust trees were never attacked by borers until 1863, when they were suddenly attacked in the manner mentioned above. Professor Sheldon, of Davenport, Iowa, has also repeatedly, for many years before 1863, split the hickory insect out of hickory wood in Davenport, although,

* Dr. Horn, who has observed this borer in the hickory, states (Proc. Ent. Soc. Phil., i, 30) that its excavations are immediately subcortical. "Unlike the *Clytus erythrocephalus*, which also bores in the hickory, its course is not in a line, but it bores in every direction, making extensive excavations. Its borings are coarse and sawdust-like, and are packed with considerable firmness. When about to become a pupa the larva bores for a slight depth into the wood, and for a distance of about three inches. The aperture is closed with some very coarse splinter-like borings, and after having turned its head in the direction of its previous subcortical dwelling, it undergoes its transformation, and requires about two and sometimes three weeks for becoming a perfect insect."

so far as he is aware, the locusts in Davenport had not been attacked by borers up to 1863. Now, if the hickory-borer is identical with the locust-borer, why did it not attack the locusts in Rock Island and Davenport before 1863 and 1864? And why, when it did attack them, did it appear suddenly in great swarms?

The larva is six or seven-tenths of an inch long, somewhat flattened, club-shaped, the thoracic segments being considerably broader than the abdominal ones, but at the same time distinctly flattened above and below. The head when extracted from the thorax appears almost circular and narrower than the prothorax. The latter is twice broader than long, rounded anteriorly, flattened above and below, brownish yellow, covered, especially on the sides and below, with a short golden pubescence. A deep longitudinal sinuated furrow is visible on each side, a short transverse furrow crosses its posterior end. The upper disk is inclosed between two furrows beginning at the posterior margin, and not reaching the anterior one; a transverse furrow, parallel to the posterior margin, separates a narrow fleshy fold. The anterior portion of this upper disk is irregularly punctured and wrinkled, although shining; in some specimens it has an indistinct, elongated, somewhat oblique brownish spot on each side, about the middle; the posterior portion of the disk is opaque, covered with dens-longitudinal wrinkles, among which a straight impressed line is apparent in the mide dle. The ventral side is irregularly punctured on the sides, and has a depression in the middle which is less apparent in some specimens.

The other two thoracic as well as the two first abdominal segments have, above and below, a transverse flattened opaque disk, limited on each side by a furrow, and showing some indistinct furrows on its surface; the other abdominal segments have the usual protuberances, on the dorsal as well as the ventral side, marked with wrinkles. The last segment is short and divided in two halves by a transverse fold; the latter half has the anal opening at the tip. All these segments are beset with short golden hairs on the sides. There are no feet, as in the *Lamii*. (Ostensacken.)

The pupa has numerous pointed granulations on the prothorax; similar granulations ending in sharp points are placed in a row on the dorsal segments of the abdomen, near the posterior margin; the same segments have, more anteriorly, a few similar sharp, horny projections. On the penultimate segments these projections are larger and recurved anteriorly at the tip; there are six in a row near the posterior margin, and two others more anteriorly. The last segment has four similar projections in a row. (Ostensacken.)

The beetle.—Body velvet-black, and ornamented with transverse yellow bands, of which there are three on the head, four on the thorax, and six on the wing-covers, the tips of which are also edged with yellow. The first and second bands on each wing-cover are nearly straight; the third band forms a "V," or, united with the opposite one, a "W," the fourth is also angled, and runs upwards on the inner margin of the wing-cover towards the scutel; the fifth is broken or interrupted by a longitudinal elevated line; and the sixth is arched, and consists of three little spots. The antennæ are dark brown, and the legs are rust-red. These insects vary from six-tenths to three-fourths of an inch in length. (Harris.)

Remedies.—An excellent way to save a valuable shade tree from the attacks of this borer is to thoroughly soap the trunk late in August, so as to prevent the beetle from laying its eggs early in September. All insects breathe through little holes (twenty in all, ten on each side); now, if a film of soap or grease or oil of any kind closes the openings of these breathing pores, the air cannot enter the respiratory tubes which ramify throughout the interior of the body and the insect dies by asphyxiation—*i. e.*, drowns. Harris states that whitewashing and covering the trunks of the trees with grafting composition may prevent the female from depositing her eggs upon isolated trees. Also, young

trees might be headed down to the ground, so as to destroy the grubs boring in them, and also to promote a more vigorous growth. An excellent preventive remedy is to collect these beetles early in September when engaged in eating the flowers of the golden rod; children could perform this labor.

AFFECTING THE LEAVES.

2. The locust depressaria.

Depressaria robiniella Packard.

Order Lepidoptera; family Tineidæ.

Occasionally late in June defoliating the branches, a small green larva with a thick body, black head, and transforming late in July to a light brick-red moth, spotted irregularly with yellow.

The following account of this destructive moth is taken from our "Guide to the Study of Insects." The moths of the Tineid genus *Depressaria* comprise rather large species, in which the fore wings are unusually hard and oblong. The abdomen is flattened above, with projecting scales at the sides. The larvæ are extremely active and feed on a variety of substances; some in rolled-up leaves of composite plants, some in the leaves and others in the umbels of the umbelliferous plants. Many of the worms descend from the plant on the slightest agitation, so that considerable caution is necessary in attempts to collect them. The full-fed larvæ descend to the ground and change to pupæ among the fallen leaves. The perfect insects have the peculiarity of sliding about when laid on their backs.

During the summer of 1868 a large locust tree overhanging our garden in Salem, Mass., was attacked by the present species to such an extent that some of the branches were nearly stripped of their leaves. This moth we described under the name of *Depressaria robiniella* (Guide to Study of Insects, Pl. 8, fig. 14). The larva is thick-bodied, with a black head, and is green, the cervical shield being green. It devours the leaves, drawing them together by threads, and it also eats the flower buds. It was most abundant in the last week of June. It turned to a chrysalis July 8, and in about two weeks the moth appeared.

The moth.—The head, palpi, and fore wings are light brick-red, spotted irregularly with yellow, and the antennæ are slate-brown. The fore wings are a little darker in the middle, especially towards the inner edge. There is a submarginal darker brown band near the outer edge, which does not reach the costa, and on the outer edge is a row of minute black dots. The hind wings and abdomen are of a pale slate-gray, and of the same color beneath, while the legs are of a very pale straw-yellow. It differs from most of the species of the genus in having the apex of the fore wings less rounded than usual, and in this and other respects it is allied to the European *D. laterella.*

3. The locust leaf-miner.

Parectopa robiniella (Fitch).

Order Lepidoptera; family Tineidæ.

Mining the leaf in July, making a blotch on the upper surface of the leaf, with a number of lateral galleries running out from it, on each side, a flattened pale green

worm which passes the chrysalis state in the leaf, the latter falling to the ground, and the following June giving out a minute moth.

This is a common leaf-miner of the locust in the New England as well as the Middle States. Out of the seventeen leaflets which form the locust leaf, usually two or three and often more make the blotches. The mines are not tenanted, Clemens states, at the time the leaf is mined by *Lithocolletis robiniella* (Clem. Proc. Phil. Acad., 1860).

The larva makes a pale yellowish mine, usually on the midrib, with lateral branches running out from it. It pupates in a small nidus on some object on the ground.

The moth.—Fore wings fine brown, somewhat golden, shaded with dark brown. Along the costa are three oblique silvery streaks; on the inner margin are three silvery dorsal spots, placed opposite the spaces between the costal streaks. Near the tip of the wing is a transverse narrow curved silvery line, passing from the costa to the inner angle. (Clemens.)

4. THE GREATER LOCUST-LEAF GELECHIA.

Gelechia pseudacaciella Chambers.

Order LEPIDOPTERA; family TINEIDÆ.

From eggs laid on the under surface of the leaf hatches a green larva with reddish head and thoracic plate and six longitudinal dusky stripes; spinning a slight web between two leaves; changing to a moth in late spring, whose wings expand 0.63 inch. It is sombre in color, the fore wings dark slate, flecked with brown and white; the hind wings pale slate, whitish towards the base.

5. THE LESSER LOCUST-LEAF GELECHIA.

Gelechia robiniæfoliella Chambers.

Spinning two locust leaves together and feeding between them, leaving the outer surface and the larger ribs untouched, a minute, greenish white slender larva, which transforms to a chrysalis in the same situation, the moth differing from its closely allied species in the palpi being slender and rather long, while the hind wings are emarginate beneath the apex. (Comstock and Chambers.)

6. THE AUTUMNAL LOCUST LEAF-MINER.

Lithocolletis robiniella Clemens.

Mining the underside of the locust-leaf late in September and early in October (in the Middle States) a cylindrical larva, with a pale brown head and the body greenish white, sometimes spotted with yellow; the chrysalis contained in a white silken cocoon within the mine, and transforming late in October and early in November into a minute moth with narrow pointed fore-wings, which are golden yellow along the costal edge and with a spot at the tip.

The species of Lithocolletis are known by their small size, the narrow, pointed fore wings, the tuft on the top of the head, and the simple, not ciliated antennæ. The larvæ mine the upper and under side of leaves and usually transform within a silken cocoon in their burrows. The present species is one of the best known of the genus.

The larva.—Body cylindrical, the head pale brown; the body pale greenish white, with a red median dorsal line from the 5th to the 9th segment; on the 9th segment are two irregular chrome-yellow patches, which are sometimes wanting. (Clemens.)

The moth.—Antennæ dark brown; front of head silvery white, the tuft dark brown

mixed with grayish; thorax dark brown; fore wings golden yellow above the fold, and dark cinereous, somewhat dusted with blackish beneath it. About the middle of the wing is an oblique silvery costal streak, black-margined on both sides, extending to the fold; another beyond the middle, meeting nearly in the center of the wing at an angle, a dorsal streak from the inner margin, the former black-margined on both sides, extending to the fold; another beyond the middle, meeting nearly in the center of the wing at an angle; a dorsal streak from the inner margin, the former black-margined on both sides, the latter internally; another costal streak near the tip with an internal circular black margin opposite to a dorsal streak of the same hue, and joined or nearly joined to it. Just behind the apical spot is a straight silvery streak, black-margined internally. A black round spot at the tip of the fore wings. Hind wings shining dark gray. (Clemens.)

7. The locust skipper butterfly.

Eudamus tityrus Fabricius.

Drawing the leaves together in July, a large pale green caterpillar about 2 inches long, with a red neck and large red head, with a large yellow spot on each side of the mouth, feeding by night, sometimes pupating between the leaves, and transforming into a stout-bodied, brown butterfly with a skipping, rapid, strong, low flight, and antennæ flattened and bent over at the end. (Harris.)

These voracious worms sometimes strip the leaves of the common locust and especially the viscid locust (*Robinia viscosa*), which is cultivated in New England as an ornamental tree. According to Harris, the females lay their eggs singly during June or early in July on the leaves, the caterpillars hatch in July, and when quite small conceal themselves under a fold of the edge of a leaf, which is bent over their bodies and secured by means of silken threads. When they become larger they attach two or more leaves together, so as to form a kind of cocoon or leafy case to shelter them from the weather, and to screen them from the prying eyes of birds. One end of the leafy case is left open, and from this the insect comes forth to feed. They transform to chrysalids either among the leaves or desert the tree and seek some retired place, where they spin a slight loose cocoon, within which they remain through the winter, appearing in the imago state by the middle of the following June.

The butterfly is brown, the fore wings are brown with a transverse semi-transparent band across the middle, and a few spots towards the tip of a honey-yellow color; hind wings with a short rounded tail on the hind angles, and a broad silvery band across the middle of the under side. The wings expand from 2 to 2½ inches. (Harris.)

Remedies.—Nearly all the insects which prey upon the foliage of the locust can be gotten rid of by hand-picking and by collecting the leaves in autumn and burning them; in this way cherished shade trees can be protected.

8. The locust hispa.

Odontota scutellaris (Olivier). *Hispa suturalis* Harris.

Order Coleoptera; family Chrysomelidæ.

In July, blister-like spots appearing upon the leaves, within which is a small flattened, whitish worm, with three pairs of feet; a quarter of an inch long, tapering

from before backwards, with projections along each side like the teeth of a saw; remaining a week in the pupa state within the leaf, about the middle of August it issues as a small flattened black beetle with the prothorax and wing-covers, except along their suture, tawny yellow. (Fitch & Harris.)

Harris states that in Massachusetts these beetles may be observed the middle of June pairing and laying eggs on the leaves of thelocust tree.

FIG. 42.—Locust Hispa—From Packard.

While this species of leaf-mining betle is meet with in the New England States and New York, by information received from Kentucky it is at times quite injurious to locust trees in that State, but can always be kept under by hand-picking.

9. SAY'S WEEVIL.

Apion rostrum Say.

Order COLEOPTERA; family CURCULIONIDÆ.

From June until September, eating numerous small round holes in the leaves, a little black weevil with a slender projecting beak, its thorax with close coarse punctures and an oval or longitudinal indentation back of its center, and the furrows of its wing-covers with coarse punctures; its length 0.09, and to the end of the beak 0.12 inch. (Fitch.)

FIG. 43.—Say's weevil.—From Packard.

Dr. Harris states that the grubs of this little weevil live in the pods of the common wild indigo bush (*Baptisia tinctoria*), devouring the seeds. He adds, "A smaller kind, somewhat like it, inhabits the pods and eats the seeds of the locust-tree, or *Robinia pseudacacia*." Fitch regards the insect as very variable, and as most probably destructive to the seeds of both the plants here mentioned.

10. THE BLACK LOCUST MIDGE.

Cecidomyia pseudacaciæ Fitch.

Order DIPTERA; family CECIDOMYIADÆ.

In July and August, the tender young leaflets near the tip of the stem folded together like a little pod, the cavity inside containing from one to three small milk-white maggots, which descend below the surface of the ground, remaining there in the pupa state about ten days, and then appearing as a small blackish midge. (Fitch.)

According to Fitch, before the small young leaflets, which put forth along the opposite sides of the main leaf-stalks at their tips become expanded, they are closed together like two leaves of a book; and it is probably at this time that the female midge inserts her egg in the cleft between them, the irritation from which and from the small maggots which hatch from them, keeps the leaflet permanently closed; a slight cavity forming within, in which the worms reside, the leaflet hereby comes to resemble in its shape a small bivalve shell with a more or less wavy edge. The surface remains unchanged outside, but within it assumes a pale greenish yellow color. The attachment of the leaflets to the stalk becomes so weakened when infested by these worms that prob-

ably they are generally broken off by the wind, and the worms are thus carried to the ground, instead of crawling down the stalks by night, as is the habit of the wheat midge.

The female.—A small blackish midge, the base of its thorax tawny yellow, its abdomen pale yellowish with the tip dusky and clothed with fine hairs, as is also the neck; its legs black with the thighs pale except at their tips; its wings dusky, feebly hyaline, with the fringe short; its antennæ with thirteen short cylindrical joints separated by short pedicels; its length 0.065 inch to the tip of the body.

11. The yellow locust midge.

Cecidomyia robiniæ Haldeman.

Order Diptera; family Cecidomyiadæ.

In July and August a portion of the edges of the leaves rolled inwards on their under sides and thickened, inclosing one or two very small white maggots which are varied more or less with orange-yellow; producing a pale orange midge with the sides of its thorax and often three oval stripes on the back and the wings dusky; its antennæ blackish and of fourteen joints in the females, twenty-four in the males; its length 0.12 inch. (Fitch and Haldeman.)

Professor Haldeman, who described this two-winged gall fly in Emmon's Journal of Agriculture and Science, October, 1847, says that it, in conjunction with the Hispa already mentioned, had been so numerous in southeastern Pennsylvania the two preceding summers as to kill the leaves upon the locusts, the trees in August appearing as though they had been destroyed by dry weather.

This insect may be detected by the margin of the leaflets being rolled inwards upon their under sides for a length varying from over a quarter to a half inch, the upper side showing a concavity or rounded hollow at this point. "This rolled portion," says Fitch, "is changed in its color to a paler yellowish green, and its texture is thickened and succulent." The same leaf sometimes has two or more of these folds along different parts of its margin.

The larva is colorless or watery when young, becoming, as it approaches maturity, opaque and milk white, varied more or less with bright yellow. It is long oval, broadest in the middle and tapering thence to a sharp point anteriorly, the opposite end being bluntly rounded, and is divided into thirteen segments by transverse impressed lines. (Haldeman.)

12. The locust saw-fly.

Nematus similaris Norton.

Order Hymenoptera; family Tenthredinidæ.

Eating the leaves of the black locust, a small, soft, green worm $\frac{3}{8}$ inch long, with 20 legs, and a brownish head; appearing in Washington, D. C., late in August until October; transforming in a dark-brown oval cocoon, and two or three weeks later issuing as a saw-fly nearly $\frac{1}{4}$ inch long, of a dirty yellow color, with a squarish black patch on top of the head, the sides and front of the thorax black, and a transverse band on top of each abdominal segment. (Comstock.)

This saw-fly inserts its irregularly semi-ellipsoid eggs in a crescent-haped cut made in the under surface of the leaf by the "saw." In a

few days the larva hatches. Professor Comstock thinks there are two and possibly three broods in a season, and that the insect may hibernate both in the adult and pupa stages.

The following insects also feed on the locust:

13. *Spermophagus robiniæ* (Fabricius). Family *Bruchidæ* (see Horn, Trans. Amer. Ent. Soc., iv, 311).
14. *Sciapteron robiniæ* H. Edwards. (Destructive to locusts in Virginia City, Nevada. Bull. Brooklyn Ent. Soc., iii, 72.)
15. The Io moth, *Hyperchiria io* (Fabricius). (See p. 111.)
16. The hickory tussock moth, *Orgyia leucostigma*.
17. The locust goat moth, *Xyleutes robiniæ*, which more commonly affects the oak. (See p. 6.)
18. *Clisiocampa erosa* Stretch. Oregon. (Papilio, i, 67.)
19. *Gelechia pseudacaciella* Chamb. Larva feeds externally on the leaves and also in the mines of *Lithocolletis robiniella* (Chambers).
20. *Xylesthia clemensella* Chamb. Larva bores in dead locust-timber posts, etc. (Chambers.)

FIG. 44.—Locust saw-fly. *a*, eggs; *b*, *c*, worms; *d*, tail of the same; *e*, cocoon; *f*, fly.—After Comstock.

INSECTS INJURIOUS TO THE MAPLE.

(*Acer saccharinum* and *Acer rubrum*.)

1. THE SUGAR-MAPLE BORER.

Glycobius speciosus (Say).

Boring into the solid trunks of healthy sugar-maple trees, often killing them, a rather large, footless, cylindrical, whitish grub, changing in July to a large, beautiful, yellow-striped beetle, marked with a golden W on the wing-covers.

Although the question as to whether longicorn larvæ will bore into healthy solid wood is by some regarded as undecided, there is no doubt but that the present larva bores for several inches into the trunks of healthy trees, both young maples as well as trees ten or twenty inches in diameter. The following case fell under our own observation. On the grounds of Bowdoin College, Brunswick, Me., for two successive years (1873–'74) a number of fine sugar or rock maples, nearly a foot in

diameter, and which had been set out for thirty or forty years, suddenly died, and on being cut up into fire-wood were found to be deeply perforated in all directions by larvæ referable to this species by its large size and resemblance to the locust borer. More than one larva and one burrow were found in the same tree. There seemed little cause to doubt but that the grubs were the cause of the sudden death of the tree.

In the summer of 1881, I noticed that one tree in the College Campus was partly killed by these borers, and that other trees in different parts of the town had been bored by them. One tree, over one foot in thickness, had about twelve holes in the trunk, from which the beetles had issued a year or two previous. The leaves during the past summer were small and curled up, and the tree was evidently in a sickly condition. The few *Aphides* and *Psoci*, observable on the leaves in July and August, were not sufficiently numerous to occasion the trouble, and we attribute it to the effects of the borer. Another somewhat larger sugar maple in the same yard, the age of which was about forty-five years, had but two holes in it, made by the same borer, probably in 1878 or 1879; the tree was nearly healthy, with fully developed leaves. A red maple close at hand had not been affected by the borer, and we could not learn that this species (*A. rubrum*) had ever been attacked by this borer. It seems to us that these are clearly demonstrated cases, where healthy trees have been killed by borers.

FIG. 45.—*Glycobius speciosus.* Natural size. —From Saunders.

The first observer to notice this borer, and the fact that it destroys living maples, was Rev. L. W. Leonard, who gave an account of its habits to Harris. His attention was called, in 1828, to some young maples in Keene, N. H., which were in a dying condition. He discovered the insect in its beetle state under the loosened bark of one of the trees, and traced the recent track of the larva three inches into the solid wood. In the course of a few years these trees, upon the cultivation of which much care had been bestowed, were nearly destroyed by the borers.

This beetle was said by Mr. E. B. Reed, in 1872, to be gradually destroying the sugar maples at London, Canada, and in the Report of the Entomological Society of Ontario, for 1878, Mr. Saunders states that the destruction was spreading rapidly in the streets of the same city. To this society we are indebted for the use of the figure of the beetle.

The beetle, according to Harris, lays her eggs on the trunk of the maple in July and August. The grubs burrow into the bark as soon as they are hatched, and are thus protected during the winter. In the spring they penetrate deeper, and form, in the course of the summer, long and winding galleries in the wood, up and down the trunk.

The beetle is black with a yellow head, with the antennæ and the eyes reddish black; the thorax is black, with two transverse yellow spots on each side; the wing-

covers for about two-thirds of their length are black, the remaining third is yellow, and they are ornamented with bands and spots arranged in the following manner: a yellow spot on each shoulder, a broad, yellow, curved band or arch, of which the yellow scutel forms the keystone on the base of the wing-covers, behind this a zigzag yellow band forming the letter W, across the middle another yellow band arching backwards, and on the yellow tip a black curved band and spot; legs yellow, while the under side of the body is reddish yellow, variegated with brown. Nearly an inch in length. (Harris.)

Remedies.—This, like some similar borers, should be looked for in the spring, when it can be detected by the dust it casts out of its burrow, and when it can be cut out of the tree with a knife, or killed by inserting a stiff wire, or by the injection of kerosene oil into the hole.

2. The horn-tail borer.

Tremex columba (Linnæus).

Order Hymenoptera; family Urocerid.æ.

Boring in the trunk and making large round holes, a large white grub, with a prominent spine on the end of the body, and transforming in the late summer into a large clear-winged saw-fly, with a long, large "saw" on the tail of the female.

This interesting insect bores indifferently in various forest and shade trees, attacking the elm, oak, sycamore, and perhaps more commonly the maple. The holes of this borer may be recognized by their large numbers within a given space, and by their regular, evenly-cut shape, being about the diameter of a lead-pencil. We remember seeing some years ago a tree at Saratoga Springs, in the trunk of which, where the bark had been removed, were a dozen or more of the round, even holes made by these insects, who seem to work somewhat in concert. Isolated shade-trees along roads and in streets are favorite places of resort. Harris says that an old elm tree in his vicinity used to be a favorite place of resort for this saw-fly, numbers of them collecting about it during the months of July, August, and the early part of September. "Six or more females might frequently be seen at once upon it, employed in boring into the trunk and laying their eggs, while swarms of the males hovered around them. For fifteen years or more some large buttonwood trees in Cambridge have been visited by them in the same way. The female, when about to lay her eggs, draws her borer out of its sheath, till it stands perpendicularly under the middle of her body, when she plunges it, by repeated wriggling motions, through the bark into the wood. When the hole is made deep enough, she then drops an egg therein, conducting it to the place by means of the two furrowed pieces of the sheath. The borer often pierces the bark and wood to the depth of half an inch or more, and is sometimes driven in so tightly that the insect cannot draw it out again, but remains fastened to the tree till she dies. The eggs are oblong-oval, pointed at each end, and rather less than one-twentieth of an inch in length." Harris adds, what has been observed frequently by others since his time, that these larvæ

are often destroyed by the maggots or larvæ of two singular ichneumon flies (*Rhyssa atrata* and *lunator*). These are the largest known ichneumon flies; they are provided with long, slender borers or ovipositors from three to four inches in length, which they thrust into the deep holes made by the Tremex borers, in the bodies of which they insert an egg.

(We have, however, observed one of these *Rhyssæ* engaged in ovipositing in an elm tree infested with the larvæ of *Compsidea tridentata*.)

The following description of the larva is copied from our report "On the Insects affecting the Cranberry, with remarks on other injurious Insects."*

The larva.—A long, white, cylindrical worm, with the segment behind the head of the same width as the twelfth segment from the head; the thirteenth much narrower, regularly rounded behind, with a deep crease above, leading backward and a little downward to a small, sharp, terminal, dark-reddish horn. The horn is acute, with three teeth above, near the base, and two smaller ones on the under side. Each of the three last rings bulges out on the under side. The head is white, and about half as wide as the segment behind, into which it partially sinks. It is rounded, smooth, with the antennæ represented by small rounded tubercles, ending in a minute horny spine; should the spine be regarded as indicating a joint, then the appendage is three-jointed. The clypeus is broader than the labrum by a distance equal to its own length. The labrum is a little more than twice as broad as long, with the front edge slightly sinuous. The large, powerful mandibles are four-toothed on one side and three-toothed on the other. The maxillæ are three-lobed, the lobes unequal, ending in spines, the middle lobe with two spines, the outer lobe much smaller than the others. The labium or under lip is rather large, rounded, with a spine projecting on each side. The prothorax or segment next behind the head is twice as long as the one behind it, divided into two portions by a suture behind it. There are three pairs of small, soft, unjointed feet, of which the first pair are considerably the largest; they do not project straight out but are pressed to the body and directed backward. There are ten pairs of spiracles, one pair on the hinder edge of the prothorax, twice as large as the others; the second pair between the second and third rings, and the eight others on the eight basal abdominal segments. Length, 2.25 inches; greatest thickness, .28 inch.

FIG. 46.—Larva of Tremex columba, nat. size.—From Packard.

The larvæ from which the above description was taken were found at Amherst, Mass., early in October, in a tree containing several of the adult insects, which had not left their holes and seemed likely to be destined to pass the winter in the tree. Clementi has in Ontario, Canada, taken several of the imago with the larvæ from the oak in March, so that it undoubtedly hibernates as an imago.

3. THE SIXTEEN-LEGGED MAPLE-BORER.

Ægeria acerni (Clemens).

Order LEPIDOPTERA; family ÆGERIADÆ.

Following the work of the flat-headed borer, burrowing under the bark of the soft maple, sometimes girdling and killing the tree, a caterpillar with sixteen legs, spin-

* In the Tenth Annual Report of the U. S. Geological and Geographical Survey of the Territories. By F. V. Hayden, U. S. Geologist. Washington, 1878.

ning a cocoon of silk covered with its castings; the moths issuing from the tree late in May and thence through the summer, the worms occurring under the bark through the summer and winter. (Riley.)

This borer is sometimes very destructive to soft and sometimes to sugar maples, especially young trees, in Ohio, Illinois, and Missouri, the moths sometimes emerging in great numbers from the trunks of the trees. Mr. G. R. Pilate states that the red maple trees in Dayton, Ohio, were greatly infested by this borer, in consequence of which a large number of those shade trees are dead or dying. (Bull. Brooklyn Ent. Club, vol. i, 20.) Mr. Riley says he has always found the worms in such trees as have been injured either by the work of the flat-headed borer, by the rubbing of the trees against a post or board or in some other way. "Where the bark is kept smooth they never seem to trouble it, the parent evidently preferring to consign her eggs to cracked or roughened parts. For this reason the worm is not found in the smoother branches, but solely in the main trunk. Whether the soap applications will prevent the moth from depositing her eggs is not known; judging from analogy, probably not. Yet it will tend to keep the bark smoother, and in being used to shield the tree from the other borer, it will indirectly shield it from this one. Mr. Gennadius recommends whitewashing the trunks, and filling up all holes and fissures with mortar, so as to render the bark as smooth as possible."

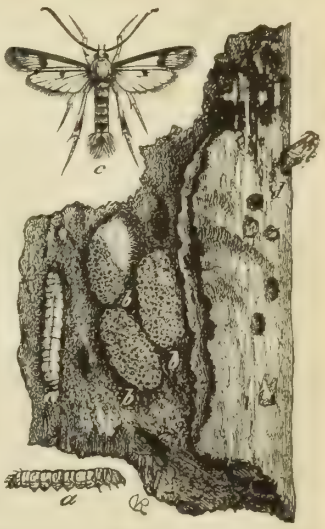

FIG. 47.—*c*, Ægeria acerni; *a*, caterpillar; *b*, cocoon; *d*, pupa cases.—After Riley.

The moth.—Head and palpi deep, reddish orange, thorax ochreous yellow; abdomen bluish black varied with yellow, with a deep reddish terminal tuft. Fore wings with the edges and median vein bluish black dusted with yellowish; a large discal bluish black patch; end of the wing ochreous yellow, with a blackish subterminal band, and the veins blackish. Hind wings with a blackish discal patch. Body beneath ochreous yellow, with a bluish black patch on each side of the second abdominal segment. Middle and posterior tibiæ ringed with bluish black; the fore legs blackish, with the coxæ (or hip joints) touched with reddish orange; expanse of wings about 0.80 inch.

The larva is a little over half an inch long, livid white, the head small and yellow, with 16 legs, all of which are reddish. (Clemens.)

4. The flat-headed apple-tree borer.

Chrysobothris femorata Fabricius.

In the Mississippi Valley, sometimes riddling soft maples through and through, confining itself mostly to the inner bark, causing peculiar black scars and holes in the trunk, a flat-headed grub, transforming to a flat, hard-shelled beetle. (Riley.)

While this beetle more commonly infests the oak (p. 16) and the apple, it threatens in the Western States, according to Riley, to impair the value of the soft maple for shade and ornamental purposes.

5. The peach and cherry flat-headed borer.

Dicerca divaricata Say.

Order Coleoptera; family Buprestidæ.

Boring in red maple stumps a flat-headed borer whose prothoracic segment is not so wide in proportion to the two following segments as in Chrysobothris larvæ.

Although Fitch says that the beech is undoubtedly the original residence of this borer, now destructive to cherry and peach trees, and that "wherever a dead tree of this kind occurs some of these beetles will almost always be found upon it on sunny days in midsummer," we have found several of the fully and half-grown larvæ, with the dead beetle, in a partly rotten stump of the swamp maple at Providence, June 1. The hole for the exit of the beetle is oval cylindrical, 8mm in its longer diameter and 4mm in its shorter. The following description of the larva was drawn up from the larger specimens; that of the beetle is quoted from Harris:

Larva.—Prothoracic segment moderately broad, not so long as wide, but not so wide in proportion to the two succeeding segments as in Chrysobothris; the second thoracic segment trapezoidal, narrower than the first by two-thirds of its length; third thoracic segment a little narrower and a little longer than the second. All the abdominal segments about two-thirds as wide as the third thoracic, and round and thick. The terminal segment a little over one-half as wide as the one before it. Prothoracic segment with a large broad rough chitinous surface, with an inverted narrow V with long slender arms to the V. On the under side of the segment the rough surface is divided into two by two nearly parallel, longitudinal smooth lines. Length of body, 35mm; length of prothoracic segment, 5mm; breadth, 7mm; width of metathoracic segment, 5mm; width of an average abdominal segment, 4mm.

The beetle.—Wing-covers much elongated and spreading widely apart at the end; the insect copper-colored, thickly covered with little punctures; the prothorax slightly furrowed in the middle; the wing-covers marked with numerous fine irregular impressed lines and small oblong square elevated black spots; middle of the breast furrowed; the male with a little tooth on the under side of the shanks of the middle pair of legs. Length, 18mm–23mm.

6. The quercitron bark borer.

Graphisurus fasciatus (De Geer).

Order Coleoptera; family Cerambycidæ.

This beetle, more commonly found on the oak, has been found in the pupa as well as adult stage under the bark of the sugar maple in Northern New York by Mr. George Hunt; and we have reared the beetle from a pupa found under the bark of the red or swamp maple, at Providence, June 1. The cell made by the larva for the repose of the pupa is about an inch long, one-third of an inch wide, and one tenth deep. (See, also, p. 22.)

7. *Xyloterus politus* Say.

Order Coleoptera; family Scolytidæ.

In this species, according to Leconte, the elytra have ill-defined distant rows of punctures, with interspaces equally strongly punctured,

pubescence erect and abundant. He has received specimens from Mr. J. A. Lintner, said by him to depredate on maple trees. "It is easily known," adds Leconte, "by being more hairy than the other species, with the interspaces of the elytra sparsely punctured, so that the rows of punctures appear confused."

8. *Stenoscelis brevis* Boheman.

Order COLEOPTERA; family CALANDRIDÆ.

This beetle occurred in a partly rotten stump of the red maple in a swamp at Providence, June 1, in company with *Dicerca divaricata* and *Xestobium affine*. All these beetles were submitted to Dr. Leconte for identification. The mine is irregular, sinuous, 1.5–2^{mm} in diameter, and were quite numerous.

9. *Xestobium affine*.

Order COLEOPTERA; family PTINIDÆ.

Several specimens of this beetle occurred June 1 in a rotten stump, with the larvæ, which closely resembles those of Ernobius. It makes a sinuous mine 4^{mm} in diameter, and opening externally by a round hole 3^{mm} in diameter; the burrows being filled with fine excrement.

Larva.—Body cylindrical, white, soft, very full and rounded at the end, a little the thickest at the thoracic portion; 3 pairs of thoracic, 3-jointed rather slender feet. Head rather large, more than half as thick as the body. End of abdomen covered with rather dense yellowish hairs. Length, 10^{mm}; thickness of body, 3.1–4^{mm}. Fig. 441 of *Ernobius mollis* in my Guide to the Study of Insects well represents the general appearance of this larva.

AFFECTING THE LEAVES.

10. THE GREEN-STRIPED MAPLE WORM.

Anisota rubicunda (Fabricius).

Order LEPIDOPTERA; family BOMBYCIDÆ.

Sometimes nearly stripping soft maples of their leaves, large smooth worms longitudinally striped with pale and darker green lines, and recognizable by two anteriorly-projecting black horns on the second segment behind the head, and transforming to a pale, ochre-yellowish, thick-bodied moth, tinged, especially on the fore wings, with a rosy hue, and expanding a little over two inches.

Although in the Eastern States this insect, especially the moth, is not common, yet we have observed it as far east as Brunswick, Me., where it feeds on the maple, the moth there appearing the middle of June; in the Western States, Illinois, Missouri, and Kansas, it proves during certain years very destructive, entirely or nearly stripping the soft or swamp and sometimes the silver maple of its leaves, and discouraging people from planting this tree along roadsides. It is known to feed on the oak.

According to Riley, the eggs are deposited in patches of thirty and upward, on the under side of a leaf. Each is about 0.05 inch long, suboval, slightly flattened, translucent, and pale greenish.

In Missouri and Kansas the worm is double-brooded, the first brood of worms appearing mostly during June and giving forth the moths late in July, while the second brood of worms appears in August and September, wintering in the chrysalis state, and not appearing as moths until the following May. The caterpillar molts four times, becoming fully fed within a month, and then entering the ground to pupate.

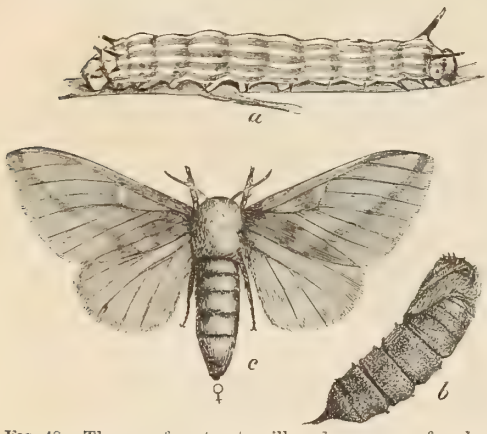

FIG. 48.—The rosy forest caterpillar. *b*, pupa; *c*, female. —After Riley.

Larva.—In the *first stage*, yellow, with a large black head, the spines forming little black tubercles of nearly uniform size. In the *second stage* the head is browner, and the spines and stripe of the full-fed larva more apparent. In the *third stage* like the caterpillar in its fourth or last stage, but smaller. The *fully-fed caterpillar* is an inch and a half long; pale yellowish-green longitudinally, striped above alternately with eight very light yellowish-green lines and seven of a darker green, inclining to black, with two slender black spines on the second segment behind the head, and two lateral rows of sharper, shorter spines. Head copal yellow; segments, 10 and 11 a little dilated and rose colored at the sides.

The chrysalis.—Rough and pitted, nearly black, with curved horns about the head and thorax, and the movable joints provided with a ring of sharp conical teeth around the anterior edge. (Riley.)

The moth.—Fore wings rose-colored, crossed by a broad pale-yellow band; the hind wings pale yellow, with a short rosy band behind the middle; the body is yellow, the under side and legs rose-colored (Harris). In Western specimens, the yellow predominates, the rose-color being but faintly visible, according to Riley, who has also had specimens which were almost white or colorless. The wings expand about two inches. The male antennæ are broadly pectinated like feathers.

Remedies.—A tachina parasite, *Tachina* (*Belvosia*) *bifasciata* Fabr., and an ichneumon fly prey upon the caterpillars, and thus reduce their numbers. Riley recommends searching for and destroying the moths and eggs late in May, while the worms, when about to leave the trees, "may be entrapped by digging a trench either around the individual tree or around a grove or belt. The trench should be at least a foot deep, with the outer wall slanting under. Great numbers of worms will collect in it, or bury themselves in its bottom, and may easily be killed."

11. THE GREEN STINGING IO CATERPILLAR.

Hyperchiria io (Fabricius).

Order LEPIDOPTERA; family BOMBYCIDÆ.

Sometimes feeding late in summer on the maple, a large, greenish, thick caterpillar, with fascicles of irritant, radiating, sharp spines over the body, spinning a thin silken

cocoon among the leaves, and transforming the following May or June into a large, stout-bodied moth; the males yellow with a very large eye-like spot on the hind wings, and the females purple-brown, the wings of the latter expanding nearly three inches

Fig. 49.—Green stinging io caterpillar.—After Riley.

Although this large caterpillar is a general feeder, devouring in the Southern States the leaves of the Indian corn, as well as the sassafras, black locust, the false indigo, wild black cherry (*Prunus serotina*), and the willow, currant, cotton, clover, elm, hop vine, balsam, poplar, balm of Gilead, dogwood, and choke cherry, we have found it in Maine, where it is a rare moth, feeding on the rock or sugar maple, and hence refer to it under this head. The eggs are top-shaped, attached by the smaller end, in patches of about thirty, on the under side of leaves. The caterpillars in the Western States begin to hatch about the end of June, getting their growth in two months, after molting five times. The spines are poisonous to the fingers and the caterpillar cannot be handled without causing some pain and irritation.

Fig. 50.—Male of io moth.—After Riley.

The larva.—About two inches long, of a pea-green color; the spreading, slender spines deeper yellow and often tipped with black. A lateral white line, edged above with lilac.

The moth.—Males deep ochre-yellow marked with purple brown, with a large, round blue spot, bordered with black, with a central white dash. The fore wings of the female are purple brown, the hind wings as in the male. In Massachusetts the moths appear during June or early in July.

12. The maple dagger-moth.

Apatela americana Harris.

Order Lepidoptera; family Noctuidæ.

In September, a rather large greenish-yellow caterpillar, with long hairs ornamented with four pencils of long hairs, and a single pencil on the eleventh ring, spinning a dense cocoon under the bark or elsewhere, and transforming into a whitish moth the next summer.

This is not uncommon on maple trees late in the autumn, and its

habits are described by Harris, who says that it also feeds on the elm, linden, and chestnut. We have often noticed it in Maine.

13. Forest tent caterpillar.

Clisiocampa sylvatica.

A colony of the worms not fully fed were found June 6, collected in a mass near the ground on the trunk of the maple at Brunswick, Me.; at this time they were molting for the last time.

14. The maple slug moth.

Lithacodes fasciola H. Sch.

Order Lepidoptera; family Bombycidæ.

According to Clemens, the larva is elliptical, somewhat pointed behind; body thickest in the middle, flattened, with the sides curving from a central ridge; this ridge has a vertical elevation at its sides above the body, growing less and less before and behind, terminating in front in a rounded margin, and behind in an obtuse, short spine. The body is smooth, with no distinct spined papulæ, but the edges of the ridge and the outline of the body are thrown into subcrenated folds.

Fig. 51.—Maple slug moth. — From Packard.

15. The lesser maple span-worm.

Stegania pustularia Guenée.

Feeding on the leaves early in June, a bluish-green looper striped with whitish and yellowish, producing the moth in July. (Saunders.)

This is a common insect and has been raised by Mr. W. Saunders, who says that the caterpillar is full grown about the middle of June, enters the chrysalis state within a few days after, and produces the moth early in July. We have found it in the woods of Northern Maine in August, and it is common in August in the Northern and Western States.

The larva.—Body cylindrical, about ⅞ inch long, head medium sized, rather flat in front, slightly bilobed, pale green. Body above bluish-green, with thickly set longitudinal stripes of whitish and yellowish. A double whitish dorsal line, with bordering lines of yellowish white, neither of which are unbroken, but are formed of a succession of short lines and dots. Below these, on each side, are two or three imperfect white lines, made up of short streaks, and much fainter than those bordering the dorsal line; spaces between the segments yellowish. The skin all over the body is much wrinkled and folded. (Saunders.)

The moth is exceedingly pretty and may be recognized by its white body and wings and four deep golden-ochreous costal spots, with two lines running across the wings, these lines sometimes wanting. It expands an inch.

16. The large maple span-worm.

Eutrapela transversata Packard.

Feeding on red maple in July, a large slender-bodied span-worm, the body thickened behind, carinated on the sides; of a dark purple-brown mixed with reddish; a dorsal

reddish-gray crescent-shaped spot on the middle of the seventh segment, behind which is a pair of low kidney-shaped tubercles, and a pair of dorsal pointed black ones on the eleventh; second ring swollen on the sides. Length, crawling, 46mm. Changes to a pupa the end of July in rolled leaf, the moth appearing August 10. (Goodell.) The moth is large, dull ochre-yellow, and the hind wings are tailed. We have taken it resting on red maple leaves in Maine.

17. The American silk-worm.

Telea polyphemus Hübner.

According to Mr. E. B. Reed, this insect "frequently attacks maples, and from the enormous size of the caterpillar and its voracious appetite a great deal of damage is often done." (Report Ontario Ent. Soc. for 1872, p. 39.)

18. The Cecropia caterpillar.

Platysamia cecropia (Linn).

This caterpillar, larger than the foregoing, also sometimes occurs on

Fig. 52.—Caterpillar of the Cecropia silk moth, nat. size.—After Riley.

the maple. It is about four inches long, and pale green, ornamented with large tubercles colored green, blue, yellow, and red.

19. The maple semi-looper.

Ophiusa bistriaris (Hübner).

Order Lepidoptera; family Noctuidæ.

Late in July feeding on the silver maple, a brownish gray caterpillar 1.40 inch long, with the first pair of prolegs small, the worm having a semi-looping gait.

When about to go into chrysalis it cuts through a portion of a leaf of the tree on which it has fed, and turning it over constructs a snug little case, fastening it up closely and carefully with silken threads, and in this completes its transformations. After remaining in the pupa state about two weeks, the moth appears. (Saunders.)

The larva is 1.40 inch long, somewhat oniscifform. Head medium sized, flattened, bilobed; color, pale ashen gray with streaks of pale brown appearing under a magnifying lens as a fine network; a dark brown, nearly black, stripe on each side, and a few short gray hairs scattered over its surface. Body above brownish-gray, with numerous streaks and dots of pale brown. A double irregular dorsal line; other broken lines composed chiefly of dots, none of them continuous. A subdorsal row of whitish dots. On the hinder part of the 12th segment is a raised crescent-shaped line edged

behind with black, and on the terminal one two whitish dots, with a small black patch at their base. Spiracles pale oval, edged with black. Under surface paler and greenish, feet greenish, prolegs bluish-green dotted with brown. The moth is rather large, with broad triangular fore wings, and is uniformly brown, with two oblique darker bands.

20. The maple leaf-cutter.

Incurvaria acerifoliella (Fitch).

Order Lepidoptera; family Tineidæ.

Cutting round holes in the leaves and consuming their pulp in rings and semi-circular spots, and using the round pieces to hide the small white worms between them and the leaf, forming a broad round case adhering to the surface of the leaves.

This larva with its singular case has been described by Fitch, and we have received specimens of maple leaves and cases from Vermont. Early in August the leaves of forest trees begin to wither, and holes appear in them, the orbicular pieces being taken by the little worm to form a broad scale concealing it. The worms fall with the leaves to the ground in the autumn, and there remain transforming in their cases, and late in the spring appear as moths.

The larva.—Nearly a quarter of an inch long; slender, cylindrical, soft, and contractile; dull white; head flattened, and, like the three succeeding segments, pale rusty brown.

The moth with long narrow pointed wings; the fore pair brilliant steel-blue, the hind wings smoky brown, with purplish reflections. Between the antennæ a dense tuft of erect bright orange-yellow hairs. (Fitch.)

The following insects also infest the maple:

21. *Gastropacha americana* Harris. (Lintner, Contr. iii.)
22. *Nadata gibbosa* Sm.–Abb. (Lintner, Contr. iii, 150.)
23. *Nematocampa filamentaria* Guen. (Lintner, Contr. iii, 165.)
24. *Amphidasys cognataria* Guen. (Lintner, Contr. iii, 166.)
25. *Heterophelps triguttata* H.–Sch. (Saunders in Packard's Monogr. Phalænidæ.)
26. *Lithocolletis aceriella* Clemens. Larva in a flat blotch mine in upper surface of leaves.
27. *Lithocolletis lucidicostella* Clemens. } Larvæ in tentiform mines in un-
28. *Lithocolletis clemensella* Chamb. } der surface of leaves.
29. *Gracilaria packardella* Chamb. Larva rolls the leaf downward into a conical figure.
30. *Catastega aceriella* Clems. Larva only known. It at first mines the leaf, and afterwards constructs a case of its frass. (Does not belong to Tineidæ?)
31. *Xylotrechus colonus* (Fabricius). Found by Mr. G. Hunt under the bark of an old sugar maple in Northern New York.

Hemiptera.

32. *Psylla annulata* Fitch. Occurs on the sugar maple.
33. *Siphonophora acerifoliæ* Thomas. On soft maple, *Acer dasycarpum*, Iowa, Illinois, and Missouri.

34. *Aphis aceris* Linn. Occurs on *Acer pensylvanica* (Fitch).

35. *Lecanium acericola* Walsh and Riley. (Amer. Ent. i, 14.) Also on box elder (Thomas).

36. *Lecanium acericorticis* Fitch. On silver maple, Washington, D. C. (Glover, Sm. Rep. 1876. See Thomas vii, 120; American Naturalist, xii, 655, 808.)

DIPTERA.

37. *Cecidomyia aceris* Shimer. On *Acer dasycarpum*. (Trans. Amer. Ent. Soc., i, 281.)

INSECTS INJURIOUS TO THE COTTONWOOD.

(*Populus monilifera.*)

AFFECTING THE TRUNK AND BRANCHES.

1. THE POPLAR BORER.

Saperda calcarata Say.

Order COLEOPTERA; family CERAMBYCIDÆ.

In the Western States, including Colorado, causing widespread injury and destruction to the cottonwood trees. (Riley. See the poplar borer, p. 117.)

2. *Hyperplatys aspersus* Say.

Boring in dry twigs at Columbus, Tex.; the perfect insect to be found throughout spring and summer, according to Schwarz. (Riley.)

3. *Oberea schaumii* Leconte.

The larva burrowing in the twigs, making a very smooth cylindrical burrow, the perfect insect appearing in the middle of June at Saint Louis, Mo. (Riley.)

4. *Oberea mandarina* Fabr.

The larva boring in the thin twigs at Saint Louis, Mo., the imago issuing in the middle of April. (Riley.)

5. *Dorytomus mucidus* Say.

Running on and flying about cottonwood trees early in April and again in August. In October it is found under dead bark of trees in winter quarters. Common. Illinois. (A. S. McBride. Can. Ent. XII, 106.)

6. *Eros coccinatus* Say.

Found in April in Illinois in the cottonwood, under logs in the woods. (McBride, *loc. cit.*)

AFFECTING THE LEAVES.

7. THE STREAKED COTTONWOOD BEETLE.

Plagiodera scripta (Fabricius).

Order COLEOPTERA; family CHRYSOMELIDÆ.

An abundant beetle, infesting the leaves of the cottonwood and other species of Populus and of willows throughout the West to Colorado, and south to Louisiana,

destroying vast groves; three annual broods; the larva peculiar from emitting from the tips of its tuberculous spines a pungent milky fluid; transforming on the leaf, the pupa remaining in the partially cast-off larva skin; the beetle usually black on the prothorax, with the sides yellow and the wing-covers yellowish, with three interrupted lines of black or bluish spots. It may be destroyed by syringing the trees with a wet preparation of London purple or Paris green. (Riley, Amer. Ent. iii, 159.)

FIG. 53.—Streaked cottonwood beetle: *a*, beetle, normal form; *b*, *c*, *d*, *e*, showing variations.—After Riley.

FIG. 54.—Grub of streaked cottonwood beetle: *a*, eggs; *b*, one enlarged; *c*, newly hatched larvæ; *d*, *d*, *d*, larvæ of different ages; *e*, pupa, nat. size; *f*, one of the middle segments of the body of larva seen from above, showing tubercles, enlarged. After Riley.

8. THE COTTONWOOD DAGGER-MOTH.

Acronycta populi Riley (*lepusculina* Guen.?)

Devouring the foliage and not unfrequently stripping the tree, a caterpillar which rests curled around on the leaf, and is easily recognized by its body being covered with long, soft, bright-yellow hairs, and a long pencil of black hairs on top of segments 4, 6, 7, 8, and 11. (Riley.)

This caterpillar is sometimes destructive to the foliage of the cottonwood in Missouri. There are two broods of these worms each year; the first brood appearing in June and producing

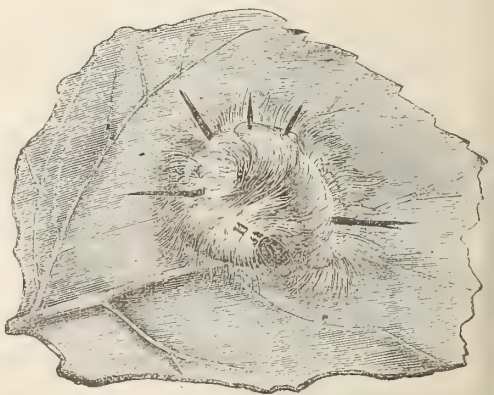

FIG. 55.—The cottonwood dagger-moth and its caterpillar.—After Riley.

moths by the last of July, the second brood appearing the last of Au-

gust and throughout September, and passing the winter in the chrysalis state. It is attacked by several parasites, *i. e.*, a Microgaster, an Ophion, and a Tachina fly.

The chrysalis is dark shiny brown, and ends in an obtuse point furnished with several forked bristles. It is formed within a pale yellow cocoon of silk interwoven with the hairs of the caterpillar and is generally spun in some sheltered place, as in a chink in the bark of a tree, etc.

The moth.—Fore wings white-gray near the anal angle between veins 1 and 2, a large and conspicuous spot like a Greek letter *psi*, placed sidewise, and from this spot a somewhat zigzag line runs parallel with the posterior border, forming a large dart-like spot between veins 5 and 6. (Riley.)

9. *Smerinthus modesta* Harris.

Larva on cottonwood in Illinois. (C. E. Worthington, Can. Ent., x, 16.)

10. *Pemphigus populi-transversus* Riley.

Forming a gall upon the petiole near the base of the leaf of *Populus monilifera* and *P. balsamifera*. Missouri, Southern Texas, and Colorado. (Riley.)

11. *Pemphigus populi-monilis* Riley.

On the narrow-leaved cottonwood in Colorado.

12. *Pemphigus populi-ramulorum* Riley.

13. *Pemphigus pseudobyrsa* Walsh.

Occurs on *Populus angulata*. (Thomas viii, 151.)

14. *Pemphigus vagabundus* Walsh.

Produces a large irregular gall on the tips of the twigs of certain cottonwoods. (Thomas viii, 151.)

15. *Pemphigus populicaulis* Fitch. (Le Baron.)

Also occurs on the aspen (*Populus tremuloides*) in Wisconsin. (Thomas viii, 149.)

16. *Chaitophorus populicola* Thomas.

Found in July at Carbondale, Ill., and early in September on the under side of young sprouts of *Populus angulata* (cottonwood).

INSECTS INJURIOUS TO THE POPLAR

AFFECTING THE TRUNK.

1. THE POPLAR BORER.

Saperda calcarata Say.

Order COLEOPTERA; family CERAMBYCIDÆ.

Often destroying the Lombardy poplar, a yellowish-white grub, nearly two inches long, and changing to a gray longicorn beetle, irregularly striped with yellow ochre, the wing-covers ending in a sharp point, flying in August and September.

Harris states that this borer, with the grubs of the broad-necked Prionus, almost destroyed the Lombardy poplars in his vicinity (Cambridge, Mass.), and that it also lives in the trunks of the native poplar.

The beetles rest on the trunks and branches of various kinds of poplars in August and September, and also fly by night, sometimes entering the open windows in the evening. According to Riley this borer is universally destructive to the cottonwood in the Western States.

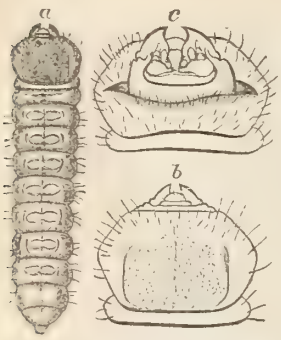

FIG. 56.—Poplar borer: *a*, natural size; *b* upper and *c* under side of head and first thoracic segment enlarged.—From Packard.

The larva.—About two inches long; the body very thick, rather larger before than behind; the segments full and rounded. The first segment broad, sloping obliquely downward to the head. On the upper side of the broad segment (prothoracic) containing the head is a large square yellowish horny area, succeeded by rough oval areas on the tops of the succeeding segments. These rasps serve as legs, which are wanting in the grub.

The beetle is called the spurred Saperda (calcarata) from the spine-like ends of the wing-covers. The body is covered all over with a short and close nap, which gives it a fine blue-gray color; it is finely punctured with brown, with four ochre-yellow lines on the head and three on the top of the thorax; the scutel is also ochre-yellow, and there are several irregular lines and spots of the same color on the wing-covers; it is 1¼ inch in length. (Harris.)

2. The lesser poplar borer.

Saperda mœsta Leconte.

Boring in the poplar and balm of Gilead, selecting the smaller branches, in many places not more than an inch or two apart, and situated chiefly at the base of the buds, the whole length of the excavation not much exceeding an inch; pupating early in May and becoming beetles by the end of May.

The larva.—Nearly cylindrical, tapering a little posteriorly, and about half an inch in length. Head very small, dark reddish brown in front, pale behind. Body deep yellow. Second segment deeper in color and more horny than the other segments; terminal segment a little more hairy than the others. (Saunders.)

3. The poplar girdler.

Saperda concolor Leconte.

Girdling the trunks of sapling poplars, by carrying a mine around the trunk, which causes a swelling often nearly twice the diameter of the tree.

Our attention was first directed to this borer and the marked effects of its work by Mr. George Hunt. In his company we have found numerous saplings of the common poplar in the woods about Providence, with the unsightly swellings around the trunk. The beetle is uniformly gray approaching the color of the downy under side of the poplar, with no spots, while the antennæ are black, stained with gray at the joints. Length 10^{mm}.

4. The broad necked Prionus.

Prionus laticollis Drury.

Order Coleoptera; family Cerambycidæ.

Boring in the wood of the trunks and roots of different poplars, a white soft grub as thick as one's thumb, producing an oval moderately convex black long-horned beetle 0.90 to 1.50 long and less than half as broad, its wing-covers rough from confluent irregular punctures and with two or three raised lines, its thorax with three irregular

teeth along each side, and its antennæ of twelve joints resembling little conical cups placed one within the other and projecting upon their lower side like the teeth of a saw; appearing abroad in July. (Fitch.)

Though of late years injurious to the apple, grape-vine, and pine, this beetle may originally have been confined to the poplars, especially as Harris does not enumerate the above-mentioned trees, but says that it lives in the trunks and roots of the balm of Gilead, Lombardy poplar, "and probably in those of other kinds of poplar also. The beetles may frequently be seen upon, or flying around, the trunks of these trees in the month of July, even in the daytime, though the other kinds of Prionus generally fly only by night." Prof. S. J. Smith, in his report as Entomologist to the State Board of Agriculture of Connecticut, for 1872, remarks: "I have noticed it in logs of poplar, bass-wood, and oak, and in the trunks of old, decaying apple trees, and Professor Verrill has collected it in great numbers, at New Haven, in chestnut railroad ties," p. 346. It seems to us most probable that this borer also infests the pitch-pine, since we have seen these beetles flying at noon in abundance in the middle of July on the sandy plains of Brunswick, Maine, among pitch-pines, two or three miles away from any poplars; and have captured them among pines at intervals for twenty-five years past.

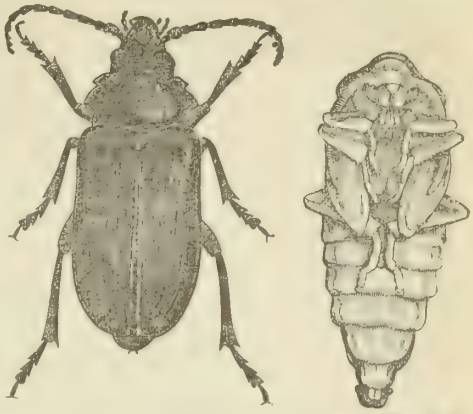

FIG. 57.—Broad-necked Prionus and pupa.—After Riley.

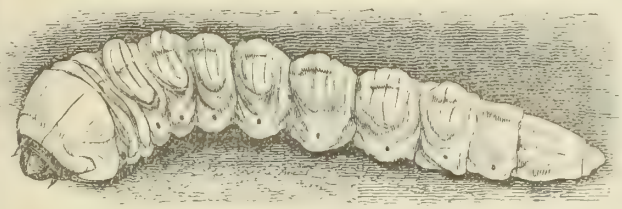

FIG. 58.—Larva of broad-necked Prionus.—After Riley.

5. THE XYLEUTES BORER.

Xyleutes populi Walker.

Nothing is known to us concerning this moth, except that the specific name indicates that it occurs on the poplar. The habitat mentioned by Walker, is St. Martin's Falls, Albany River, Hudson's Bay, the original specimen described by Walker being in the British Museum.

6. THE POPLAR GOAT-MOTH.

Cossus centerensis Lintner.

Order LEPIDOPTERA; family BOMBYCIDÆ.

Perforating the trunks of *Populus tremuloides*, a worm similar to, but smaller than, the oak caterpillar (*X. robiniæ*), the moth issuing from the trees during June. (Bailey.)

Usually trees less than a foot in diameter are attacked by this worm,

a number occurring in the same tree, according to the account of Mr. J. S. Bailey. (Can. Ent. XI, p. 1.) The eggs are laid by the long ovipositor of the female in the deep crevices of the bark of the poplar. When hatched, *i. e.*, during the summer, they bore into the tree, never apparently ceasing to eat, and extending their tunnels through solid wood, first in the alburnum and then through the heart, the burrows increasing in size with that of the larvæ, until the latter are completely grown. In consequence of the innumerable tunnels cut in feeding, many trees are destroyed. The burrows made by the larvæ are about 15 millimeters in width, and terminate in the pupating cell, which is about 40^{mm} long, and smooth; the extremity toward the opening is closed by a wad of finer and then coarser filings of the wood. The coarser splinters are *not* detached entirely from the wood, but are split up by the larva all around the top of the cell and project like bristles. These splinters make a firm wad. Against them are piled a quantity of finer chips or thin filings, which are loose, but pressed together.

The cell is about 40^{mm} from the outer bark of the tree, and the chrysalis makes its exit through the burrow by means of the teeth on the segments and the spinous process on the front, by which it forces itself by stretching and contracting the abdomen through the wood scrapings which close the cell until it comes to the end.

The larva is supposed to live two years, and attains maturity in October, the moth issuing from the trees the following June and July, leaving the empty shell of the chrysalis sticking out of the hole. It is preyed upon in the larva state by an ichneumon fly. (Bailey.) It occurs near Albany (Bailey) and in Michigan (Kellicott).

The larva is 45^{mm} long, of a pale flesh color. The first segment behind the head is blackish-brown above, the dark color edged with a dirty orange shading. Head mahogany brown; along the sides of the body a row of brown dots above the reddish stigmata, and a row of similar dots, two to a segment, on each side of the dorsal line, from each of which a hair arises.

The pupa is about 30^{mm} long, narrow brown-black, shining, rugose. On the clypeus is a strong broad spinous process, supported at base by lateral projections. The abdominal segments are provided with teeth on the back, and the anal segment is provided with two unequal sized terminal teeth on each side of the vent.

The moth, says Mr. Bailey, seems to belong to the genus *Cossus* Fabr., and not to be congeneric with *Xyleutes robiniæ*. The head is short, eyes naked, labial palpi small, oppressed, scaled. The thorax is thickly scaled, and is squarer in front than Xyleutes, and not so long or high. The male antennæ are bipectinate; those of the female serrated. It is allied to the European *Cossus terebra*, while a larger insect. It differs from *C. querciperda* by the absence of any yellow on the male hind wings, and by its darker color and closer reticulations. In color it is black and gray; fore wings covered with black reticulations. The ground color is blackish over nearly two-thirds from the base of the fore wings, and outwardly gray. Beyond the cell is a transverse continuous line, broader than the rest, and outwardly bent over the median veins. Hind wings rounded in both sexes, with blackish hairs at base, pale and sub-pellucid, with short gray fringe, before which there is a narrow blackish edging. Abdomen blackish. Male smaller than the females; the smallest male expanding about 40^{mm}, the largest female over 60^{mm}. (Bailey.)

6. The poplar ægeria.

Ægeria tricincta Harris.

Boring in *Populus candicans* in winter and spring, the moth perhaps placing her eggs in the deserted burrows of *Saperda mœsta*. They inhabit the branches, suckers, and small trunks in New York, on the smaller stalks raising galls. The larva dull white, head light brown, otherwise much as in other Ægerian caterpillars. (Described by D. S. Kellicott in Can. Ent. XIII, 3.)

AFFECTING THE LEAVES.

7. The stout poplar span worm.

Biston ursaria Walker.

Order Lepidoptera; family Phalenid.e.

In some seasons, during July, partially defoliating the Lombardy poplars in Montreal, Canada, large drab or dingy purple span worms, at the end of July burying themselves in the earth, the moths appearing during the last week in April and the early part of May.

According to Mr. G. J. Bowles (Can. Ent. VIII, p. 7) this span worm abounds year after year in the Lombardy poplars in the city of Montreal. "In some seasons the trees are partially defoliated by the larvæ, and during the last week of April and the first of May the moths are to be found in great numbers." On the 6th of May the moths laid globular eggs .04 inch in diameter, depositing them some days before the leaves expand. May 29th the larvæ began to hatch out just as the poplars were throwing out their leaves. The larvæ change but little during growth. At the end of July they descend and bury themselves in the earth, changing in a few days to pupæ, without forming any cocoon.

The larva is from 2 to 2½ inches long, of a drab or dingy purple; head of a lighter shade and spotted with black. First segment behind the head bordered in front with a yellow line, indented behind; fourth to eighth inclusive, each with six very small yellow tubercles, two on the back, one behind and one below each spiracle. Body striped from head to tail with twelve reddish lines, each bordered on both sides by an irregular narrow black line; six of the reddish lines are on the back and sides, one (interrupted) through the spiracles, and four on the abdomen. Anal segments spotted with black, as also first, second, and third segments. Mouth pinkish, legs pink-spotted with black; spiracles dark. (Bowles.)

The moth.—This genus may be known by the large heavy body and rather small wings; the fore wings have the costa straight, the tip subrectangular; the male antennæ with long pectinations. This species is dark granite-gray, the fore wings with three transverse, obscure, dusky lines, represented in rubbed specimens by black spots on the costa and veins. First line well curved; second and third lines near together. Half way between the third line and the outer edge of the wing is a fainter band than the others, represented by a costal square spot, and a black spot on the inner angle. Hind wings with three transverse diffuse bands. The fore wings expand 1.55–2.00 inches.

8. The white-S clostera.

Ichthyura albosigma Fitch.

Order Lepidoptera; family Bombycid.e.

Early in July, eating the leaves and reposing in a cavity formed of leaves drawn together like a ball, a large black caterpillar with white and yellow dots and stripes

and a hump on the back of its fourth and eleventh rings; its pupa lying in a cocoon attached among the leaves, and in ten days giving out the moth the latter part of July; the moth grayish-brown, its fore wings crossed by three faint paler streaks, the two first parallel, the hind one with its outer half silvery white and strongly waved in shape of the letter S; width, 1.50.

9. The American Clostera.

Ichthyura Americana Harris.

Consuming the leaves in summer, a pale yellow caterpillar with two little black warts close together on the back of its fourth and eleventh rings, three slender black lines on its back and three in a broad dusky stripe along each side, its pupa passing the winter in a cocoon under leaves or rubbish on the ground, the middle of June giving out a pale grayish moth more or less varied with brown, its fore wings with three whitish bands, the first transverse and dislocated, the second oblique and giving off a transverse branch from its middle which runs to the inner margin, uniting with the third band, the two thus forming a letter V, a faint whitish band across the middle of the hind wings; width about 1.35. (Harris.)

10. V-marked Clostera.

Ichthyura vau Fitch.

A moth which is very similar to the preceding, but darker colored and smaller, with the bands more slender and distinct, may be readily distinguished from that species by its having the first band not dislocated, but in its middle strongly curved backward, the apex of the curve usually forming an acute point. The last band also is much more strongly undulated near its outer end, curving backwards almost in a semicircle, and is of a much more vivid white color, and broadly bordered on its hind side with bright rust-red. Its hind wings also are destitute of the paler band across their middle. Its width is about 1.20.

I am unacquainted with its larva, but, like the other species of this genus, it doubtless feeds on the poplars and willows. Though quite rare in my own vicinity, it is oftener met with than the two other species. (Fitch.)

11. The poplar-stem gall-louse.

Pemphigus populicaulis Fitch.

Forming imperfectly globular galls the size of a bullet at the junction of the leaf with its stalk, these galls having a mouth-like orifice on their under side, and a large cavity within, crowded with small dull white lice and their white cast skins, and with winged lice of a blue black color, their antennæ reaching beyond the base of their wings, the rib-vein of their fore-wings black, thick, much thicker at its apex along the inner margin of the stigma, and the short veinlet bounding the anterior end of this spot more slender than the rib-vein; its length 0.10, and to the tips of its wings 0.15. (Fitch.)

12. The poplar gall-louse.

Pemphigus popularia Fitch.

Late in autumn, wandering up and down the trunk of the balsam poplar, a gall-louse closely like the preceding, but its abdomen green, its antennæ short, reaching but two-thirds the distance to the wing sockets, and the rib-vein of its wings not thicker along the inner margin of the stigma; its length 0.13 to the tip of its wings.

The female black, slightly dusted over with a glaucous gray powder; the abdomen

dull green with a small coating of white flocculent wool, its opposite sides parallel and its tip abruptly rounded; the antennæ short, thick, and thread-like; the wings dull hyaline, their rib-vein black and the oblique veins slender and blackish with the basal third of the third vein abortive and the fourth vein perceptibly thicker towards its base; and the small branch of the rib-vein bounding the anterior end of the stigma having nearly the same thickness with the rib-vein. (Fitch.)

13. The poplar-bullet gall-louse.

Pemphigus populi-globuli Fitch.

In July, on the leaves of the balsam poplar slightly above their base, an irregular globular apple green gall the size of a bullet, projecting from the upper surface of the leaf, with a curved mouth-like orifice on the under side, the cavity within containing numerous small pale green and smaller dusky lice with the end of their bodies covered with short white cotton-like threads, and larger winged ones which are of a black color, with the abdomen dusted over with white meal and with thin white woolly fibres on the back, and their antennæ reaching the base of the wings, which are clear hyaline, their veins slender and white or colorless, except the outer marginal vein, which is black to the end of the stigma, and also the rib-vein, which is much thicker at its apex; their length 0.07 and to the tip of their wings 0.11.

14. The poplar-vein gall-louse.

Pemphigus populi-venæ Fitch.

In July an oblong compressed excrescence like a cock's comb, of a light red color varied with pale yellow, growing from the midvein of balsam poplar leaves on their upper side with an orifice on the opposite under side; a cavity within containing a multitude of lice and their white cast skins, interspersed with a whitish meal-like powder; those with wings being black, with coarse thread-like antennæ reaching to the base of the wings, which, with their oblique veins, are pellucid and colorless, the coarse rib-vein being blackish and more thick at its tip along the inner margin of the stigma, and the vein of the outer margin being blackish and somewhat coarse from its base to the stigma; its length 0.05 and to the tip of the wings 0.08.

Other insects occurring on the poplar are the following:—

15. *Saperda vestita* Say. On poplar in July, Providence (G. Hunt, p. 124).
16. *Xyleutes robiniæ* Harris. In *Populus candicans*. (Kellicott Bull. Buffalo Soc. Nat. Sc., iv, 30.)
17. *Ægeria tibiale* Harris. Found in New Hampshire on *P. candicans* Harris. (Amer. Journ. Sc., xxxvi, 1839, 309.)
18. *Limenitis misippus* (Lintner, Contr., ii, 166).
19. *Lemenites disippus* B.-Lec., Lintner, Proc. Ent. Soc. Phil., 1866).
20. The prickly caterpillar, *Hyperchiria io* (Fabricius). On balsam poplar and aspen (Lintner, Contr., ii, 146.)
21. The prickly black caterpillar, *Vanessa antiopa* (Linn).
22. Elm measuring worm, *Eugonia subsignaria* Hübner.
23. *Notodonta dictæa* Linn. On aspen (Lintner, iv, 77).
24. *Cossus undosus* Lintner (Contr., iv, 130). At Green River, Wyoming, probably on *P. balsamifera*).
25. *Smerinthus modesta* Harris. On aspen (Kellicott).
26. *Tephrosia cribrataria* Guenée. Larva on *Populus tremuloides* and *P. fastigiata* (Guenée).

The following Tineidæ occur according to Chambers on the poplars, aspens, &c.:

27. *Cemiostoma albella* Chamb.
28. *Batrachedra salicipomonella* Clems.
29. *Batrachedra præangusta* Haworth.
30. *Batrachedra striolata* Zeller.
31. *Aspidisca* sp? makes a minute mine in aspen leaves in Oregon. Possibly it is *A. splendoriferella* Clems.
32. *Gracilaria populiella* Chamb. Larva rolls aspen leaves in the Rocky Mountains.
33. *Gracilaria purpuriella* Chamb. Larva mines leaves of silver-leaf poplar.
34. *Lithocolletis populiella* Chamb. Larva in a tentiform mine in under side of leaves of silver poplar.
35. *Appis populifoliæ* Fitch. On under side of leaves of *Populus grandidentata* (Thomas, viii, 102).
36. *Chaitophorus candicans* Koch. Balm of Gilead.

INSECTS INJURIOUS TO THE LINDEN TREE.

AFFECTING THE TRUNK.

1. The linden borer.

Saperda vestita Say.

Order Coleoptera; family Cerambycidæ.

Boring in the trunk, undermining the bark for six or eight inches in sinuous galleries, or penetrating the solid wood an equal distance, rather slender grubs, with three pairs of thoracic feet, transforming into a greenish snuff-yellow longicorn beetle, with six black spots near the middle of the back.

The beetles, according to Dr. Paul Swift, as quoted by Dr. Harris, were found in Philadelphia upon the small branches and leaves May 28, and it is said that they come out as early as the first of the month, and continue to make their way through the bark of the trunk and large branches during the whole of the summer. They immediately fly into the top of the tree, and there feed upon the epidermis of the tender twigs and the petioles of the leaves, often wholly denuding the latter, and causing the leaves to fall.

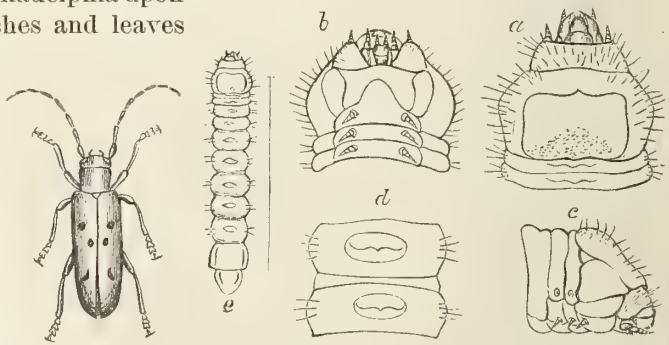

Fig. 59.—The Linden borer, beetle of nat. size. *a*, upper, *b*, under, side of head and three thoracic segments; *c*, side view of head of grub; *d*, top view of two segments, showing the oval spots; *e*, the grub, slightly enlarged.—(From Packard.)

They deposit their eggs, two or three in a place, upon the trunk or branches, especially about the forks, making slight incisions or punctures for their reception with their strong jaws. As many as ninety eggs have been taken from a single beetle.

AFFECTING THE LEAVES.

2. The lime inch-worm.

Hibernia tiliaria Harris.

Order Lepidoptera; family Phalænidæ.

In May and June, defoliating the branches, a bright yellow looper or measuring worm with a rust-colored head, and ten crinkled black lines along the back, descending at the end of June to the ground and pupating three or four inches under the surface of the soil; appearing as moths with their buff-brown wings in October and November.

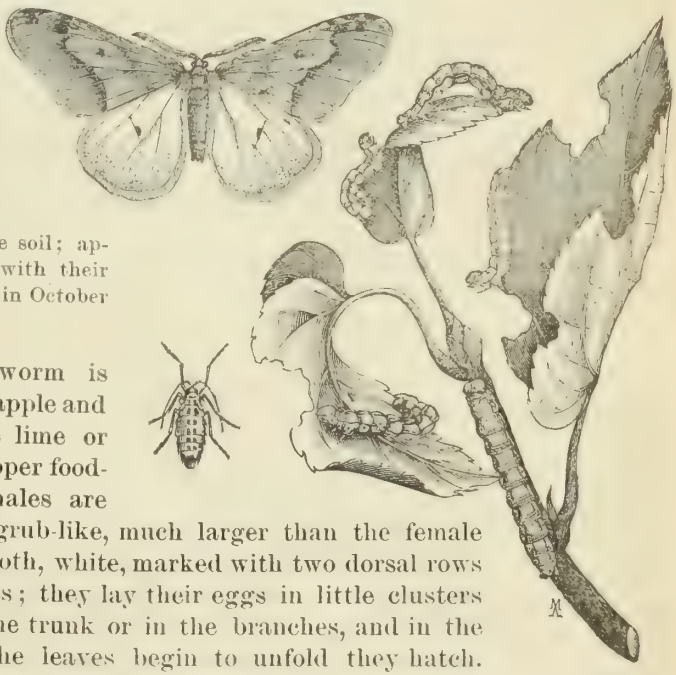

Fig. 60.—The lime inch worm.—From Comstock.

While this worm is often found on apple and elm trees, the lime or linden is its proper food-tree. The females are wingless and grub-like, much larger than the female canker-worm moth, white, marked with two dorsal rows of black patches; they lay their eggs in little clusters in crevices in the trunk or in the branches, and in the spring when the leaves begin to unfold they hatch. Their habits are similar to those of the canker-worm, and the best means of protection against them are those employed against the canker-worm, *i. e.*, the use of tarred paper daubed over with printer's ink or troughs of oil around the trunk of trees to prevent the females from ascending the trees to lay their eggs.

The male.—Pale ochreous, with light brown specks and bands. Head, body, front or costal edge of the fore wings and transverse band on the wings concolorous, being pale brown. Fore wings with a point, curved, sinuate, diffuse inner line; outer line dark brown, slightly sinuate, with a large obtuse angle in the middle of the wing; it is shaded externally with a broad pale-brown band, which breaks up into flecks on the outer edge; a well-marked discal dot. Hind wings without any markings, somewhat paler than the fore pair. Expanse of wings 2 inches.

3. The linden leaf-beetle.

Chrysomela scalaris Leconte.

Order Coleoptera; family Chrysomelidæ.

Injuring the leaves, a stout-bodied beetle with silvery wing-covers spotted with green, laying eggs on the leaves in the spring, from which fat, thick-bodied white grubs develop, with a lateral row of large black dots, which also prey on the leaves.

While this beautiful and abundant beetle is more common on the alder, it also occurs on the lime-tree and elm. They may be found on these trees in April, May, and June, and a second brood in September and October. We have taken them *in coitu* on the alder in Maine the middle of May. The grubs are hatched from eggs laid by the beetles on the leaves in spring and come to their growth towards the end of June in Massachusetts, according to Harris, who believes that they go into the ground to turn to pupæ.

The beetle is about three-tenths of an inch in length, the body almost oval, hemispherical; head, thorax, and under side of the body dark green, the wing-covers silvery white, ornamented with small green spots on the sides, and a broad jagged stripe along the suture or inner edges; the antennæ and legs are rust red, and the wings rose-colored.

The larva is short and thick, the back curving up in the middle about six-tenths of an inch long, white, with a black line along the top of the back, and a row of small square black spots on each side of the body; the head is horny, and of an ochre yellow. (Harris.)

Since the foregoing account was prepared, we have during the past summer observed this beetle in all its stages. At Brunswick, Maine, during July and August, 1881, it was very abundant on the numerous linden trees in the campus of Bowdoin College, eating rounded holes in the leaves and causing them to turn yellow and unsightly, as if to prematurely fall. Nearly every tree and, in some cases, nearly every leaf on a tree was infested by the disgusting pale grubs, while scattered patches of eggs occurred on the under side of the leaves; and during the first to last of August the beetles were found not uncommonly upon the leaves. The trees could be protected by showering the leaves with London purple in water when the grubs first appear late in June. From these specimens the following descriptions were drawn up:

Egg.—Rather large, oval cylindrical, yellow, several together attached by one end; about 1.5^{mm} in length.

Larva.—Body very thick, curved up like that of the grub of the Colorado potato-beetle, being much swollen behind the thoracic segments, while the tip of the abdomen is curved down. Head honey-yellow, darker over the jaws; antennæ bluish, except at base; eyes black. Prothoracic shield blackish in the young before the last molt; in full-grown individuals not all black, but pale, with four irregularly square black spots. Body behind dirty white, with a row of dorsal and lateral dusky spots. Legs pale, spotted with black at the joints. A pair of meso-thoracic spiracles and 8

pairs of smaller abdominal ones. Low down, on the sides of the second and third thoracic segments a curvilinear black spot. Length, 8–9mm.

Pupa.—Body pure white; prothoracic shield, with long scattered hairs around the edge and in two groups on the back; antennæ curving around between the eyes and jaws, and with the ends resting on the tips of the elytra. The insect undoubtedly descends into the earth to pupate.

The beetle.—Head, prothorax, and under side of body dark coppery green, with scattered pits. Antennæ palpi and legs pale pitchy yellow; elytra coppery green and whitish, the green forming a broad median stripe, sending prolongations outwards toward the middle of the elytra, the first pair of branches nearly parallel to the band, the second becoming more and more at right angles to the band, the last short and broad near the tip of the body. Eleven rounded dark-green spots in the whitish field; the pair near the shoulders gourd-shaped; two of the spots behind the middle of the elytra touching each other. The pits or punctures near the sutures of the elytra arranged in three lines parallel to the median line of union of the body; elsewhere they are arranged irregularly.

The following insects also occur on the linden:

4. *Selandria tiliæ* Norton (Trans. Amer. Ent. Soc., i, 250).
5. The swallow tail, *Papilio turnus* Linn (Ent. Soc. Ontario).
6. The semicolon butterfly, *Grapta interrogationis* (Fabricius).
7. *Ceratomia amyntor* Hübn. (Lintner i, 188).
8. *Acronycta hastulifera* (Sm. Abb.), Lintner (Contr. iii, 158).
9. *Apatela americana* Harris.
10. *Sciapteron robiniæ* H. Edwards. Destructive to *Populus alba* in Nevada (Edwards, Bull. Buffalo Ent. Soc., iii, 72).
11. *Eugonia alniaria* Hübn. (Harris).
12. The elm measuring worm, *Eugonia subsignaria* (Hübner).
13. The maple moth, *Acronycta americana* Harris.
14. The leaf-miner beetle, *Hispa quadrata* Fabr. Mines the leaves. (Chambers.)
15. *Prionus brevicornis* Fabr. In logs of bass wood (Smith, Rep. Ent. Conn. 1872, 346).
16. *Parandra brunnea* Fabricius (in stumps, Schaupp, in letter).
17. The Linden dipterous gall-fly, *Cecidomyia (tiliæ) verrucicola* Ostensacken. Massachusetts and New York (Ostensacken).
18. *Lithocolletis lucetiella* Clems. Larvæ in tentiform mine on under surface of leaves. (Chambers.)
19. *Lithocolletis tiliavella* Chamb. Larvæ in tentiform mine on upper surface of leaves. (Chambers.)
20. *Coleophora tiliæfoliella* Clems. Larva only known. It lives in a case and feeds on the under side of leaves. (Chambers.)
21. *Cecidomyia citrina* O. Sacken.
22. *Lachnus longistigma* Monell. St. Louis, Mo.
23. *Drepanosiphum tiliæ* Koch? (Monell-Thomas).

INSECTS INJURIOUS TO THE BIRCH.

(*Betula lenta, etc.*)

AFFECTING THE LEAVES.

1. The triple-rowed syneta.

Syneta tripla Say.

Order Coleoptera; family Chrysomelidæ.

In May and the fore part of June, eating the leaves of this and various other trees, an oblong chestnut-brown and closely punctured beetle, with wing-covers usually pale dull yellowish except on their suture, and their punctures forming about three rows between each of the three raised lines; its length 0.25 and about a third as wide. A common insect in New York. (Fitch.)

2. The variable leaf-hopper.

Athysanus variabilis Fitch.

Order Hemiptera; family Cercopidæ.

Puncturing the leaves and succulent shoots and extracting their juices, from the middle of June till the middle of July, an oblong oval leaf-hopper of a sulphur yellow color, its wing-covers commonly with an oblique black stripe, their tips hyaline: its thorax and scutel often tawny yellow or black; its length 0.20. (Fitch.)

This insect may every year be met with in numbers upon birch trees and also upon alders. It was once found literally swarming upon a white birch standing apart from other trees. (Fitch.)

3. The smaller leaf-hopper.

Athysanus minor Fitch.

From the middle of June till the middle of August, a similar leaf-hopper to the preceding, but of a cinnamon color, including its face, and having a colorless hyaline spot on the middle of its wing-covers and a larger one on their tips; its length 0.18 to 0.20. (Fitch.)

4. The windowed leaf-hopper.

Athysanus fenestratus Fitch.

From the middle of June till the last of July, a leaf-hopper resembling the foregoing species, but with blackish wing-covers with similar hyaline spots and a smaller third one placed on the middle of the inner margin, and its forehead black with a pale yellow band between its eyes; its length 0.20 inch. (Fitch.)

The following insects also occur on the birch*:—

5. *Chrysobothris 6-signata* Say. Beetle and pupa found in the yellow birch June 1, Providence.

* In Europe *Rhamnaptera hastata* (Hübner) and *Operophtera boreata* Hübner live upon the birch: these are common insects in the Northern United States, but their habits have not yet been observed.

6. *Tylonotus bimaculatus* Hald. Under bark of white or paper birch, Northern New York. (G. Hunt.)
7. *Bellamira scalaris* (Say). Beetle and pupa found under the bark of the yellow birch in July, Northern New York. (G. Hunt.)
8. *Cræsus latitarsus* Norton. Saw-fly. (Bred by Walsh. Trans. A. Ent. Soc., i, 84.)
9. The black-birch borer, *Xiphidria attenuata* Norton. Inhabits the black birch. Patton. (Can. Ent. XI, 15.)
10. *Tremex columba* Linn. In yellow birch at Providence.
11. *Gastropacha americana* Harris. On *Betula lenta.* (Lintner Contr., i, 193, iii, 154.)
12. *Brephos infans* Moeschler. Lintner, Contr., iv.
13–14. *Telephorus cordinus* and *fraxini* occurred in Maine June 2, the former *in coitu*, on the leaves of *Betula populifolia.*
15. *Callaphis betulella* Walsh. Abundant in Illinois on *Betula nigra.* Proc. Ent. Soc. Phil., i, 301.
16. The spruce leaf-hopper, *Athysanus abietis* Fitch.
17. The butternut tingis; *Tingis juglandis* Fitch.
18. *Callipterus betulæ* Koch ? The birch aphis.
19. *Callipterus betulæcolens* Thomas. Saint Louis, Mo.

INSECTS INJURIOUS TO THE BEECH.

(*Fagus ferruginea.*)

1. The beech span-worm.

Hyperetis nyssaria Abbot.

Order Lepidoptera; family Phalænidæ.

Feeding on the leaves the middle of September, a dark brown span or measuring worm, changing to a beautiful delicate thin-winged moth.

According to Mr. W. Saunders two larvæ were found by him on the beech, the 10th of September, in London, Canada. Two of them entered the chrysalis state on the 19th of September, having formed a rude case in which to secrete themselves by binding two leaves together with threads of silk. One of them, he says, produced the imago on the 18th, the other on the 21st of May following.

The caterpillar is dark brown, the body cylindrical and an inch long. Head medium sized, bilobed, dark brown, with the bluish-white lines in front. Body above dark brown, with a row of dull white dots on each side, one or two on each segment most prominent from fifth to eighth segments inclusive, less distinct towards each extremity. On the posterior part of ninth segment are two rather prominent roundish black tubercles, with a few whitish streaks in front at their base. Terminal segment of a bluish tint, flattened and spreading. (Saunders.)

The moth.—The moths of the genus Hyperetis have long rather narrow fore wings with the apex acute, bent on the outer edge, which is sinuous. The species is pale whitish ash, dusted over with black specks. On the fore wings is an inner curved

pale brown line, wider on the costa, and an outer line making a great bend in the middle of the wings. Beyond the outer line the wing is brown, either reddish or umber brown, with dark cross specks, and two diffuse spots near the middle; one near the head of the outer line and another near the tip of the wing. The hind wings are sinuous on the outer edge; the wings expand from an inch to an inch and a half.

2. The beech leaf-miner.

Brachys æruginosa Gory.

Order Coleoptera; family Buprestidæ.

Mining the leaves of the beech, a whitish flattened larva, changing to a small flattened hard-shelled beetle.

Dr. Harris has given in his "Treatise" an account of the larva of Hispa which mines the leaf of the apple tree, eating the pulpy substance between the upper and under surface of the leaf. The insect of which we now treat belongs to the family of Buprestids, several species of which, as we have seen, do much injury to our fruit and shade trees in the grub state. They are footless grubs and recognized by the broad, rounded, flattened segment just behind and partially enclosing the head. The young of *Brachys*, etc., depart somewhat from this typical form owing to their peculiar leaf-mining habits. The first of these is the young of the *Brachys æruginosa*, which has been found by V. T. Chambers, Esq., of Covington, Ky., mining the leaves of the beech tree, and I am indebted to him for a specimen of the larva here figured (Fig. 60½).

Fig. 60½.—The beech leaf-miner, much enlarged.—From Packard.

I may remark here that a closely allied beetle (*B. terminans*) is often to be seen in Maine resting on the leaves of the oak and beech. The beetles of this genus are flattened, angular ovate, and less than a quarter of an inch in length, and the scutellum is small, as Leconte observes, while the shanks (tibiæ) are linear. In the succeeding genus, Metonius, Leconte says that the body is triangular, while the scutellum is large, and the shanks are dilated.

Larva.—The body of the larva is rather long, with the segments very deeply cut, being flattened, and produced laterally into a triangular projection, giving a serrate outline to the body, the teeth being obtusely rounded. The segment next behind the head is the widest, the succeeding segments gradually decreasing in width and increasing slightly in length to the end. The terminal segment is about half as wide as the body in its widest portion, and is somewhat triangular, with the sides parallel, and the tip obtusely pointed. The prothoracic segment or the one next the head is broader than long, and has a fleshy projection on each side at the base of the head. On the upper side of this segment is a large, square, slightly horny area. The head is anteriorly pale honey yellow, with two dark longitudinal parallel lines; the horny portion is about as long as broad, much flattened, subtriangular. The antennæ are very minute, slender, three-jointed, with the joints nearly equal in length. The jaws and palpi are so minute that a description will be of no practical use here. The body is finely shagreened, with a few fine scattered hairs. It is whitish, with a slight greenish tinge, and a quarter (.25) of an inch long, and less than a tenth (.07) of an inch broad. It was sent to me alive in September.

The following insects also occur on the beech:

3. *Dicerca divaricata* Say. (Fitch; and Schaupp in letter; observed by Mr. George Hunt laying its eggs in the bark in July. See Fitch, 3d Report, 48.)
4. *Scolytus fagi* Walsh. (Pract. Ent., ii, 58.)
5. *Parandra brunnea* Fabr. (Schaupp in letter.)
6. *Osmoderma scabra* Beauv. (Schaupp in letter.)
7. *Actias luna* (Linn.). (Saunders Can. Ent. vii, 33.)
8. *Smodicum cucujiforme* Say. (See p. 28.)
9. *Dryobius 6-fasciatus* Say. (C. G. Siewers.)
10. *Goes pulverulentus* Haldeman. "The insect is very destructive to living beech trees. It bores into those branches which are about three inches in diameter. The length of the channel is about eight inches." (Horn.)
11. *Acanthoderes 4-gibbus* Say. Bores in dead twigs of beech. (Schwarz.)
12. *Hoplosia nubila* Leconte. "Larva boring in dry beech twigs. Detroit, Michigan, Schwarz." (Riley.)
13. *Cryptolechia faginella* Chamb. The larva sews together the leaves in August and later. (Chambers.)
14. *Schizoneura imbricator* Fitch. Beech tree blight.
15. *Schizoneura fagi* (Linn.).

The following deciduous trees mentioned in their botanical order are affected by the insects enumerated below, and which for the most part feed upon the leaves:

Tulip tree (*Liriodendron tulipifera*).

Order Lepidoptera.

1. *Callosamia promethea*, var. *angulifera* Walker. (Akhurst in Riley, Bull., vi, 55.)
2. *Samia cynthia* Hübner. (G. D. Hulst, Bull. Brooklyn Ent. Soc. i, 91.)
3. *Bronchelia hortaria* Guenée. (Abbot MS. in Guenée.)
4. *Phyllocnistis liriodendrella* Clem. Makes a long, winding linear mine on either surface of the leaves. (Chambers Bull., Hayden's U. S. Geol. Surv., 1878, iv, 108.)

Order Coleoptera.

5. *Acanthoderes morrisii* Uhler. (Leconte, Trans. Amer. Ent. Soc. viii, xxiv.)

Order Hemiptera.

6. *Siphonophora liriodendri* Morell. (Saint Louis, June and July, Morell.)
7. *Lecanium tulipiferæ* Cook. (American Naturalist, xiii, 324.)

Order Diptera.

8. *Cecidomyia liriodendri* O. Sacken. (Monogr., i, 204, on leaves.)
9. *Cecidomyia tulipiferæ* O. Sacken. (Monogr., i, 202.)

MAGNOLIA (*Magnolia umbrella*, and probably other species).

Order LEPIDOPTERA.

The larva of *Phyllocnistis magnoliæella* Chambers makes a long, winding linear mine on either surface of the leaves. The imago is unknown, and it may prove to be *P. liriodendronella* Clem. (Chamb. Bull., Hayden's U. S. Geol. Surv., 1878, iv, 108.)

PAPAW (*Asimina triloba*).

1. *Sphinx hylæus* Drury. (Proc. Amer. Ent. Soc., iii, 434.)
2. *Amphalocera cariosa* Lederer. (Larva described by French, Rep. Curator S. Illinois Normal Univ., 1880, 46.)

PRICKLY ASH (*Zanthoxylum americanum*).

Order COLEOPTERA.

1. *Liopus xanthoxyli* Shimer. (Trans. A. E. Soc. ii, viii. Described in full by Packard in 1st Rept. Ins. Mass., Boston, 1871, p. 13. Fig. of larva and adult.)
2. *Micracis suturalis* Leconte (Shimer, *l. c.*).

FIG. 61.—Liopus xanthoxyli.—From Packard.

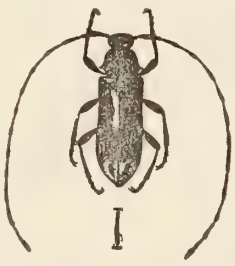

FIG. 62.—Liopus facetus.—From Packard.

Order LEPIDOPTERA.

3. *Papilio cresphontes* Cramer. Larva found chiefly on prickly ash, *Z. fraxineum*, and on *Dictamnus fraxinella* in Canada West. (Saunders in Rept. Ent. Soc., Ontario, 1880.) In Texas on *Z. carolinianum* (Boll. Psyche, ii, 289.) In Southern Illinois prickly ash is its usual food. (French.)

TREE OF HEAVEN (*Ailanthus glandulosus*).

Order LEPIDOPTERA.

1. *Samia cynthia* Hübner. (Imported.)
2. *Oeta compta* Clemens. (Riley's 1st Report.)

BUCKEYE OR HORSE-CHESTNUT (*Æsculus glabra*).

Order LEPIDOPTERA.

1. *Orgyia leucostigma* (Sm. Abb.).
2. *Acronycta hastulifera* (Sm. Abb.). Also feeds on linden. (Lintner, 26th Rept. N. Y. State Mus., 158.)
3. *Protosteras æsculana* Riley. (Trans. St. Louis Acad. Sc., iv, 321. "Larvæ boring the tender terminal twigs of buckeye and maple in Missouri.")
4. Buckeye stem-borer, *Sericoris inscrutana* Clemens.

5. *Tortrix larva.**
6. *Lithocolletis guttifinitella* Clem., var. *æsculisella* Chamb. Larva in flat, blotch mine in upper surface of leaves. (Chamb., *l. c.*)

Box elder (*Negundo aceroides*).

Order Lepidoptera.

1. *Gracilaria negundella* Chamb. Larva curls down the edge of a leaf.

Order Hemiptera.

2. *Pulvinaria innumerabilis* Rathvon. (Comstock, N. Amer. Ent., i, 25
3. *Chaitophorus negundinis* Thomas. (In Illinois in June, Miss Smith, Thomas, 8th Rept. Ill., 103.)

Order Coleoptera.

4. *Chrysobothris femorata* (Fabr.).

Mesquite (*Prosopis*).

Order Coleoptera.

1. *Chrysobothris octocola* Leconte. (Texas, Arizona, and Colorado River of California; lives in species of Prosopis. Leconte, Rev. of Buprestidæ of U. S. Trans. Am. Phil. Soc., 1859, 230.)
2. *Cyllene antennatus* White. ("Lives in the mesquite wood," Arizona, Horn. Trans. Am. Ent. Soc., viii, 135.)
3. *Bruchus uniformis* Leconte. (Colorado Desert. Abundant in the pods of Prosopis and Strombocarpus. Leconte.)
4. *B. prosopis* Leconte. (Found with the preceding. Leconte.)

Honey locust (*Gleditschia triacanthus*).

Order Lepidoptera.

1. *Heterogenea shurtleffii* Packard. (Shurtleff in Packard's Synopsis of Bombycidæ.)
2. *Anisopteryx vernata* Peck. (Feeding on the leaves in Providence, May and June. Packard.)
3. *Laverna? gleditschiavella* Chamb. Larva burrows in the thorns. (Chambers, *l. c.*)
4. *Helice pallidochrella* Chamb.
5. *Agnippe biscolorella* Chamb. The larvæ of these species no doubt feed *in some way* on this tree. A larva (of one of them?) feeds in the "honey" inside the seed-pods. (Chambers, *l. c.*)

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*Several Tortricid larvæ occurred on the leaves of the horse-chestnut at Salem, Mass., August 20–27, of which the following is a brief description: Pale reddish brown, curiously mottled with pale green, forming much interrupted, very irregularly-edged brown lines. Beneath, grass-green. Head greenish, irregularly speckled with brown. A dark green dorsal line. It spun a cocoon of silk, with very fine bits of leaves woven in.

Order COLEOPTERA.

6. *Bruchus* sp. (Hentz in Harr. Corr., 39.)

Order DIPTERA.

7. *Cecidomyia gleditschiæ* O. Sacken. (Proc. Ent. Soc. Phil., vi, 219, Newport, R. I.)

WILD CHERRY* (*Prunus serotina*).

Order HYMENOPTERA.

1. *Abia cerasi* Fitch.
2. *Crœsus latitarsus* Norton. (Aug. 16, Norton, Trans. Am. Ent. Soc., i, 84.)

Order LEPIDOPTERA.

3. *Papilio turnus* Linn. (Lintner, Contr., iii, 131.)
4. *Smerinthus myops* Harris. (See also Hulst in Bull. Brooklyn Ent. Soc., iii, 99.)
5. *Smerinthus excæcatus* (Smith). (Lintner, iv, 188.)
6. *Hyperchiria io* (Fabr.).
7. *Callosamia promethea* (Drury.)
8. *Samia cynthia* Hübner. (Feeding in freedom. P. E. Nostrand, Bull. Brooklyn Ent. Soc., ii, 77.)
9. *Clisiocampa americana* Harris.
10. *Cerura borealis* Harris. (French, Can. Ent. xiii, 145.)
11. *Catocala ultronia* Guenée. (Florida, Koebele in Bull. Brooklyn Ent. Soc., i, 44.)
12. *Apatela radcliffei* Harvey. (R. Thaxter in Psyche ii, 121.)
13. *Tortrix cerasivorana* Fitch. (N. Y., Fitch; Maine, Packard.)
14. *Lithocolletis cratægella* Clem. (Larva in tentiform mine in under surface of leaves. Chambers, *l. c.*)
15. *Aspidisca splendoriferella* Clem. (Larva in a minute, flat mine in August, and later cuts out a case in which it pupates. Also occurs on *P. coronaria*. Chambers, *l. c.*)
16. *Ornix prunivorella* Chamb. (Larva at first in a tentiform mine in under surface of leaves, at the margin; leaves the mine to pupate. Chambers, *l. c.*)
17. *Coleophora pruniella* Clem. (Imago unknown; the larva lives in a case which it attaches to the leaves. Chambers, *l. c.*)
18. *Nepticula? prunifoliella* Clem. (Insect unknown. Dr. Clemens gave the name to an unknown larva, *possibly* Dipterous, which makes a crooked, linear mine on the upper surface of the leaves. Possibly it is identical with the next species. Chambers, *l. c.*)
19. *Nepticula serotinœella* Chamb. (Larva makes a red, crooked linear mine in the upper surface of the leaves. Chambers, *l. c.*)

*The list of insects affecting the wild cherry and wild red plum, service-berry, and thorns is confessedly very imperfect.

20. *Machimia tentoriferella* Clem. (Imago unknown; the larva lives in a web on the under side of a leaf. Chambers, *l. c.*)

Order DIPTERA.

21. *Cecidomyia serotinæ* O. Sack. (Trans. Amer. Ent. Soc., iii, 346. New York. Osten Sacken.)

Order COLEOPTERA.

22. *Dicerca divaricata* Say. (Harris, etc.)

CHOKE CHERRY (*Prunus virginiana.*)

Order LEPIDOPTERA.

1. *Cœlodasys unicornis* (Sm. Abb.). This interesting caterpillar feeds not only on the hazel, but also the choke cherry, according to Mr. Lintner. It also occurs on the apple and plum. It is to be found in August.
2. *Hyperchiria io* (Fabr.).

Order COLEOPTERA.

3. *Uroplata rosea* Weber. (Harris.)

Order HEMIPTERA.

4. *Aphis cerasifoliæ* Fitch. (June, Sauk City, Wisconsin, Bundy., Thomas 8th Rept., 93.)

RED WILD PLUM (*Prunus americana*).

Order LEPIDOPTERA.

1. *Lithocolletis cratægella* Clem. (Larva as in *Prunus serotina;* also on *P. coronaria.* Chambers, *l. c.*)
2. *Anarsia pruniella* Clem. (Larva feeding in woody excrescences. Chambers, *l. c.*)
3. *Evippe prunifoliella* Chamb. (Larva feeds under the tip of the leaf turned down. Chambers, *l. c.*)
4. *Xylesthia pruniramiella* Clem. (Larva feeds in woody excrescences. Chambers, *l. c.*)

Order COLEOPTERA.

5. *Conotrachelus nenuphar* (Herbst.). (Plum weevil, on wild plum, Canada. Saunders, Rept. Ontario Ent. Soc., 1880.)

Order HEMIPTERA.

6. *Mytilaspis conchiformis* (Gmelin).

JUNE OR SERVICE BERRY (*Amelanchier canadensis*).

Order LEPIDOPTERA.

1. *Ornix quadripunctella* Clem. (Larva in a tentiform mine in the leaves. Chambers, *l. c.*)

2. *Nepticula amelanchierella* Clem. (Larva makes a linear, crooked mine in the leaves; imago unknown. Chambers, *l. c.*)

Order COLEOPTERA.

3. *Saperda bivittata* Say. Apple tree borer.
4. *Uroplata rosea* Weber. (Harris, 120.)

MOUNTAIN ASH (*Pyrus americana.*)

1. *Acronycta occidentalis* G. & Sh.
2. *Chrysobothris femorata* Fabr. (Harris Correspondence, 311.)
3. *Saperda bivittata* Say. Apple tree borer.
4. *Mytilaspis pomicorticis* Riley.

PEAR OR BLACK THORN, HAWTHORN, ETC. (*Cratægus* different species).

Order LEPIDOPTERA.

1. *Papilio turnus* Linn. (Brunswick, Me., Sept. 5; larva.)
2. *Thecla falacer* Godart. (Harris, 276.)
3. *Cœlodasys unicornis* Sm. Abb. (On thornbush at Brunswick, Me., Sept. 5.)
4. A notodontian allied to the foregoing. (Maine, Sept. 5.)
5. *Spilosoma virginica* Fabr. (On buckthorn, middle of September, Maine.)
6. *Orgyia antiqua* (Linn.). (Injuring thorn hedge in Rhode Island. Miss Dix, Amer. Journ. Sc., xix, 1st series. Harris, 369.)
7. *Lithocolletis cratægella* Clem. (Larva and mine as in *P. serotina.* Chambers, *l. c.*)
8. *Aspidisca splendoriferella* Clem. (Larva and mine as in *P. serotina.* Chambers, *l. c.*)
9. *Tischeria malifoliella* Clem. (Larva in a flat, trumpet-shaped, yellowish mine in upper surface of leaves. Chambers, *l. c.*)
10. *Ornix cratægifoliella* Clem. (Larva in tentiform mine on under side of leaves. Chambers, *l. c.*)
11. *Ornix inusitatumella* Chamb. (Larva in white, flat mine, speckled with "frass," in upper surface; pupates in the mine. Chambers, *l. c.*)
12. *Nepticula cratægifoliella* Clem. (Larva in a crooked, linear mine in upper surface of leaves; imago unknown. Chambers, *l. c.*)

Order DIPTERA.

13. *Cecidomyia cratægi-bedeguar* Walsh. (Can. Ent., i, 179; Proc. Ent. Soc. Phil., vi, 266, on *Cratægus tomentosa.* In the same paper Mr. Walsh mentions galls on Cratægus, which he calls *cratægi-plica, limbus* and *globulus*, without giving any further description. Osten Sacken, Cat. Dip.)

Order COLEOPTERA.

14. *Saperda bivittata* Say. On hawthorn.
15. *Conotrachelus cratægi* Walsh. (Proc. Bost. Soc. Nat. Hist., ix, 1863, 311.)
16. *Xylotrechus convergens* Leconte. Bred from branch of an undetermined *Cratægus*, locally known as Red Haw. Iowa. (Leconte, Trans. Amer. Ent. Soc. viii, xxiv.)
17. *Gaurotes cyanipennis* Say. In spring on thorn blossoms and later in the season pairing and ovipositing on butternut. (Caulfield, Can. Ent. 1881, 60.)

Order HEMIPTERA.

18. *Aphis cratægifolii* Fitch. (On leaves of *C. punctata*. Fitch.)
19. *Siphonophora cratægi* Monell. (July, Saint Louis, Monell.)

SWEET GUM (*Liquidambar styraciflua*).

Order LEPIDOPTERA.

1. *Actias luna* (Linn.).
2. *Callosamia promethea* (Drury).
3. *Eacles imperialis* Hübner. (Smith-Abbott.)
4. *Phyllocnistis liquidambarisella* Chamb. (Larva in a long, winding, linear mine in upper surface. Chambers, *l. c.*)

Order COLEOPTERA.

We have found Buprestid and longicorn borers in a dead sweet gum tree at Houston, Texas, in April.

5. *Mytilaspis pomicorticis* Riley?

GUM TREE (*Nyssa multiflora*).

1. *Darapsa chœrilus* (Cram.). (G. D. Hulst, Bull. Brooklyn Ent. Soc. ii, 77.)

PERSIMMON (*Diospyros virginiana.*)

Order LEPIDOPTERA.

1. *Orgyia leucographa* Walker. (Larva described by French, Rep. Curator S. I. Normal Univ., 1880, 44.)
2. *Aspidisca diospyriella* Chamb. (Larva in a minute blotch mine, from which it cuts out a case in which it pupates. Chambers, *l. c.*)

Order HEMIPTERA.

3. *Aphis diospyri* Thomas. (8th Rep., Ill., 5.)

CALIFORNIAN BAY OR LAUREL (*Laurus*).

1. *Ptilinus basalis* Leconte. (Trans. Amer. Ent. Soc. viii, xxiii.)
2. *Micracis hirtella* Leconte.

ASH (*Fraxinus americana, pubescens, sambucifolia, etc.*).

Order LEPIDOPTERA.

1. *Sphinx kalmiæ* Sm.–Abb. (Lintner, Contr. i, 188.)
2. *Sphinx chersis* G. & R. (*cinerea* Harris.) (Proc. Ent. Soc. Phila. iii, 655.)
3. *Sphinx gordius* Cramer. (Black ash.)
4. *Daremma undulosa.* (Black ash, Lintner, Contr. ii, 128.)
5. *Smerinthus geminatus* Say. (Psyche, ii, 72.)
6. *Ægeria denudatum* Harris. (Can. Ent. xiii, 8.)
7. *Callosamia promethea* (Drury.)
8. *Hyperchiria io* (Fabr.).
9. *Halesidota maculata* (Harris). (Corr. 290.)
10. *Clisiocampa sylvatica* Harris. (Can. Ent. ix, 159; Riley, 3d Rt. 126.)
11. *Apatelodes angelica* Grote. (Lintner, Contr. iii, 130.)
12. *Anisopteryx vernata* Peck. (Black ash, John Sears in Packard's Monograph of Geometrid Moths, 404.)

Order COLEOPTERA.

13. *Neoclytus capræa* (Say). (Thomas Ins. Illinois, vi, 151.)
14. *Tylonotus bimaculatus* (Hald.). (Riley in Amer. Ent. iii, 239, also in "tulip poplar.")
15. *Hylesinus opaculus* Leconte. (Riley, Ag. Dept. Rt. 1879, 45.)
16. *Thysanocnemis fraxini* Leconte. (Rhyncophora, 214.)
17. *Hylesinus aculeatus* Say. (Rhyncophora, 379.)

Order HEMIPTERA.

18. *Pemphigus fraxinifolii* Thomas. (On ash, June, Wisconsin, Bundy in Thomas Rt. viii, 146.)

Order DIPTERA.

19. *Cecidomyia pellex* O. Sacken. (Galls on leaves of *Fraxinus americana.*)

SASSAFRAS (*Sassafras officinale*).

Order LEPIDOPTERA.

1. *Papilio troilus* Linn. (Harris Corr., 271.)
2. *Callosamia promethea* (Drury).
3. *Samia cynthia* Hübner. G. D. Hulst, Bull. Brooklyn Ent. Soc. i, 91.)
4. *Hyperchiria io* (Fabr.).
5. *Coscinoptera dominicana* Fabr. (Riley.)
6. *Gracilaria sassafrasella* Chamb. (Larva, when very young, mines the leaves ; when older, rolls them downwards. Chambers, *l. c.*)

SYCAMORE (*Platanus occidentalis*).

Order COLEOPTERA.

1. *Cyllene crinicornis* Chevr. On Platanus in Texas, Dr. Brous. (Leconte in Trans. Amer. Ent. Soc. viii, xxiv.)

Order LEPIDOPTERA.

2. *Eacles imperialis* Hübner.
3. *Halesidota tessellaris* (Sm.-Abb.).
4. *Anchylopera platanana* Clemens.
5. *Ianthaphe platanella* Clemens.
6. *Nepticula platea* Clem.
7. *Nepticula maximella* Chamb.
8. *Nepticula clemensella* Chamb. (Larva of these three species in the upper surfaces of the leaves. See Can. Ent., v, 125. Chambers.)
9. *Cirrha platanella* Chamb. (Larva feeds on the under side of the leaves, and pupates in a tube composed of silk and the down from the leaves. Chambers.)

HAZEL (*Corylus americana*).

Order LEPIDOPTERA.

1. *Apatela brumosa* Guenée. (August, Ill., Coquillet, "Papilio," i, 56.)
2. *Zerene catenaria* (Drury.) (July, Aug., Ill., Coquillet, "Papilio," i, 56.)
3. *Lithocolletis coryliella* Chamb. Larva in a nearly circular blotch mine in the upper surface.
4. *Nepticula corylifoliella* Clem. Imago unknown. Larva in a linear, crooked mine in the upper surface.
5. *Gelechia coryliella* Chamb. Imago unknown. Larva in the male catkins in autumn.
6. *Hyale coryliella* Chamb. (Larva in a web on under surface of the leaves. Chambers, *l. c.*)

Order COLEOPTERA.

7. *Balaninus nasicus* Say. (Eating the nuts. Harris, 74.)
8. *Attelabus rhois* Boh? Rolls attached to the drier leaves like those of *A. rhois* on the alder.

HORNBEAM, IRONWOOD (*Ostrya virginica*).

Order LEPIDOPTERA.

1. *Smerinthus juglandis* Sm. Ab. (Taken fully grown Sept. 5, N. Y. Lintner.)
2. *Lithocolletis obscuricostella* Clem.
3. *Lithocolletis ostryæfoliella* Clem. (Larvæ of both species in tentiform mines in under side of leaves. Chambers, *l. c.*)
4. *Lithocolletis coryliella* Chamb.
5. *Lithocolletis tritæniaella* Chamb. (Larva in roundish blotch mine in upper surface of the leaves.)
6. *Æœa ostryæella* Chamb. (Larva in a flat mine between two ribs, with a row of "frass" on each side. Chambers, *l. c.*)
7. *Aspidisca ostryæfoliella* Clem. (Imago unknown. Larva in a minute blotch mine in upper surface of leaves, from which it cuts out its pupal case. Chambers, *l. c.*)

8. *Nepticula ostryæfoliella* Clem.
9. *Nepticula virginiella* Clem. (Imago of both species unknown. Larvæ make linear, crooked mines in upper surface of leaves. Chambers, *l. c.*)
10. *Gracilaria ostryæella* Chamb. (Imago unknown. The larvæ when very small makes a linear, whitish mine in the upper surface of the leaves. Chambers, *l. c.*)
11. *Coleophora ostryæ* Clem. (Imago unknown. The larva lives in a case and feeds on the under surface of the leaves. Chambers, *l. c.*)

Order HEMIPTERA.

12. *Psylla carpini* Fitch.

WATER BEECH, HORNBEAM (*Carpinus americana*).

Order LEPIDOPTERA.

1. *Lithocolletis coryliella* Chamb.

Order DIPTERA.

2. *Cecidomyia pudibunda* O. Sacken. (On the leaves, District of Columbia. O. Sacken.)

ALDER (*Alnus serrulata, etc.*).

Order HYMENOPTERA.

1. *Nematus* sp. (A rather large, dirty yellowish false-caterpillar, in clusters on the leaves. Brunswick, Me., Packard.)

Order LEPIDOPTERA.

2. *Eacles imperialis* Hübner. (G. D. Hulst, Bull. Brooklyn Ent. Soc., ii, 77.)
3. *Acronycta* sp. (Common on the leaves in August and September. Maine, Packard.)
4. *Acronycta acericola* Guenée. (Feeds on birch and alder. Riley, Rt. ii, 121.)
5. *Lithocolletis alnivorella* Chamb.
6. *Lithocolletis alnifoliella* Hübner.
7. *Lithocolletis auronitens* Frey and Boll. (The larvæ of these three species live in tentiform mines in the under side of the leaves. Chambers, *l. c.*)
8. *Gracilaria alnicolella* Chamb.
   Gracilaria alnivorella Chamb. (When very young the larvæ of these two species mine the leaves; when older, they roll them downward; *alnicolella* from the tip, *alnivorella* from the side. Chambers, *l. c.*)
9. *Lyonetia alniella* Chamb. (The larva makes a large, brownish blotch mine in the leaves. Chambers, *l. c.*)

Order DIPTERA.

10. *Cecidomyia serrulatæ* O. Sacken. (District of Columbia, on *Alnus serrulatæ*. O. Sacken. Monogr., i, 198.)

Order COLEOPTERA.

11. *Dichelonycha elongatula* (Schönhen). (*In coitu*, June 10, Brunswick, Me. Packard.)
12. *Calligrapha scalaris* Leconte. (Maine, Packard.)
13. *Attelabus rhois* Boh. (Rolling up the leaves into cylinders in June and July, depositing an egg in the center. Orono, Me., Packard. Memoirs Peabody Academy of Science, Salem, iii, 1872, 7.)
14. *Saperda* (Mecas) *inornata* Say. (Making temporary galls in saplings of *Salix longifolia*.)
15. *Saperda lateralis* Fabricius. (Mr. George Hunt has found this beetle attacking the alder in Rhode Island.)
16. *Pogonocherus mixtus* Hald. Abundant. (Can. Ent., iii, 1881, 60.)

Order HEMIPTERA.

17. *Lachnus alnifoliæ* Fitch.
18. *Schizoneura tessellata* Fitch. (Alder blight. Common in Maine.)

WILLOW (*Salix* various species).

Order HYMENOPTERA.

The following list of saw-fly larvæ, producing galls on different species of willow, is taken from Walsh, Proceedings of the Entomological Society of Philadelphia, v, 284.

1. *Euura orbitalis* Norton. (Galls on *Salix humilis* Walsh.)
2. *Euura S. gemma* Walsh. (On *Salix humilis*.)
3. *Euura S. ovum* Walsh. (On *Salix cordata*.)
4. *Euura S. ovulum* Walsh. (On *Salix humilis*.)
5. *Euura S. nodus* Walsh. (On *Salix longifolia*.)
6. *Nematus S. pomum* Walsh. (On *Salix cordata* and very early on *S. discolor*.)
7. *Nematus S. desmodioides* Walsh. (On *Salix humilis*.)
8. *Nematus S. pisum* Walsh. (On *Salix discolor*.)
9. *Nematus inquilinus* Walsh. (Guest, bred from Cecidomyidous gall *S. rhodoides*.)
10. *Nematus hospes* Walsh. (Guest, bred from Cecidomyidous gall *S. rhodoides*.)
11. *Nematus mendicus*. (Guest, bred from gall of *N. s. pomum*.)
12. *Nematus fur* Walsh. (Guest, bred from gall of *C. s. batatas* on *Salix humilis*.)
13. *Pristiphora sycophanta* Walsh. (Guest, in gall of *C. s. brassicoides*.)

Order LEPIDOPTERA.

14. *Vanessa antiopa* (Linn). (Brunswick, Me., June; Providence, June, Packard.)
15. *Limenitis misippus* Fabr. (Lintner, Contr., ii, 166.)
16. *Apatelodes torrefacta* Sm. Ab. (Eats willow leaves. Harris, Corr., 307.)
17. *Notodonta dictæa* (Linn). (September, N. Y., Lintner, Contr., iv, 76.)
18. *Smerinthus geminatus* Say. (Psyche ii, 72.)
19. *Smerinthus excæcatus* Harris. (Can. Ent. x, 16.)
20. *Actias luna* (Linn).
21. *Samia cynthia* (Linn). "Feeding voluntarily in freedom." P. E. Nostrand (Bull. Brooklyn Ent. Soc., ii, 77.)
22. *Eacles imperialis* Hübner. G. D. Hulst (Bull. Brooklyn Ent. Soc., ii, 77.)
23. *Hyperchiria io* (Fabr.).
24. *Pheosia rimosa* Packard. Larva on willow. (F. Tepper in Bull. Brooklyn Ent. Soc., ii, 3.)
25. *Cerura borealis* (Boisd.). (August and September, N. Y., Lintner, Contr., iii, 151.)
26. *Cerura multiscripta* Riley. (F. Tepper in Bull. Brooklyn Ent. Soc., i, 4.)
27. *Cerura occidentalis.* (Larva described by French, Can. Ent., xiii, 144.)
28. *Euchronia maia* (Fabr.). (Wescott, Can. Ent., 1877, 220.)
29. *Xyleutes robiniæ* Harris. (Kellicott, Bull. Buffalo Soc. Sc. iv, 30, 1881.)
30. *Acronycta americana* Harris MS. (Trouvelet, Lintner, Contr., iii, 136.)
31. *Acronycta salicis* Harris. (August, Harris, Corr., 315.)
32. *Scoliopteryx libatrix* (Linn). (Lintner, Contr., iii, 164; Illinois, Aug. Coquillet.)
33. *Catocala parta* Guen. (Lintner, Contr., iii, 164.)
34. *Catocala concumbens* Walker. (Saunders, Proc. Amer. Ent. Soc., ii, 29.)
35. *Homoptera salicis* Behr. (On willows in California. Behr. W. A. E. Soc., iii, 28.)
36. *Metrocampa perlaria* Guenée. (Saunders, Can. Ent., iii, 226.)
37. *Hydria undulata* (Hübner). (In Europe feeds on the willow; not yet observed in United States.)
38. *Cymatophora pampinaria* Guenée. (Larva noticed, French in "Papilio," i, 82.)
39. *Grapholitha gallæsaliciana* Riley. (Trans. St. Louis Acad. Sc., iv, 320. "Bred from galls on willow twigs." Riley.)
40. *Lithocolletis salicifoliella* Chamb. (and Clem?). (Larva in a tentiform mine in the under surface of leaves. Chambers, *l. c.*)
41. *Gracilaria salicifoliella* Chamb. (Larva in a blotch mine in upper surface of the leaves. Chambers, *l. c.*)

42. *Gracilaria purpurilla* Chamb. (Larva rolls the leaves from the tip.)
43. *Cemiostoma albella* Chamb. (Larvæ in large blackish blotch mines. Chambers, *l. c.*)
44. *Aspidisca saliciella* Clem. and Chamb. (Larva in a minute blotch mine, from which it cuts out its pupal case. Chambers, *l. c.*)
45. *Nepticula fuscotibiella* Clem. (Larva in a linear mine bent back in itself. Chambers, *l. c.*)
46, 47. *Nepticula*. Two unknown species make narrow, linear, crooked mines, one of which is in the upper and the other in the lower surface of the leaves. (Chambers, *l. c.*)
48. *Marmara salictella* Clem. Larva burrows in young twigs. (Chambers, *l. c.*)
49. *Batrachedra præangusta* (Haworth.)
50. *Batrachedra salicipomonella* Clem.
51. *Batrachedra striolata* Zeller. (The specific distinctness of these three species seems to me not sufficiently established. *B. salicipomonella* was bred from galls made by other insects on willows. The mode of feeding of the others is not satisfactorily determined. Chambers, *l. c.*)
52. *Gelechia salicifungella* Clem.
53. *Gelechia fungivorella* Clem. (Larvæ of these two species in galls made by Cynips. Chambers, *l. c.*)
54. *Gelechia* sp.? Imago unknown. The larva sews together willow leaves at great elevations in the Rocky Mountains.

Order Diptera.

The following gall-flies occur on the willow, according to Walsh, who gives a synopsis of cecidomyidous galls of the genus Salix in Proceedings of the Entomological Society of Philadelphia, iii, p. 575.

55. *Cecidomyia S. brassicoides* Walsh. (On *Salix longifolia.*)
56. *Cecidomyia S. strobiloides* Osten Sacken. (On *S. cordata.*)
57. *Cecidomyia S. strobiliscus* Walsh. (On *S. rostrata* and *S. discolor.*)
58. *Cecidomyia S. gnaphalioides* Walsh. (On *S. humilis* and *S. discolor.*)
59. *Cecidomyia S. rhodoides* Walsh. (On *S. humilis.*)
60. *Cecidomyia S. coryloides* Walsh. (On *S. discolor?* and *S. discolor.*)
61. *Cecidomyia S. cornu* Walsh. (On *S. humilis.*)
62. *Cecidomyia S. siliqua* Walsh. (On *S. humilis*, *S. cordata?*, and *S. discolor.*)
63. *Cecidomyia S. nodulus* Walsh. (On *S. longifolia.*)
64. *Cecidomyia S. triticoides* Walsh. (On *S. cordata.*)
65. *Cecidomyia S. hordeoides* Walsh. (On *S. humilis.*)
66. *Cecidomyia S. batatas* Walsh. (On *S. humilis*, *S. cordata?*, and *S. discolor?*)
67. *Cecidomyia S. verruca* Walsh. (On *S. humilis* and *S. discolor.*)

Guest or inquiline galls.

68. *Cecidomyia albovittata* Walsh. (On galls of *C. s. strobiloides* and *s. strobiliscus.*)
69. *Cecidomyia orbitalis* Walsh. (On galls of *C. s. batatas* and *Tenthredinidous*, gall *s. ovulum.*)
70. *C. cornuta* Walsh. (In willow stems bearing galls of *C. s. brassicoides.*)
71. *Diplosis atrocularis* Walsh. (In gall of *C. s. strobiloides.*)
72. *Diplosis atricornis* Walsh. (In gall of *C. s. strobiloides.*)
73. *Diplosis annulipes* Walsh. (In gall of *C. s. strobiloides.*)
74. *Diplosis septem-maculata* Walsh. In gall of *C. s. brassicoides* and *C. q. ficus.*)
75. *Diplosis decem-maculata* Walsh. (In gall of *C. s. strobiloides.*)
76. *Lonchæa?* (Raising blisters on twigs of willow. Figured and described in Packard's Guide to Study of Insects, 412.)

Order COLEOPTERA.

77. *Cotalpa lanigera* (Linn). (Brunswick, Me., June 23, Packard.)
78. *Hoplia trifasciata* Say. (Brunswick, Me., June 23, Packard.)
79. *Dichelonycha elongatula* Schönh. (Brunswick, Me., June 23, Packard.)
80. *Buprestis fasciata* Fabricius. (Mr. George Hunt informs us that he has found an elytron of this beautiful beetle under the bark of the willow in Northern New York in July. We have taken it in Northern Maine, and have always supposed that it inhabited the pine.)
81. *Chrysomela bigsbyana* Kirby. (Brunswick, Me., June 23, Packard.)
82. *Chrysomela spiræ* Say. (Brunswick, Me., June 23, Packard.)
83. *Phyllodecta vulgatissima* (Linn). (Brunswick, Me., June 23, Packard.)
84. *Galerucella sagittariæ* Gyllenhal. (Brunswick, Me., June 23, Packard.)
85. *Plectrodera scalator* (Fabr.). (On small swamp willows in August. Can. Ent., xii, 107.)
86. *Pachybrachys livens* Leconte. (Colorado River, California, on Salix, Leconte, *l. c.*, p. 84.)
87. *Rhynchites æratus* Say. (Brunswick, Me., June, Packard.)
88. *Rhyncolus angularis* Leconte. (Under willow bark at New River, Colorado Desert. Leconte, Proc. Acad. Nat. Sci. Phila., March, 1858, p. 81.)

Order HEMIPTERA.

89. *Tingis hyalina.* (Maine, Packard.)
90. *Capsus* sp. (Also on alders. Maine, Packard.)
91. *Evacanthus orbitalis* Fitch. (Brunswick, Me., July 22, Packard.)
92. *Bythoscopus* sp. (Brunswick, Me., July 22, Packard.)
93. *Chaitophorus salicicola* Monell. (Is it Lachnus salicicola Uhler? Thomas, 8th Rep., 105.)

94. *Chaitophorus viminalis* Thomas. (On young twigs and leaves of *Salix lucida* and *S. babylonica*. Thomas, 8th Rep., 200.)
95. *Lachnus salicicola* Uhler. (*Aphis salicti* Harris. Thomas, 8th Rep., 113.)
96. *Lachnus salicetis* Fitch. (Thomas, 8th Rep., 119.)
97. *Rhopalosiphum salicis* Monell. (On under side of leaves of *Salix lucida*, *S. nigra*, and *S. babylonica*. Monell.)

ACARINA.

98. *Acarus? semen* Walsh. (Producing galls on *Salix nigra* Walsh, Phila. Entomol. Soc., Phila., v.)
99. *Acarus? ænigma* Walsh. (Producing galls on *Salix nigra* Walsh, Phila. Entomol. Soc., Phila., v.)

INSECTS INJURIOUS TO THE PINE.

Pinus strobus, P. rigida, etc.

AFFECTING THE TRUNK.

1. THE LARGE PINE FLAT-HEADED BORER.

Chalcophora virginiensis (Drury).

Order COLEOPTERA; family BUPRESTIDÆ.

Boring in the sap-wood and girdling the tree, a flat-headed, white grub; the track beginning as narrow and shallow grooves on the surface of the wood, forming irregular wavy or serpentine tracks, which gradually increase in width as the larva grows, ending in a large hole where the grub pupates; the beetle occurring on the leaves in spring and autumn.

The habits of this beetle in its preparatory stages are probably much like those of *Chrysobothris femorata*, which infests the oak, and the galleries which it makes under the bark are much like those of the oak buprestid. No thorough observations have been made upon the natural history of this beetle. It appears in the Northern States toward the end of May, and through the month of June, as Harris states, while we have observed it in Maine on pine trees the middle of July, and Fitch states that they occur upon the leaves of the pine in autumn. Harris says that in the larva state it bores into the trunks of the different kinds of pines, and is oftentimes very injurious to these trees.

The beetle.—Oblong oval, brassy or copper-colored, sometimes almost black, with hardly any metallic reflections. The upper side of the body is roughly punctured; the top of the head is deeply indented; on the thorax are three polished, black elevated lines; on each wing-cover are two small square impressed spots, a long elevated smooth black line near the outer, and another near the inner margin, with several short lines of the same kind between them; under side of the body sparingly covered with short, whitish down. Length 0.8 to 1.10 inch. (Harris.)

2. The liberated buprestis.

Chalcophora liberta Germar.

Very similar to the Virginian Buprestis, but always smaller sized, measuring from 0.75 to 0.90 in length, with the second raised line of the wing-covers broader than the first or inner line, and totally obliterated where it is crossed by the posterior impressed spot, its middle portion between the two impressed spots usually showing a few scattered punctures. (Fitch.)

This species is much more common in Eastern New York than the Virginian Buprestis, the beetle appearing upon the leaves of pines throughout the summer and autumn. From a small grove of young pines only a few rods in extent, upwards of a hundred specimens were taken the middle of last September, one or two being found upon almost every tree and bush; whilst only four individuals of the preceding and two of the following species were found in company with them. They had probably been bred in the numerous stumps of larger trees which had been cut down the year before by the side of this grove. They stationed themselves at the tips of the limbs, clinging to the leaves with their feet, with their heads inwards, their position, shape, and size giving them a close resemblance to the young aments or fruit cones which were growing from the same points on several of the limbs; and they appeared to be eating the young buds, which are probably the food on which all these beetles subsist after arriving at their perfect state. (Fitch.) This Buprestid is also found in Maine, but after several years' attempts we have not been able to clear up the habits of either species of *Chalcophora*, or to detect the larvæ.

3. The oregon buprestis.

Chalcophora angulicollis Leconte.

A beetle intimately related to the preceding species I met with in a collection of insects made at The Dalles, on Columbia River, many years since, by Rev. George Gary, of the Methodist Episcopal Church, and presented to me by the late Dr. Skilton, of Troy. Its close relationship to the species above described renders it altogether probable that its larva is similarly pernicious to the pine timber of the region where it abounds. And as no insect of this genus has hitherto been recorded as an inhabitant of that vicinity, that I am able to discover, I herewith submit a short account of its distinctive marks. (Fitch.)

The beetle slightly exceeds an inch in length, with the elevated smooth lines and spots, black and for the most part broader than the rough intervals between them, which are burnished brassy, tinged with coppery red. Its sculpture is very similar to that of the species last described above. The elevated line on the middle of the thorax is here twice as broad as in that species and at each end is rapidly, but not abruptly widened to double the breadth which it has in the remainder of its length, these widened portions having a few scattered punctures. Both at the apex and the base this widened portion is confluent with the irregular elevated stripes which are placed upon each side of the middle. The smooth pyramidal spots on the base oppo-

site the middle of the anterior end of each wing-cover are here larger and more prominent than in either of the foregoing species and each of these spots has the shape of a right-angled triangle, the line bounding its outer side running directly forward instead of obliquely inward and forward, each spot being also more broad than long. The rough depression which extends forward from these spots to the anterior angles of the thorax has in its middle a well marked, elevated, smooth spot, which is oblong and placed obliquely, with an oblique groove on its outer side separating it from a smooth and somewhat triangular spot on the outer margin, which is more distinct in this than in either of the preceding species, and produces a slight undulation of the outer edge, this edge being almost rectilinear with the opposite sides, parallel with each other two-thirds of their length, and then abruptly or angularly inclining inwards to the anterior angles. The wing covers have the elevated lines much broken and irregular, resembling those of the preceding species, though on a particular examination several differences will be noticed. (Fitch.)

This insect has also been found by Dr. Leconte, at Sacramento, Cal.

4. The tooth-legged buprestid.

Chrysobothris dentipes (Germar).

Though usually occurring in oak trees, occasionally living under the bark of the white pine, where it makes a flat, shallow burrow, sometimes half an inch broad and ending in an oval cell, in which the larva occurs in autumn, winter, and early spring.

We have already noticed this Buprestid among oak borers. We have found, May 20, at Providence, R. I., the dead beetle in its burrow under the bark of a white pine stump.

5. Harris's buprestis.

Chrysobothris Harrisii Hentz.

Order Coleoptera; family Buprestidæ.

Appearing on the trees in May and becoming most common about the middle of June, a small beetle 0.32 long, of a brilliant blue-green color with black antennæ and feet, and in the male the sides of the thorax and the thighs copper-colored, its surface punctured, with a groove on the middle of the thorax and two indentations near the base of each wing-cover, slightly separated by a raised line, the inner one running into a groove which extends along the suture to its tip. Its larva living under the bark of young trees and small limbs. (Fitch.)

According to Leconte this beetle inhabits the twigs of the white pine. Mr. George Hunt also informs us that it inhabits the white pine in Rhode Island, where he has collected it late in June and during July.

6. *Chrysobothris trinervia* Kirby.

As this beetle occurs in the pine forests of Colorado, it is most probable that it bores in pine trees. It is a rather small, short, broad species, dull blackish, with faint metallic reflections. Surface of the body, especially the wing-covers, with irregular ridges, the inner one parallel to the inner edge of the wing-cover; wing-covers with smooth, elevated areas, between which the surface is minutely pitted with dense golden punctures. Body clothed beneath with short, coarse hairs. Length, 0.45 inch. (Leconte.) We collected a specimen on the Divide, Colorado, July 12. Prof. F. H. Snow has taken it at Santa Fé, N. Mex.

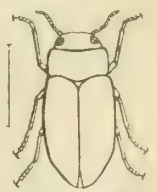

Fig. 64.—*Chrysobothris trinervia*. Colorado.—From Packard.

7. The golden buprestis.

Buprestis striata (Fabr.).

Order Coleoptera; family Buprestidæ.

Appearing upon pine and spruce trees in May and June, a brilliant and sparkling copper-red beetle, 0.55 to 0.70 long, its wing-covers marked with a broad brilliant bluish-green stripe on each and with four elevated smooth lines in which are several deep punctures, the two outer lines nearly or quite united at their hind ends and the exterior middle one a fourth shorter, the depressed spaces between these lines twice as wide as the lines and rough from coarse confluent punctures; its thorax with a wide shallow groove along the middle, which is sometimes very slight, the surface covered with coarse punctures which become dense and confluent along the sides, as they are upon the head also, which has a slender elevated line along its middle; the under side brilliant coppery. (Fitch.)

Like most of the other insect borers in the pine, it appears to be the dead wood of logs and stumps which this species prefers to living trees. T. B. Ashton informs me that he once found the fragments of one of these beetles in the interior of a pine log. I have met with it, in two instances, stationed at the tips of the limbs of young spruce trees in my yard, and it is probable that in its perfect state it feeds upon the tender young buds of the pine and the spruce. (Fitch.)

Mr. George Hunt tells us that it occurs on the white pine and yellow pine (*P. rigida*) in Northern New York.

Leconte states that it inhabits the Middle States, Canada, and the Lake Superior region. It varies in brilliancy of color; the male is narrower than the female, and has the tip of the abdomen more distinctly truncate, or, rather, more broadly rounded.

Allied to this species is *Buprestis lauta* (Leconte), which is abundant in Washington Territory and Oregon; while we have received it from Utah, through Mr. J. L. Barfoot, curator of the Salt Lake Museum. It has also been detected by Prof. F. H. Snow at Santa Fé, N. Mex. The male is a little narrower, says Leconte, than the female, but the tip of the abdomen is somewhat truncate in both.

Buprestis radians (Leconte) also inhabits Oregon. It is shaped like the male of *B. lauta*, but may be known by the very hairy front and prosternum. The tip of the abdomen is somewhat truncate.

Nearly allied to the two last named is *B. adjecta* (Leconte) from Oregon. It is said by Leconte to be broader even than the female of *B. lauta*, with intermediate elevated ridges on the elytra; the tip of the latter is distinctly bidentate, while the abdomen is less strongly punctured and scarcely truncate.

8. The ultramarine buprestis.

Buprestis ultramarina Say.

This species has been found by Fitch in the middle of July in a forest of pines and other trees, and is probably a pine insect. It is said by Leconte to be a broader form than *B. decora* Fabricius, to which it is

allied, with the intervals of the elytra less irregularly punctured, especially towards the suture, with the tips rounded, or hardly truncate, not bidentate as in that species. The abdomen is broadly rounded at the apex. The following description is quoted from Fitch's Fourth Report:

The Ultramarine Buprestis is half an inch long and of a brilliant green color tinged with golden yellow, the sides of the thorax being pure golden, with also a stripe along the middle where is a very slight wide groove, scarcely obvious. The wing-covers are brilliant blue, which color is margined on each side and at the base with golden yellow tinged with green, the suture and outer margin being burnished coppery red. On each wing-cover are about eight rows of large deep punctures placed closely together, and some of them united or confluent, and between each of these rows is a series of smaller round punctures. Their tips are cut off transversely, and on the side next to the suture is a minute projecting tooth. The scutel is circular, deeply concave, and green, with its sides blue. The thorax is covered with close, deep, coarse punctures, which are more dense and confluent on each side. The head is rough from similar confluent punctures, with a slender, smooth elevated line in its middle. The antennæ are black with the basal joints coppery red. The under side is burnished coppery with the sutures of the abdomen green. (Fitch.)

9. Spotted-winged Buprestis.

Buprestis lineata Fabricius.

A shining brassy-black beetle, sometimes blue-black or dark bottle-green, of the same shape with the preceding and 0.45 to 0.65 long, each wing-cover with from three to six pale tawny yellow spots of irregular shape and very variable, the mouth and throat often and sometimes the face of same color, and also a spot on each side of the last segment of the abdomen beneath, the wing-covers with several impressed lines and a row of punctures on each of the interstices between them, the thorax with coarser close punctures and a single large one on the middle of its hind edge. (Fitch.)

I have met with this beetle, in July, on pines growing at a distance from any other trees, an evidence that it had been bred from them. The spots on its wing-covers are extremely variable, being alike in no two specimens.

The more usual form is slightly larger, measuring 0.60 to 0.75 in length, and the wing-covers with two tawny orange stripes on each, the inner one of which is widest at its base and does not reach to the tip. Here also the last segment of the abdomen, beneath, has a tawny orange spot on each side, and the throat, mouth, and face, and a stripe on each side of the thorax are yellow, varied in places with red. (Fitch.) It occurs not infrequently in the Middle and Southern States according to Leconte. I have found, in company with Mr. Calder, the elytra of this beetle under the bark of the white and pitch pine, in Providence, R. I.

10. *Buprestis rusticorum* Kirby.

This is an abundant insect in the pine woods of Oregon and Washington Territory, and appears to range eastward into British America. We have found it in pine woods at Manitou, Colorado, July 16th, while it is not uncommon in New England, Mr. George Hunt finding it at

Providence, R. I. The body is brown, with an olive-green tint. Head and thorax punctured. Each wing-cover with five ridges, four of them well marked and smooth, the interspaces with scattered punctures. On the head between the eyes are five yellow spots; two simple dots, two long spots on the orbits, sending two projections outward, and a line in front sends three projections upwards. Two unequal yellow spots under the eyes. Labrum and labium yellow. Fine orange-yellow spots on each side of the end of the abdomen beneath. Length 0.65 to 0.92 inch. Leconte also adds that this species is nearly allied to *Buprestis maculiventris*, which occurs in the northeast from Pennsylvania to Newfoundland.

FIG. 65.—*Buprestis rusticorum*, Colorado.—From Packard.

11. YELLOW-DOTTED BUPRESTIS.

Melanophila fulvoguttata (Harris).

Appearing upon pines in June, a more flattened beetle than the foregoing, 0.30 to 0.43 long, of a brassy black color with three pale yellow dots on each wing-cover placed towards the hind part and equidistant from each other, the hindmost ones nearest to the suture and the middle ones farthest from it; the fore ends of the wing-covers moderately rounded and fitting into corresponding concavities in the base of the thorax; the whole surface covered with shallow rough punctures running together transversely and somewhat resembling the grained side of morocco leather, and the thorax having an indentation on the middle of its base like the impression of the head of a pin. (Harris's Treatise, p. 44.)

12. DRUMMOND'S BUPRESTIS.

Melanophila drummondi Kirby.

This species, with *Buprestis rusticorum*, *Chrysobothris trinervia*, and *Dicerca prolongata*, we have collected in the pine timber of the mountains of Utah, in the American Fork Cañon, late in July, and it is probable that all will be found to inhabit the trunks of coniferous trees. It also inhabits Oregon and Washington Territory as well as Alaska and New Mexico, (Santa Fé, Snow.) Leconte describes it as being densely punctured, shagreened, with shining, metallic colors, especially on the prothorax, with three bright yellow spots on the posterior two-thirds of each wing-cover, the anterior spot being the larger. Length 0.40 inch.

FIG. 66.—Drummond's *Melanophila*, Colorado.—From Packard.

13. THE PITTED BUPRESTIS.

Dicerca punctulata Schonherr.

Occurring mostly upon the pitch pine (*Pinus rigida*); an obscure coppery or black beetle, half an inch long, convex above with the tips of

its wing covers tapering, and this narrowed portion more lengthened than in any of the foregoing species, their surface occupied with close fine punctures and double rows of coarse ones, the narrow spaces between these rows often elevated in places, the elevations forming smooth oblong spots or irregularly interrupted ribs; the thorax with coarser confluent punctures and with four elevated smooth stripes, the outer ones narrower and interrupted by a slight depression in the surface back of their middle; and finally, a smooth transverse elevation upon its front, extending from one eye to the other, is a mark whereby this species may be readily distinguished from most of those related to it. (Fitch.) I have found a dead beetle under the bark of the pitch pine in the same stump with *Buprestis lineata* in May, 1881, at Providence, R. I.

14. The tuberculated buprestis.

Dicerca tuberculata Laporte.

Another beetle which is met with upon the pitch pine, and resembles an individual of the preceding species of a more brassy tint and having all its marks more coarse, rough, and irregular; but the rows of coarse punctures on its wing-covers are at equal distances from each other instead of being in pairs, the intervening spaces having many irregular elevated black polished spots, and the elevated transverse line upon the front is interrupted and less prominent, and its size is rather larger, being about 0.60 inch long. (Fitch.)

15. The slender dicerca.

Dicerca prolongata Leconte.

Although originally recorded by Leconte from Lake Superior, Wisconsin, and Nebraska, we have found this Buprestid among the pines and poplars in the mountains of Colorado, and are disposed to regard it as a pine beetle, though our specimen was found on a poplar tree.

Fig. 67.—*Dicerca prolongata*, Colorado. From Packard.

It is described by Leconte as being coppery gray, often pruinose; the width of the thorax twice its length, sides well rounded in front, behind somewhat sinuous, punctate, furrowed, each side with an oblique, deeply impressed line; wing-covers with deeply impressed lines; apex rounded, the wing-covers scarcely divaricate. Length 0.77 to 0.85 inch.

16. The pine dicerca.

Dicerca tenebrosa Kirby.

Mining under the bark of the white pine, the beetle occurring in October. (G. Hunt.)

Leconte describes this beetle as follows: ashy-bronze or obscurely bronze, the prothorax dilated on the sides, which are rounded in front, sinuous behind, coarsely punctured; behind broadly excavated on each

side, with apical and basal shining smooth rugosities; a definite dorsal deep furrow with smooth sides, somewhat interrupted in the middle; elytra densely punctured, with alternate oblong, raised, shining interstitial spaces, prolonged entire to the apex; length, 0.57 to 0.75 inch. Male with the pectus broadly sulcate, villose; the intermediate tibiæ armed with an internal acute tooth; the last ventral segment truncate-emarginate. Female with the pectus smoother, less sulcate; the last ventral segment tridentate; the intermediate tooth obtuse, defined by minute incisions.

Abundant at Lake Superior; according to Kirby found in latitude 65° and in the Rocky Mountains. In addition to the characters given above, Leconte adds that the under surface is copper-colored, coarsely and densely punctured on the sides, abdomen and prosternum, less densely on the metasternum and middle of the first segment of the abdomen; the divided portions of the mesosternum are coarsely and tolerably densely punctured. The outer costæ of the thorax are interrupted so as to form on each side an apical and basal callosity. A female from Newfoundland differs by the epipleuræ being green, the under surface of the prolonged extremity of the elytra blue, and by the incisures between the anal teeth being more widely separated. (Leconte.)

Mr. George Hunt has found this beetle under the bark of the white pine in the Adirondack Mountains, New York, in October.

17. The common longicorn pine-borer.

Monohammus confusor Kirby.

Order Coleoptera; family Cerambycidæ.

Boring a hole, in outline round and regular, deep in the wood of sound, though usually in decaying, trees, and doing much injury to pine timber; a large, soft, white, fleshy, nearly cylindrical grub, the segment next the head larger than the others, flattened, horny and inclined obliquely downward and forward, the succeeding rings very short, with a transverse oval rough space on the middle above and below, pupating inside in the wood, the beetle emerging from a round hole half an inch in diameter; the beetle one of our largest longicorns, with very long antennæ; the body brownish-gray, the wing-covers spotted with black and white; length 1.20 inch.

Nothing was known of the habits of this borer by Harris, in the third edition of whose treatise the beetle is well figured. In 1860, Dr. Fitch gave an excellent account of the habits, and a brief description of the larva and pupa and adult, in his Fourth Report on the Noxious Insects of New York. The following description of the larva and pupa is based on specimens obtained at Brunswick, Me., and compared with some received from Mr. F. C. Bowditch, who published in the *American Naturalist*, August, 1873 (p. 498), an account of the habits and transformations. He sent me a block of pine wood split off, containing the terminal portion of the cell, stuffed with large chips arranged quite regularly. In the museum of the Peabody Academy of Science, at Salem, is a piece of planed plank, which had been sawn so as to uncover part

of the hole, with the beetle within, as seen in Fig. 69. Fitch states that this and *Monohammus scutellatus* and *marmoratus* are the most common and pernicious borers which occur in the pine timber of New York. On a still summer's night as well as in the day-time the peculiar grating or crunching noise which the larvæ make in gnawing the wood may be distinctly heard at a distance of eight or ten rods. "That the insect does not open a passage out of the wood, whereby to make its exit, until it attains its perfect state, I infer from the fact that several of these beetles gnawed their way out of one of the pillars of the portico of a newly built house in my neighborhood some years since, the noise being heard several days before they emerged, and while they were still some distance in the interior of the wood." (Fitch.)

Mr. Bowditch found, June 9, at Brookline, Mass., this species in *Pinus mitis*, the yellow pine, in which were several holes about the size of a pencil. He makes the following statement in regard to its habits:

> On removing the bark I found an adult insect already free—the heads of several others appearing through the wood. On further investigation during the next few weeks I obtained from the tree no less than eighty of these beetles in all stages of development, which, considering the size of the tree, was a large number. I observed that the largest beetles were near the foot of the tree. * * * After remaining in the pupa state during a space of time, which varies according to circumstances, it is transformed to a beetle, and after a short time gnaws its way out, appearing from the first of June to the middle of July.

I have found numbers, at least twenty of these larvæ under the bark of the white pine (*Pinus strobus*), at Brunswick, Me.,* in the early part of June, but no pupæ or beetles, though most of the larvæ were fully grown. Some were one half an inch long and had, without much doubt, hatched from eggs laid in the preceding June or July, so that the larvæ must live nearly two years before transforming. My attention was called to their presence in the tree by the creaking sound made by the larvæ, the noise being heard a rod from the tree. Some of the larvæ were molting. In this process the entire head of the tegument about to be cast is pushed off anteriorly, while the thin skin of the rest of the body peels off from the prothorax backwards.

Mr. A. C. Goodell, of Salem, Mass., presented the museum of the Peabody Academy with an adult of this species which came from a pine bureau about the year 1875. The bureau had been in his house for about fifteen years previous, being newly made when purchased. The family had heard the creaking noise for some time before the insect appeared; and, after inquiring into the circumstances, I have no doubt but that the insect had lived in the bureau for fully fifteen years.

This longevity is probably due to the fact that the insect had not coupled, it being well known that continence in insects leads to the prolongation of life far beyond their natural term of existence. Further observations and experiments on this point are greatly needed.

* I have also found the cells under the bark of the white pine at Providence, R. I.

Apropos of this interesting subject I quote the following observations of Dr. Fitch:

The wood of the apple tree was formerly highly valued for cabinet work in this country. In 1785, a son of General Israel Putnam, residing in Williamstown, Mass., had a table made from one of his apple trees. Many years afterward the gnawing of an insect was heard in one of the leaves of this table, which noise continued for a year or two, when a large long-horned beetle made its exit therefrom. Subsequently, the same noise was heard again, and another insect, and afterwards a third, all of the same kind, issued from this table-leaf; the first one coming out twenty and the last twenty-eight years after the trunk was cut down. These facts are stated more fully in the History of the County of Berkshire, published at Pittsfield, in 1829, p. 39. This, I believe, is the longest period of an insect remaining alive in timber of which we have any record, and it is desirable to ascertain, if possible, what insect this was. John J. Putnam, esq., of White Creek, N. Y., was a young man residing at his father's when these remarkable incidents occurred. On showing to him specimens of all the larger long-horned beetles of this vicinity, he points to *Cerasphorus balteatus* as being the same insect, according to the best of his recollection, but is not certain but it might have been the *Callidium agreste*.

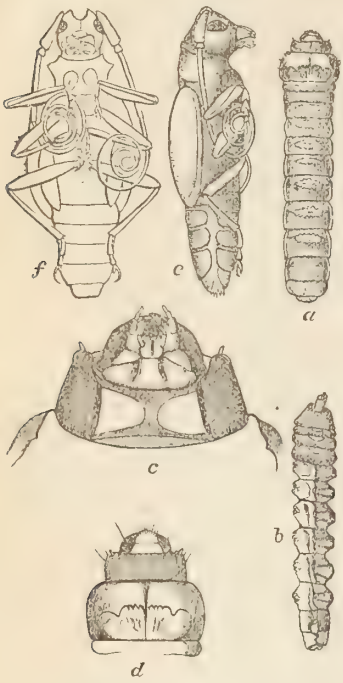

FIG. 68.—Larva of *Monohammus confusor*; *a*, top, *b*, side view, nat. size; *d*, upper, *c*, under side of the head; *e*, side, and *f* under side of pupa.—From Packard in Hayden's Survey.

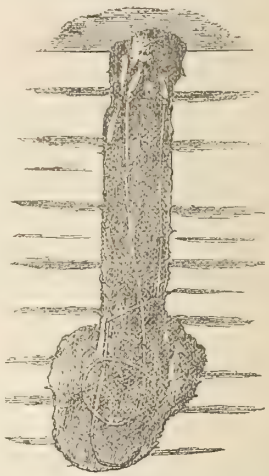

FIG. 69.—*Monohammus confusor*, the beetle in its cell in a piece of planed plank.—After Packard.

"This testimony, in connection with what President Fitch, of Williams College, says of the insect in the notice above referred to—'its color dark glistening brown, with tints of yellow'—releases us from all doubts upon this subject, as the *agreste* is of a uniform brown, whilst the *balteatus* commonly presents traces, more or less distinct, of an oblique yellowish spot or band, near the middle of the wing-covers."

Larva.—Body soft, white, long, nearly cylindrical, being but slightly flattened, entirely footless, all the abdominal segments of the same width, except the minute small one. From the first abdominal segment (or fourth from the head), the body increases in width, being widest on the prothoracic segment (or the one next to the head). This segment is transversely oblong, being as wide in front as behind; it is a little more than twice as wide as long. The head is large and square, not narrowing

in front, but as wide anteriorly as posteriorly. When the head is forcibly pulled out it is found to be as long as broad; anterior one-fourth of head, deep mahogany red, becoming blackish on the edge. Clypeus very short and broad, about four times as broad as long. Labrum rather wide, not much contracted at base, rounded in front, with very stout bristles on the margin. Mandibles gouge-like, the ends oblique, hollowed out, with the outer edge produced into a point. Antennæ very minute, three-jointed, the second and third joints about as long as the basal. The maxillæ form a basal joint, throwing off a three-jointed palpus, and an inner lobe armed with stiff bristles, reaching to the end of the second joint of the palpus. The two-jointed labial palpi reach to as far as the middle of the brush-like lobe of the maxillæ; the second joint is about as long, but half as wide, as the basal. The middle of each segment, especially the third to the seventh above and below, with a transverse callous spot. The upper side of the first abdominal segment has a very narrow oblong square area impressed upon it. The callous spot is best marked on the fifth segment, consisting of an area about one third as long as broad, with a square, shallow sinus posteriorly, and with the sides projected inwards; it consists of two series of callous spots, the outer forming the limits of the area as above described, and the inner series forming a simple transverse, narrow, lanceolate, oval spot. The callous spot on the under side has a sinus in front, but slightly rounded behind. The one on the seventh segment (below) is but little more than one-half as wide, with a broad sinus on the hind edge, and with the sides directed obliquely inwards. Terminal segment very small, half as wide, and one-fourth as long as penultimate segment. Nine spiracles, the first on front edge of second thoracic (mesothoracic) segment. Length when fully grown, 1½ inches.

This larva may be known from that of *Rhagium lineatum* by its lack of any thoracic feet and by its much longer, more cylindrical body, and differs at once by the long, square head, that of *Rhagium* rounding in front; by the wider clypeus, and proportionately wider and shorter labrum. The palpi and antennæ do not differ much. The callous spots on the abdominal segments are smaller and otherwise different from those in *Rhagium*.

Pupa.—The pupa is far advanced, being nearly ready to change to a beetle, the body becoming dusky and horn-colored, while the characteristic dark spots have already appeared on the wing-covers. The antennæ are coiled up three and a half times at the end between the fore and the middle pairs of legs, and the genus may be recognized by their great length and the deep excavation in the head between them, as well as by the lateral short spine on the prothorax.

The wing-covers in my single specimen reach to the third abdominal segment, and are pressed obliquely to the side of the body. The salient portions of the upper side of the abdominal rings with fine spines. End of the body sinuate.

In the absence of another pupa of this genus for comparison, additional characteristics cannot now be given. Length, ¾ of an inch.

Mr. George Hunt has taken both this species and *M. scutellatus* "coming out of the white pine" in July in northern New York and in Rhode Island. Prof. F. H. Snow records it in the seventh volume of the Transactions of the Kansas Academy of Science as occurring in the Baptist church in Lawrence, Kans., "where repairs had been made with pine lumber."

15. Marbled pine-borer.

Monohammus marmoratus Randall.

A large white grub very similar to the last preceding one, and boring in the interior of the wood, often in the same trees and logs with it. The beetle coming abroad in July and very similar to the preceding, but always smaller, measuring 0.75 to 0.90 in length, and distinguished from it by having the short hairs coating the base of the spine on each side of the thorax of an ocher yellow color instead of white, the thorax with numerous confluent punctures across its middle, its wing-covers ash gray marbled with tawny brown cloud-like spots, and punctured like the preceding species, but the punctures here becoming much more dense towards the base and running into each other, the antennæ in the females with an ash-gray band at the base of each joint, their length in the two sexes as in the preceding species. (Fitch.)

This is not a particularly common insect, though more closely allied to the foregoing species than the following better known one.

16. The white-scuteled pine-borer.

Monohammus scutellatus Say.

A large white grub closely like the foregoing and boring in the wood in a similar manner, in the month of June producing a beetle of similar form but of a shining black color, its wing-covers having small patches of short hairs here and there, resembling spots of white mold, their surface rough from coarse confluent punctures and the thorax similarly punctured across its middle, its base and apex with irregular transverse wrinkles, and its sides with a conical spine which is not clothed with hairs, the scutel coated over with white hairs, and the antennæ double the length of the body in the males, and in the females with a gray band on the base of each joint, its length varying from 0.60 to 0.75. (Fitch.)

This is a common and sometimes abundant beetle in Maine and Northern New England generally, and especially in the lumber regions of Lake Superior, whence I have received it in large numbers. It also occurs in the pine forests of British America and in Washington Territory and Oregon along the Pacific coast. Though I have taken it on the white pine (Maine) in July, I cannot relate more concerning its habits and larval forms than is contained in Dr. Fitch's brief account given above.

17. The pine-eating gay-beard.

Eupogonius pinivora Fitch.

Order Coleoptera; family Cerambycidæ.

A small grub resembling a young apple-tree borer, mining the wood of the pine, and in July becoming a small cylindrical long-horned beetle, which is found upon the leaves, 0.25 long and about a third as broad, clothed with numerous erect black hairs

on the body and antennæ, and gray ones on the legs; its color shining pale chestnut, with irregular oblique and transverse spots and streaks of gray on the wing-covers, which are coarsely punctured, the punctures dense on the base and fine on the apex; its thorax narrower, slightly darker colored, closely punctured, having a very small tooth-like point on each side and along its middle a gray line which is widely interrupted in the center, the sides and also the head with thin gray pubescence; its antennæ shorter than the body, coarse, and the joints becoming suddenly shorter after the fourth; its under side blackish brown, the legs pale chestnut.

This species is of the same color with *E. tomentosus* of Haldeman, which, however, is larger, with gray hairs instead of black, and the wing-covers with ocher-yellow spots and streaks. (Fitch.)

18. The commixed leptostylus.

Leptostylus commixtus Haldeman.

Order Coleoptera; family Cerambycidæ.

A small long-horned beetle occurring on the leaves of the pine in July, its appearance and shape closely like that of the prickly Leptostylus No. 4, Plate 1, Fig. 4, and its larva probably having similar habits and the same form: the beetle 0.25 to 0.36 long, its thorax closely punctured, blackish obscurely varied with ash-gray and with elevated black dots placed symmetrically, the sides convex and with a small angular tooth back of their middle; its wing-covers coarsely and closely punctured, dull and gray varied with paler gray and with black clouds and dots, two faintly elevated ribs on each wing-cover of a slightly paler gray tint alternated with black dots, the inner rib having an elongated black spot near its base, another beyond the middle, and a third one farther back, formed by obscure dusky transverse clouds which cross the ribs at these places; the sides black, alternated with a whitish cloud-like spot near the base, and a smaller one near the middle. (Fitch.)

19. The lesser pine-borer.

Asemum mœstum Haldeman.

Order Coleoptera; family Cerambycidæ.

Perforating the trunk of the white pine in all directions and sinking into the heart of the tree, making a flattened cylindrical hole or mine when seen in outline; a rather small larva, which emerges late in May through oval holes in the bark, especially around the base of the trunk; the beetle blackish brown with short antennæ and legs.

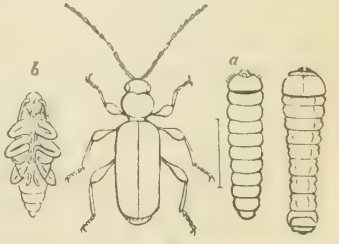

Fig. 70.—*a*, Larva; *b*, pupa and beetle (enlarged twice) of the lesser pine borer.—From Packard.

The transformations of this common borer, which apparently attacks the tree in health as well as in disease, like the species of *Monohammus*, were first briefly described and figured in our "Guide to the Study of Insects" from specimens found in all stages under the bark of the oak early in May at Salem, Mass. I have also received a larva of this species from Dr. Shimer, which was found by him boring in the grape-vine. Since then Mr. Riley has bred it from the Scotch pine, and Mr. Schwarz has found the pupa under the bark of pine stumps in Florida

in March. During the past May I have found, in company with Mr. Calder, at Providence, the perfect beetles, and also the pupa in deep burrows or mines in white-pine stumps. I have heretofore regarded the holes made by this borer as probably those of *Chalcophora virginiensis*, but they are regularly oval cylindrical, less flattened oval than those made by a Buprestid, and exactly like those of other flat-bodied longicorns. The openings perhaps more abundant on the south side of the tree or stump, in the base of the trunk of the white pine, are at times very numerous, as many as ten in a space of 5 square inches. They are, on the average, 6mm wide by 3mm deep, or half as deep as wide. The sides are smooth, but the orifice is often partially concealed by projecting portions of the bark. The holes are deep, extending 6 or 8 inches towards the heart of the tree. Seen longitudinally the "mine" or tunnel is about a quarter of an inch (6mm) wide, sometimes wider, and ends in an elongate oval cell, wherein the pupa rests. Some extend up and down under the bark, while most plunge deep into the wood.

The larva.—We have not specimens at hand for elaborate description, but those found in the oak were footless, white, with a rather large prothorax, in which the head sinks, with strong black jaws; the body is quite uniform in thickness, gradually diminishing in width posteriorly. It is .6 inch in length.

The pupa is .44 inch long. It is flattened and rather broad, and may be readily identified from the other pupæ of the genus, as it has the characters of the species, viz, by the short antennæ, which do not extend quite as far as the hinder edge of the metathorax, the joints composing it being much shorter than in the other species. It may also be recognized by the two raised longitudinal lines on the wing-covers corresponding to those on the wing-covers of the beetle; the wing-covers extend to near the middle of the second abdominal segment, and the tips of the hind legs reach nearly to the posterior edge of the third abdominal segment. The end of the abdomen is square, and ends in two sharp, slender incurved hooks, which are dark red at tip. Length, .44 inch.

The beetle differs from two larger common beetles (*Criocephalus agrestis* and *obsoletus*) with which it associates, by its much smaller size, which, however, is very variable, and by the much shorter antennæ, the joints being much shorter and thicker and more coarsely pitted than in the two species above named. It is brown-black, with a rounded, flattened prothorax, and two longitudinal ridges along the wing-covers.

I have taken this beetle at Nederland, in Colorado, June 30; it undoubtedly preys upon coniferous trees in the Rocky Mountain region. It is also said by Leconte to occur in Russian America (Alaska).

20. *Criocephalus agrestis* Kirby.

Boring into pines from Maine to Colorado and the Pacific coast, a rather large white longicorn larva; assuming the pupa state in May and the beetle state in June and July.

This large beetle closely resembles *Asemum moestum*, but is about twice as large, with much longer and slenderer antennæ; it is also characterized by the three large irregular pits on the top of the prothorax; these pits are also seen in the pupa, and by them the pupa noticed below was identified as belonging to this species. In color and the two

high ridges on each wing-cover it closely resembles the more abundant *Asemum moestum*.

I found what I regard as the pupa of this species under the bark of the pitch-pine at Providence, May 20, 1881. From its close resemblance to the pupa of *Asemum moestum*, from the form of the prothorax and the three pits which correspond so closely to the beetle, I do not doubt but that the pupa should be referred to *C. agrestis*.

The antennæ of the pupa are long and reach to the basal sixth of the wing-covers; they thence recurve, so that the tip touches the basal third of the fore tibiæ. The end of the abdomen has two spines, much as in the pupa of *Asemum moestum;* the wing-covers have each two longitudinal parallel straight raised lines, while the body in general is flat and rather broad, as in the beetle. The pupa is 25^{mm} in length; breadth of body, 7½^{mm}.

Fig. 71.—*Criocephalus productus*.—From Packard.

Criocephalus productus Leconte (Fig. 71) I have taken in Colorado, and in Utah, and I have received it from Tacoma, W. T. on the shores of Puget Sound. It undoubtedly inhabits pine trees, and represents the Eastern *C. agrestis*.

21. *Ædilis nodosus* Fabricius.

Found under the bark of the pine from June to September. The specimens collected about Philadelphia are quite small compared with those found in the pine forests of New Jersey. (Bland, Proc. Ent. Soc. Phil., i, 97.)

22. *Ædilis obsoletus* Olivier.

Taken under the bark of pine stumps at and near Philadelphia. Not common. (Bland, *l. c.*)

23. The pine euderces.

Euderces pini Olivier.

Order Coleoptera; family Cerambycidæ.

A small cylindrical long-horned beetle, having a wide separation between its thorax and abdomen, giving it some resemblance to an ant, 0.23 to 0.30 long, of a bright chestnut color, with its abdomen and the posterior third of its wing-covers black, the wing-covers crossed obliquely forward of their middle by a silvery white line which does not reach to the suture, and posteriorly on the fore part of their black portion a gray band, which is placed in a shallow groove running obliquely and parallel with the silvery line; the thorax covered with fine impressed lines running lengthwise.

This is said by Olivier to have been found on pines around the city of New York but it is probably a Southern insect. (Fitch.)

24. Black-horned callidium.

Callidium antennatum Newman.

Order Coleoptera; family Cerambycidæ.

A flattened long-horned beetle, appearing in May and June, about 0.52 long, of a deep Prussian blue color, often with shades of green in places, its antennæ and legs

black, its thorax hairy, and as broad as the wing-covers, with the sides strongly rounded and above on each side of the middle a little round hollow spot, and its wing-covers rough from close shallow punctures. (Fitch.)

Dr. Harris regarded this as identical with the European *C. violaceum*, deeming the latter to have been probably introduced into Europe from this country. (Treatise, page 88.) But entomologists now consider the insects of the two continents to be distinct species. Ours, doubtless, has the same habits with that of Europe, the larva living in the trunks of pines, excavating a wavy shallow track under the bark, which is packed full of sawdust, and when almost fully grown, sinking itself obliquely downwards several inches into the wood, to repose during its pupa state.

Specimens occur in which the thorax is plainly narrower than the wing-covers, more distinctly punctured, and destitute of the two impressed spots. These are the violet-colored Callidium, *C. janthinum* of Dr. Leconte and of Dejean's Catalogue. But individuals appear to occur of all intermediate varieties, and I am therefore inclined to think they can scarcely be regarded as constituting two distinct species. (Fitch.)

We have observed this in considerable numbers under pine boards, and also flying, at Brunswick, Me., in the middle of May. Mr. George Hunt has observed it in pine trees at Providence, R. I. We found at Providence, May 14, a dozen or more individuals under the bark of a dead *Juniperus virginiana*. The track made by the larva, as we supposed it must have been of this insect, was irregularly wavy, like that of other longicorn grubs, and filled compactly with a fine dust, its castings; it was shallow and 4 or 5 inches long. Whether it was made before the death of the tree is unknown, but the work of this and its fellows had loosened the bark, several larvæ having been at work together.

25. The Porter hylotrupes.

Hylotrupes bajulus Linnæus.

Order Coleoptera; family Cerambycidæ.

A beetle very similar to the preceding in its shape and habits, appearing in July and August, 0.45 to 0.75 long, of a black color, its thorax nearly circular and clothed with white hairs, with a smooth polished black line in its center, and a callous-like spot on each side of it, and its wing-covers with very coarse, shallow confluent punctures and some downy whitish spots, forming two irregular bands near the middle.

This species is supposed to have been introduced in its larva state in timber from Europe, and is found in our country only near the sea-coast. (Harris's Treatise, page 88.)

26. The lesser prionus.

Orthosoma brunneum De Geer.

Order Coleoptera; family Cerambycidæ.

A flattened long-horned beetle, 1.00 to 1.30 long, and less than a third as broad, with its opposite sides parallel, its thorax twice as broad as long, and with three sharp

teeth on each side, its wing-covers with two or three slight elevated lines, its antennæ scarcely as long as the body, and its color chestnut red, darker anteriorly.

Larva.—Described while alive. Body cylindrical, not flattened, the segments very distinct, as the sutures are deeper than usual; head moderately broad; prothorax large and broad and rather long, being 9^{mm} broad and 4½^{mm} long; surface rough on the posterior two-thirds. On each of the 1st to 7th abdominal segments is a transverse oval, cylindrical fleshy area, each with three transverse folds, the area on the 7th ring being nearly twice as long (antero-posteriorly) as that on the first; the areas becoming longer and narrower; *i. e.*, more rounded, going backward towards the 7th segment; the end of the abdomen smooth and shining; each thoracic segment with a pair of slender 3-jointed feet. Length, 35^{mm} (1¼ inches). Two dozen or more were taken May 26 by Mr. Calder and myself from a very soft, rotten pine stump; up to June 24 they had not pupated in confinement, but by the 5th to the 8th of July one of them became a pupa.

FIG. 72.—The lesser Prionus. Natural size.—After Riley.

Pupa.—Antennæ bent near their end at right angles and laid across the end of the elytra, the latter reaching to the middle of the hind tarsi. End of the abdomen terminates in a singular ruffle-like expansion, armed on the edges with stout spines. Hind tarsi reaching to the middle of the 5th abdominal segment. The body considerably curved. Maxillary palpi extended well beyond the end of the mandibles. Prothorax with a broad-based spine on the side. The projecting parts of the abdominal segments with fine spines, and segments 3 to 5 with a pair of transverse, thin, dark-brown, chitinous patches. Length, 30^{mm}.

Mr. Calder has also found the fully grown larvæ in August in maple logs at Warwick, R. I., and in the rotten wood of another deciduous tree. So that it appears that this beetle lives indifferently in the soft, decayed logs or stumps both of hard and coniferous trees.

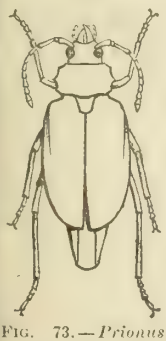

FIG. 73.—*Prionus emarginatus.*—From Packard.

27. PRIONUS EMARGINATUS Say.

Probably injuring shade or timber trees in Utah, a dark brown beetle of the following appearance:

Body castaneous; head, thorax, and breast covered with long yellowish ferruginous hair; antennæ fourteen-jointed, glabrous, perfoliate, imbricate; the imbrications emarginate beneath; mandibles black at tip; thorax but slightly margined, one-toothed on the middle of the lateral edge; angles obtusely rounded; elytra somewhat unequal, punctured; feet and venter subglabrous. Length nearly seven-tenths of an inch. Female glabrous; antennæ simple. Length, four-fifths of an inch. This species exhibits the general form of *brevicornis*, but the thorax is proportionally much

narrowed, and the characters above detailed prove it to be very distinct from that species. The lepaceous processes of the antennæ are so profoundly emarginate beneath as to appear each bilobate. I obtained it on the Arkansas River near the mountains. (Say.)

28. *Ergates spiculatus* Leconte.

Bores in *Pinus ponderosa* in Colorado. (A. S. Fuller. Amer. Ent., iii, 238.)

Cryocephalus nubilus Leconte.

Larva boring in roots of yellow pine (Tampa, Fla.), the beetle appearing in April. (E. A. Schwarz. Amer. Ent., iii, 238.)

29. Harris's prionus.

Tragosoma Harrisii Leconte.

Order Coleoptera; family Cerambycidæ.

A beetle closely resembling the preceding, but with much shorter antennæ, only one tooth on each side of the thorax, and several raised lines on the wing-covers.

This rare insect, which has only been found hitherto in New England and Newfoundland, inhabits New York also, and I infer it to be bred in the pine, having in one instance met with the beetle, dead, under the loose bark of one of these trees. (Fitch.)

"A specimen of this species was found by Mr. Gibbs east of Fort Colville [Oregon]. It probably extends its range across the continent in more northern latitudes." (Leconte, Proc. Acad. Nat. Sc. Phil., Nov., 1861, p. 354.) Mr. George Hunt has collected it among the pine forests of the Adirondacks, Northern New York.

30. The Ribbed rhagium.

Rhagium lineatum Olivier.

Order Coleoptera; family Cerambycidæ.

Common in the pitch-pine, several often in the trunk of the same tree, excavating a broad irregular patch in the outer surface of the sap-wood, the cavity being mostly filled with sawdust; a yellowish-white grub about an inch long, divided into segments of nearly equal length and width, except the second which is the broadest, and the last which is narrowest with its end rounded; surrounding itself with a broad oval ring of woody fibers, like short threads, placed between the bark and the wood, in which to pass its pupa state; changing to a beetle, which lies in the same cell through the winter and comes abroad in the spring; the beetle 0.40 to 0.70 long, long and narrowish, its head and thorax much narrower than the wing-covers, cylindric, clothed with soft gray hairs upon a black ground, the thorax with a black stripe above and one on each side, where is also a stout spine; the antennæ only reaching the base of the wing-covers, which are dull yellowish gray variegated with black, each with three elevated lines, the outer two uniting at their tips. (Harris's Treatise, page 102.)

We have found the beetles and pupæ of this beetle under the bark of a white pine log, at Salem, Mass., in abundance in October, and have also detected it frequently in Maine in the same situations in the spring, April 24, both in the larval and adult state.

Larva.—It may be readily recognized by having three pairs of long and slender thoracic feet, which are 3-jointed, ending in a long claw, as well as by the broad, flat body, the end being broad and rounded. The prothorax is large, transversely oblong, not quite so wide, but nearly as long as the three succeeding segments. A pair of spiracles on the mesothoracic segment, and the usual ones on the abdominal segments. Length, 12^{mm}; breadth, 4^{mm}. Described from one found May 26, at Providence, under the bark of the white pine.

The cell in which the larva rests during the winter, and in which the pupæ and beetles reside, is irregularly oval, about 2 inches long and one-third as wide, very shallow, and partly surrounded by a wide border of closely packed chips gnawed off from the wood; and partly by the excrement or reddish sawdust-like closely packed material, derived originally from the inner part of the bark. The entire cavity is thus about 4 inches long and 2 wide, and very irregularly oval in outline. It seems probable that this larva does not make a regular wavy burrow, but remains in one spot, eating out in all directions from a comparatively fixed point; in this respect it differs from many other Cerambycid larvæ.

31. WOOD-ENGRAVER BARK-BEETLE.

Xyleborus xylographus Say.

Order COLEOPTERA; family SCOLYTIDÆ.

In the outer surface of the sap-wood and inner layers of the bark, mining a long slender thread-like track, usually straight, lengthwise, 4 to 8 inches long, from which numerous smaller short tracks branch off mostly at right angles; a small bark-beetle 0.12 long, which comes abroad mostly in May, of a chestnut color, the declivity at the tip of its wing-covers having four or five minute projecting teeth upon each side. (Fitch.)

This, like other bark beetles, has a compact cylindrical body at least three times as long as broad, with the thorax forming almost half of the entire length, and having the head deeply sunk in its anterior end and almost hid. Their antennæ are quite small, and are composed of a long basal joint, which becomes thicker towards its tip, and is followed by five very small joints, surmounted by a large, round, flattened club, which is divided by sutures into three or four segments.

This species is glossy and bearded with fine hairs. Its thorax is shagreened anteriorly with minute elevated points, which farther back become less dense, and the basal half is covered with fine punctures, with a smooth line above along the middle from the center backwards. The wing-covers have rows of coarse punctures and minute ones on the interstices between these rows, and their tips are abruptly declined as though cut or gnawed off, the outer margin of this declivity having four or five small projecting teeth upon each side. It is usually chestnut colored, with the antennæ and legs paler, but individuals may be met with of the following varieties:

Variety *a*, *nigricollis*. Thorax black.
b, *niger*. Thorax and wing-covers black.
c, *fulvus*. Thorax and wing-covers pale yellowish.

The wood-engraver bark-beetle is the most common and probably the

most pernicious of all the insects infesting the forests of white pine in the State of New York, and of yellow pine (*P. variabilis*) in the States south of us. Whilst it is old and decaying or dead trees that most of the larger borers which we have described above attack, this small insect is liable to invade trees that are in full health and vigor, those that are young as well as old, mining beneath the bark and loosening it from the wood, so completely separating it that it breaks off in large pieces. Frequently, on elevating this loosened bark, its inner layers and the whole outer surface of the wood are found plowed in every direction, and the furrows are so intricate and confused that it is impossible to follow the track which any one individual has traveled. But in places where they have been less numerous, the work which each insect has performed is distinctly marked and is so regular and artistic in its appearance as to have suggested to Mr. Say the name of the wood-engraver as a most appropriate designation for this beetle. The cut on the following page is an exact copy of the tracks made by one of these beetles and its young, their natural size.* It will be seen to consist of a main central track running nearly straight, from which numerous smaller short ones branch off at nearly right angles. Though I have not observed the habits of these insects sufficiently to be perfectly certain respecting all the points in their operations, the course they pursue in forming these tracks appears to be as follows: The female having selected a situation which will furnish suitable sustenance to her young, bores through the bark to the outer surface of the wood, and then mines a passage between the bark and the wood, in a straight line lengthwise of the tree or limb where no obstructions occur to cause her to deviate from her course. The male probably accompanies her and shares with her in this labor, each working by turns. Thus a long slender cylindrical gallery is formed, which is excavated about equally in the outer surface of the wood and in the inner layers of the bark. In some instances, two, three, or even six tracks will be seen to start from one point, running in opposite directions, but always lengthwise of the tree or limb, and with lateral branches so similar to those in the figure, that I am in doubt whether they are the work of this or one of the other species which belong to this tree. Upon each side of the main track, little notches are excavated at intervals, whilst the work is in progress, similar to those represented in our figure of the tracks of the pinebark-beetle on the succeeding page, though larger than those, being about equal to the width of the track in their length, but less in their width, and having their outer ends evenly rounded. In each of these notches from one to four eggs are placed. And as the beetles mine their way onwards, the fine dust which they form probably becomes strewed along the track behind them. Then, as they travel backwards and forwards in the burrow from time to time, the little stiff hairs with which their bodies are bearded, serve as a brush to sweep this dust into these lat-

* The cut is not reproduced.

eral openings. Thus the mouths of these notches become filled and the eggs therein covered and concealed from any predaceous insect which may enter the burrow after the parent has completed her work and before the eggs have hatched and the young have mined their way beyond the reach of such enemies. The female continues her operations until her stock of eggs is exhausted, forming a burrow from 4 to 8 inches or more in length.

The eggs of this beetle are about 0.025 long, of a broad, oval shape, and a watery white color. They may be met with in their newly formed burrows beneath the bark, the fore part of June. They probably hatch in ten to twenty days, according to the temperature of the atmosphere at this time. The infantile larva is invariably found lying with its back towards the sawdust with which the notch in which it is bred is filled, its mouth being thus brought in contact with the soft innermost layer of the bark at the extremity of the notch—the elastic nature of the sawdust probably aiding in pressing its mouth against its destined nourishment. Thus it has only to part its jaws and close them together again to fill its mouth with food. And by repetitions of this motion a cavity is gradually formed between the bark and the wood, into which its head sinks, and afterwards its body. This cavity consequently takes a direction outwards at right angles with the central burrow. And thus the larva eats its way onward until it has obtained its growth, forming hereby a gallery varying in its length from about one to three inches, as the material consumed has been of a quality more or less nutritious, and winding and turning where impediments have been encountered or the track of another larva has been approached. Many of these lateral galleries, however, end abruptly before they are half completed, the worm having been destroyed by insect enemies or some other casualty. And it is curious to notice how these little creatures respect the territory which is already in possession of another, changing their course to avoid any encroachment thereon; and if one of them finds himself so surrounded and hemmed in by other tracks that it becomes impossible for him to refrain from encountering them, he so shapes his course as to cross his neighbor's road as nearly as possible at right angles instead of obliquely, thus intruding thereon as little and for as short a time as possible. Sometimes also two females happen to excavate their galleries parallel with each other, and so near that no adequate space remains between them for their young to mine their burrows, the beetles having been unaware of their proximity, no doubt, until too much labor had been expended to admit either one to abandon the ground and go elsewhere. In such cases the eggs are all placed along the outer side of each gallery, and thus the larvæ all mine their way outward in opposite directions to each other.

The larva is a plump soft white worm, broadest anteriorly, and with its body bent into an arch or having its tail turned partially inward under the breast. By transverse impressed lines it is divided into

thirteen segments, the head being counted as one. Its head is polished and white, at least during the first periods of its life, with its mandibles chestnut brown, and no indications of eyes, and no feet, but with their places supplied by two small round retractile teat-like protuberances on the under side of each of the three segments next to the head. Having completed their growth, they sink themselves into the wood to repose during their pupa state. The small round hole which they perforate in the wood for this purpose, is seen at or near the outer end of each burrow in which the worm has lived to reach maturity.

The pupa resembles the perfect insect in its size and shape, with the rudimentary legs and wings inclosed in sheaths and appressed to the outer surface of its body in front. After taking on its perfect form it perforates a small round hole through the bark and comes out from the tree.

This and the other bark-beetles of the pine have numerous insect enemies which wage incessant war upon them. Various species of small beetles pertaining to the families *Staphylinidæ*, *Histeridæ*, &c., are always to be met with under the loose worm-eaten bark of pines, and M. Perris has ascertained that these insects resort to this situation for the purpose of rearing their young, their larvæ being predaceous and subsisting upon the larvæ and pupæ of the bark-beetles. (Fitch.) We have found this species common under the bark of pines in Maine, the beetles flying in April and May.

31. The fine-writing bark-beetle.

Tomicus calligraphus Germar.

Under the bark of the pitch pine and other species of pine, mining long, and often zigzag tracks lengthwise of the tree, these tracks having short, coarse, irregular branches; a chestnut-brown bark-beetle 0.18 to 0.22 long, clothed with numerous yellowish gray hairs, its thorax rough anteriorly from close elevated points, and punctured posteriorly, its wing-covers with rows of coarse punctures, their tip broadly excavated as though with gouge-chisel, the surface of this excavation rough from coarsish punctures, and its margin on each side with five or six small unequal teeth. Appearing mostly in the month of May. (Fitch.)

This species was originally named *exesus*, or the excavated bark-beetle, in allusion to the tips of its wing-covers, in the old Catalogue of Rev. F. V. Melsheimer, under which name a short account of it was published by Mr. Say, in the year 1826. Germar, however, had described it two years before, under the name *calligraphus*, meaning elegant writer, which name it must retain, although not happily chosen, the tracks which this beetle forms under the bark being coarse, irregular, confused, and far less beautiful than those of many of the species of this genus.

It is in the pitch pine that this beetle mostly occurs in the State of New York, but I have also met with it in the limbs of aged white pines, and farther south it is common in the yellow pine. Its burrow is somewhat like that of the preceding species, consisting of a single long fur-

row extending lengthwise of the tree or limb, from six to twelve inches in length, but it is less straight in this species, being usually curved more or less, and according to accounts it is often perfectly zigzag. The same notches are formed along its sides as noticed in the foregoing species, in which the eggs are deposited; but the lateral burrows which branch from the central one have no regularity whatever to them, being given off sometimes obliquely and sometimes at right angles, sometimes abruptly widening into a broad irregular, flat cavity, and sometimes continuing of the same width through their whole length, either straight, irregularly wavy or tortuous, turning here and there, wherever an unoccupied space occurs into which they can be extended. These branches are usually of the same width with the central gallery, and like it are furrowed equally deep in the outer surface of the wood and the inner surface of the bark. The pupa state is passed in a cell excavated in the bark, and not in the wood, as in the foregoing species, and when changed into a beetle this cell is extended onwards through the bark for the escape of the insect. Being a larger species than the preceding, the galleries which it excavates, and the holes it perforates through the bark, are proportionally larger. Several dead individuals may usually be found in the galleries of this as of the other species. (Fitch.)

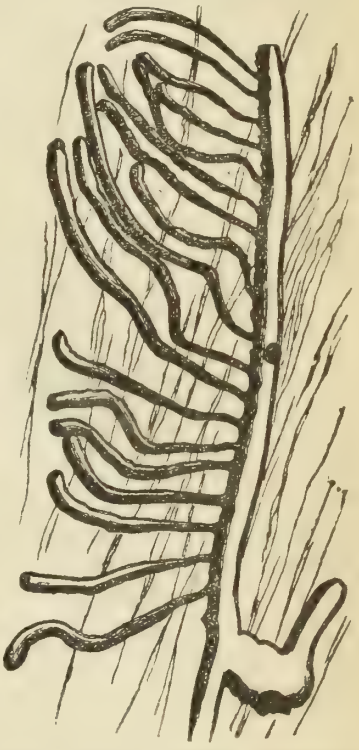

FIG. 74.—Mine of *Tomicus calligraphus* in southern pitch pine, Houston, Tex. Packard del.

I have found the "mines" or galleries of this bark-borer under the bark of the southern pitch pine at Houston, Tex., where it seemed to be abundant. Beetles taken from the mines were sent to Dr. G. H. Horn, who kindly identified them as *T. calligraphus*. Fig. 74 represents a typical mine. It consists of a primary or main gallery or mine which is $3\frac{1}{2}^{mm}$ wide; the holes for the exit of the beetle, of which two are represented in the engraving, being 2^{mm} in diameter. The primary gallery is nearly straight, with, in the cases noticed by us, only one set of secondary galleries arising on one side, as represented in the figure. The secondary galleries are from one to nearly two inches in length, and at the end a little over half as wide as the main gallery. At one end the main gallery opens into a broad irregular cell, where the worm probably transforms into the pupa, connecting with the hole for the exit of the beetle.

Another form of cell without any lateral or secondary galleries is

represented at Fig. 75. The arrow indicates a point in the gallery made when the larva was small. A specimen taken from this mine was also submitted to Dr. Horn for identification. It occurred under the bark of the southern or yellow pine at Atlanta, Ga., where I collected it in April, 1881.

FIG. 75.—Primary mine of *Tomicus calligraphus* in yellow pine, Georgia. (Packard del.)

33. THE SOUTHERN TOMICUS.

Tomicus cacographus Leconte.

Injuring the pines of North Carolina and southward even more than *T. pini* in the north; a very similar beetle, with similar habits.

This is the *Bostrichus pini* of Zimmermann, but not the one so named by Say. It inhabits, according to Leconte, the Southern and Western States. It is said by Leconte to be similar to *Tomicus calligraphus*, but is usually of smaller size (3.5–4^{mm}, .14–.16 inch); the cusp of the second interspace is very small, and that of the third is wanting; that of the fifth is compressed and scarcely more prominent than that of the fourth interspace, and is somewhat connected with it; there are but two teeth between the tooth of the fifth interspace and the terminal acutely elevated margin, and these teeth are all of them less prominent than in *T. calligraphus* in some specimens (♂), but equally prominent in others (♀), those less acute than in *T. calligraphus*. The interspaces from the third outward are marked each with a regular series of punctures behind the middle, whereby it differs from the next species (*T. confusus* Leconte, of Southern California and Arizona). The club of the antennæ is quite similar to that of *T. calligraphus*.*

The mine made by this species has been found under the bark of the southern pine at Atlanta, Ga., the beetle from it having been labeled by Dr. Horn. The mine is like that of *C. calligraphus*, but the main burrow is narrower, being 2½^{mm} wide, and the holes are smaller, the beetle itself being smaller. Living beetles were taken from the mine March 28, 1881.

32. PINE BARK-BEETLE.

Tomicus pini Say.

From a common center excavating several broad shortish galleries lengthwise of the trunk in opposite directions, resembling the spread fingers of a hand; a bark-beetle very similar to the preceding, but of smaller size, measuring only 0.15 in length, and with but four small teeth on each side of the concave declivity at the tips of its wing-covers, and usually showing more or less distinctly an impressed line along the middle of the hind part of its thorax. (Fitch.)

The tracks formed by this insect are so different from those of the other species that they are recognized at a glance. They occur under

* A number of other Scolytids which probably infest the pine are described by Leconte in his work on the Rhynchophora of America north of Mexico, where all the species are characterized, and to which the reader is referred.

the bark of old trees of the white pine, and have some resemblance to the fingers of a hand spread apart, or to the track of a bird. From a common center they run off in opposite directions up and down the tree, lengthwise of the grain, moderately diverging or nearly parallel with each other, appearing, when the bark is stripped off, like linear grooves in the outer surface of the wood and inner surface of the bark. They are about 0.10 wide and 1.50 to 2.00 long, all those belonging to the same cluster being of nearly equal length. Along the sides of these grooves several short sinuous excavations or notches appear, in which the eggs have been placed, where they would remain undisturbed by the beetle as it crawled backwards and forth through the gallery. The accompanying figure* is a representation of one of the clusters of these tracks, copied from the surface of the wood. In this instance, the commencement of some of the galleries, and the principal part of the lower one on the right hand, had been excavated wholly in the bark, and thus made no mark upon the wood.

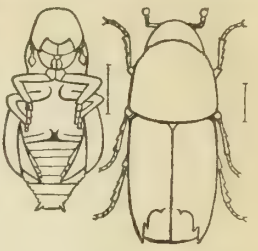

FIG. 76.—Pine back-borer and pupa.—From Packard.

M. Perris has ascertained that with the European *Tomicus laricis*, which excavates several galleries from a common center like the insect now before us, a male beetle is found in each of the galleries, whilst only one female is associated with them, she being stationed sometimes alone, in the center, and at other times in one of the galleries in company with the male. And from his observations it appears that these galleries are excavated by the males, each of them being the work of one individual, whilst the female supplies the whole of them with eggs.

As there are no lateral galleries branching off from these main ones, I infer that the young of this insect move and feed along the sides of the galleries in which they are born, and that thus these galleries become widened and broad as we find them, their width being much greater than those of the other species, although the insect is but the usual size. (Fitch.)

We have little to add to the foregoing account as to the habits of this bark-borer. It is common in the pine woods of Maine, making burrows under the bark, not always so regular as Fitch figures.

This timber-beetle is common in the timber region of the Rocky Mountains of Colorado, boring irregularly into the inner bark of *Abies menziesii*. The burrows are like those made by the same insect in the white pines from Maine to North Carolina. On the Atlantic coast the more regular burrows radiate from a common center. Those observed on Gray's Peak were 0.08 inch in diameter.

In the pupa the body ends in two long, pointed, horn-like appendages arising from each side beneath. The ends of the hind tarsi extend to the terminal third of the wings. The antennæ are clavate, not extend-

*Not here reproduced.

ing beyond the coxæ of the first legs. It is larger, more bulky than the adult. Length, 0.22 inch.

The beetle (Fig. 76) is cylindrical, with the head and prothorax together three-fourths as long as the rest of the body; end of the abdomen suddenly truncated, slanting, forming a scoop, the declivity smooth, concave, and bounded by high walls, which are four-toothed on each side, the third from the top the largest. On each wing-cover are eight lines of fine, raised tubercles; prothorax with concentric rows of fine tubercles, but smooth on the posterior third. Seen from beneath, the wing-covers project well beyond the end of the abdomen. Color, pale tan-brown, a little paler on the thorax than on the wing-covers. Body covered with stiff, dense hairs. Length, 0.20 inch.

34. The little bark-beetle.

Pityophthorus puberulus Leconte.*

Under the bark of small sapling pines, mining exceedingly fine slender wavy burrows running in every direction; a cylindrical chestnut-brown bark-beetle much smaller than any of our other species, measuring only 0.05 in length, its surface shining and pierced with small deep punctures which on the wing-covers are placed in close rows, the thorax but half as long as the wing-covers and rough anteriorly from dense minute elevated points, the middle of the outer edge of the wing-covers showing a slight concavity, the declivity at their tips with a moderate excavation formed by a smooth longitudinal groove upon each side of the suture, the suture itself being elevated and having on each side of it an impressed line in which are minute punctures, the outer margin of the declivity with numerous fine bristles, but without any projecting teeth, and the tips of the wing-covers drawn out into a very small acute point.

This beetle very closely resembles the *T. ramulorum* of Perris, which mines the small twigs of European pines, but it is evidently a distinct species. It was described by Dr. Harris in the Transactions of the Natural History Society of Hartford, Conn., vol. i, p. 82, from a specimen imperfectly displayed, which he met with in the collection of Mr. Halsey, but he had no knowledge of its habits. And this I believe is the only notice of this insect which has hitherto appeared. Its minute size has probably caused it to be overlooked by collectors, although it is so common that the bark of dead young pines which are two inches in diameter or less can seldom be broken away without coming upon its tracks, with some of the dead insects in them. Its tracks are readily distinguished from those of other species by their extreme slenderness, and being packed with fine white sawdust they resemble a tangled mass of small threads lying upon the surface of the wood. On coming to inspect them particularly, small irregular cavities will be noticed, one of which is represented by a knot-like appearance. This cavity is appropriately termed the nuptial chamber by French and German writers. From it

* Leconte states that this is not the *Tomicus pusillus* of Harris, as Fitch supposed, "but is quite different, and is closely allied to *T. ramulorum* Perris, which is considered by Eichhoff as the same with *typographus* Ratzburg." Leconte adds in a letter that this is most probably *P. puberulus*

there are usually four galleries leading off in opposite directions and running obliquely to the grain of the wood, but curving, commonly, till they obtain a longitudinal direction. And from these numerous smaller and irregular wavy galleries branch off, at right angles or nearly so, and overspread the whole surface with a seemingly confused multitude of little furrows. The bark being quite thin in the young trees to which these beetles resort, their galleries are excavated mostly in the wood, the surface of which is deeply grooved whilst only a shallow impression is made on the inner surface of the bark. But at the end of each of the lateral galleries, a deep cavity will be noticed, sunk in the bark, in which cavities the insects repose during their pupa state.

The accompanying figure of the tracks of these beetles handsomely illustrates some of the facts which have already been stated above under the Wood-engraver bark-beetle, and it may interest the reader to notice some of the habits of these insects as shown by this figure.* In its upper half two leading galleries are seen running parallel with each other and so near together that no adequate space exists between them for any young larvæ to form their burrows there without encroaching upon each other or crossing the tracks already made. The parent beetles appear to have been aware of this, and accordingly so disposed of their eggs that all their young with but two or three exceptions mined outwards, traveling away from each other. Again, on the outer side of the left gallery two notches are observed, in which no eggs appear to have been placed, the parent beetle probably perceiving, what the figure indicates, that there was not suitable room to the left of these notches to duly accommodate all of the other larvæ that would traverse that spot. Furthermore, it will be noticed that of the burrows leading off to the right, above the large knot or nuptial chamber, the worm which excavated the fourth one, soon after commencing his journey perceived that the course he was pursuing would run his track into that of the third one. He hereupon abruptly alters his course, bearing directly away from the track of this neighbor until he has attained a suitable distance therefrom, and he then travels forward again, keeping at this exact distance from his neighbor's path. But this soon brings him into proximity with another neighbor upon the other side; and he now becomes aware of the fact that he is between two paths that are approaching each other, and that will consequently come so near together forward of him that he cannot proceed onward without running into one or the other of them. In this dilemma, to encroach the least that is possible upon his neighbors, he makes an abrupt turn so as to go square across one of these tracks. But this only serves to bring him into similar proximity with another track, and after this comes another and another; and now he reaches a fifth one, running in a different direction, requiring another alteration of his course to cross it at right angles. But we need not follow this subject further. Others also of these galleries,

* Not reproduced.

when carefully inspected, will be found scarcely less curious. How wonderful is nature, that thus presents an interesting subject for our study in each particular track an inch or two in length which a family of little worms make as they eat their way along in the bark of a tree, the parenchyma of a leaf, or elsewhere! How marvelous, that in such minute and seemingly unimportant and insignificant operations, we invariably meet with so much to admire! (Fitch.)

35. The least white-pine bark-borer.

Pityophthorus puberulus Leconte.

Very abundant under the bark of the white pine, a very small timber-beetle with long narrow secondary galleries branching off from the main one.

This may possibly be the insect which Dr. Fitch has regarded as the *Tomicus pusillus* of Harris. We have found the mines in abundance under the bark of the white pine at Providence, R. I., sometimes four or five occurring in the space of six or seven square inches. They vary a good deal in irregularity, and we will select the one here figured for description as being one of the more regular mines. The main gallery is slightly sinuous, from 1½ to 2 inches long, originally notched alternately on the sides, the notches where the eggs are laid being the starting point for the secondary galleries where the larvæ have hatched and lived. About fifteen secondary galleries arise from each side of the primary mine, the longest being about two-thirds as long as the primary gallery; all end in a slight enlargement in which the larva transforms, or connect with the hole through the bark for the exit of the insect. (The figure, as engraved, makes the main gallery and branches somewhat wider than in nature, and wider than in my original drawing.) The width of the main gallery is $1\frac{1}{2}^{mm}$; of the secondary gallery, 1^{mm}. In some cases two main galleries cross each other, while in another case two unite to make a figure 8, but in such a case the secondary galleries do not cross the main ones, and in examples where two main galleries run parallel and somewhat near each other, they do not send secondary galleries into the narrow interspaces between the two main galleries.

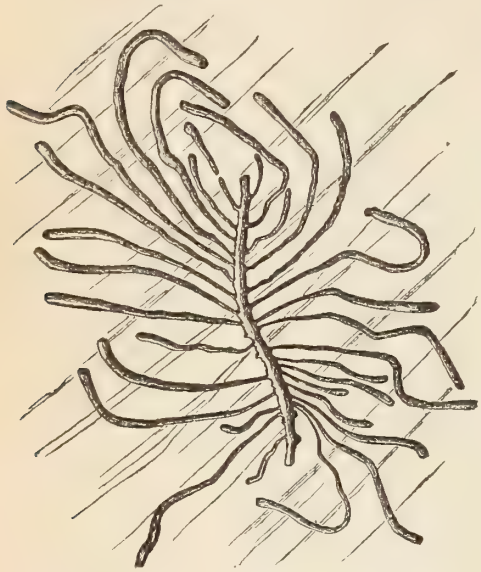

Fig. 77.—Mine of least white-pine bark-borer, Providence, R. I.—Packard del.

On submitting specimens of the beetle to Dr. Leconte for identifica-

tion, he writes us that it is a species of *Pityophthorus*, not described. Dr. Leconte adds: "Blanchard writes that *Hypophlœus tenuis* depredates on this species." (Leconte afterwards identifies it as probably *P. puberulus*.)

36. *Xyleborus impressus* Eichhoff.

Leconte states that this species occurs in Georgia under pine bark.

37. PINE TIMBER-BEETLE.

Pityophthorus materiarius Fitch.

Order COLEOPTERA; family SCOLYTIDÆ.

In the interior of the sap wood, mining slender straight cylindrical burrows in a transverse direction, parallel with the outer surface, from which very short straight lateral galleries branch off at right angles above and below; a rather slender cylindrical black shining bark-beetle, 0.15 long, with pale dull yellow legs and antennæ, the fore part of its thorax and of its wing-covers tinged with reddish yellow; the thorax equaling two-thirds the length of the wing-covers with a small elevated tubercle in the middle, forward of which it is rough from minute elevated points; the wing-covers with rows of minute punctures, their tips rounded, the upper part of the declivity with a shallow longitudinal depression or groove along the suture, forming a slight notch.

The insects belonging to the genus *Tomicus* and kindred genera of the same family by their habits divide themselves into two distinct groups. The larger portion of them reside in or immediately beneath the bark of different trees, and are currently termed bark-beetles. But this designation is inappropriate for another portion of them which dwell in the interior of the wood, and there excavate their galleries. The name timber-beetles appears to be the most appropriate for these. Another point in which, from the observations of M. Perris, these two groups appear to differ in a remarkable manner, is the relative numbers of the two sexes. With the bark-beetles there are commonly several males in company with but one female, and the former appear to perform the chief part of the labor in the excavation of their galleries. With the timber-beetles, on the other hand, the females are much the most numerous, and probably mine their galleries without any assistance from the other sex. M. Perris states of one of the species that upwards of fifty females were met with in the burrows they had excavated without a single male being found there.

It is the habit of these timber-beetles to penetrate the tree in a straight line, passing inwards through the bark and into the sap wood to a depth of from half an inch to two inches, and then abruptly turning they extend their burrow in another straight line parallel with the outer surface and at right angles with the fibers of the wood, for a length of two to six inches. The only instance in which the burrow of the species now under consideration has come under my notice was recently in a billet of stove wood, which unfortunately did not contain the extreme end of the gallery. The annexed cut* is an exact representation of this bur-

*Not reproduced.

row, in which a live and a dead beetle were found, both of them females, and the only specimens of this species which have come under my observation. The transverse burrow was excavated in the sap wood at the depth of half an inch from its outer surface. Near its middle it was crossed by another perforation extending from the outside directly towards the heart of the tree, which is indicated by a black dot in the figure; and at this point the burrow curved slightly outwards towards the exterior surface, as represented in the section above the principal figure in the cut; and at its end on the left, where it passed out of the billet of wood, it commenced curving inwards towards the heart of the tree. Twelve lateral burrows of the same diameter as the transverse one extended upwards and two downwards, as shown in the figure, all of the same length, each one having been excavated probably by a single larvæ. The gallery of our insect thus differs widely from that of the European species (*T. eurygaster* Erichson) which mines in the interior of the pine, which has no lateral burrows branching off from it.

The presence of these timber-beetles in the wood can be distinguished from those which mine under the bark by the little piles of sawdust which they throw out at the mouth of their burrows, this dust being so much more white and clean, and not composed in part of the brown or rust-colored particles of gnawed bark which are intermixed with the dust produced by the bark-beetles. (Fitch.)

The beetle.—In addition to the short description of this beetle which is given above, it may be observed that the head is finely punctured, the punctures on the face giving out small pale yellowish hairs, while those on the vertex or crown are destitute of hairs, and there is a slight transverse elevation of the surface between the face and the vertex, from which an elevated smooth line extends backwards along the middle of the vertex. Thorax, when viewed from above, with its base transverse and rectilinear, its basal angles rectangular, its opposite sides parallel for a distance equaling the length of the base, and from thence rounded in a semicircle at its anterior end; its surface anteriorly with minute asperities, which, viewed vertically, appear like fine transverse wrinkles; its basal half with very minute punctures, and in its center a small transverse tubercle. Wing-covers with fine shallow punctures in rows; the upper part of the apical declivity moderately depressed in the middle, producing a slight concavity in its outline when viewed from above anteriorly, the suture not elevated in this depression, but showing a slightly impressed line along each side; the hind end bearded with hairs similar to those upon the front. Under side black, the legs and antennæ pale dull yellow. (Fitch.)

We have found this beetle in the pine woods of Maine; it was kindly identified for us by Dr. Leconte. It bores deep into the sapwood of *Pinus strobus* in long nearly straight burrows; the beetles may be found in them in March, their heads pointing towards the center of the tree.

This species, or one very similar to it, has been found by Mr. Hunting-

ton, of Kelly's Island, Ohio, to bore into empty wine casks and spoil them for use. (Guide to Study of Insects, p. 493.)

38. The spruce timber beetle.

Xyloterus bivittatus Mannheim.

This insect, though common under the bark of the white pine in Maine, is especially destructive to the spruce and fir, and for a further account the reader is referred to spruce insects.

39. The pine-bark carver.

Xyleborus cælatus Zimmermann.

Occurring in all stages of growth in July and August under white pine and spruce bark in Maine, sometimes in immense numbers, sufficient to kill the tree, a rather stout bark-borer, the declivity of the elytra with two prominent tubercles and some smaller marginal ones, with rows of punctures.

Bark borers of this genus are said by Leconte to have the body stout, cylindrical, with the slope of the elytra oblique, scarcely flattened; the funicle of the antennæ with four distinct joints, and the sensitive surface of the antennæ concentrically annulated. In the present species along the slope of the elytra are two prominent tubercles and some smaller marginal ones, the elytra are strongly punctured in rows, the interspaces with rows of distant punctures, while the tibiæ are strongly serrate.

From eight hundred to a thousand specimens of this bark borer, with hundreds of larvæ and many pupæ, were found in July and August at Brunswick, Maine, under the bark of a white pine stump about 22 inches in diameter, the tree having been cut down the preceding November. The bark was honey-combed with its holes, the pupæ resting in cells in the bark. The mines usually run obliquely through the thick bark, not sinking into the sapwood, so that no regular mine was formed, and it is difficult to give a good description of it. The diameter of the track and of the hole for the exit of the beetle is slightly larger than that of *Xyloterus bivittatus*. It is often two-striped, but this is due to the fact that it begins to turn dark after transforming in the middle of the elytra. It also occurred in abundance under the bark of the spruce, in the same place, associated with *X. bivittatus*, and also with the common undescribed species of *Dolurgus* to be noticed under spruce insects.

40. *Dryocœtes septentrionis* (Mann).

Occurring under the bark of the pine in Alaska, Canada, and Virginia, a bark-borer closely allied to *Xyleborus*, with the prothorax strongly punctured, not roughened in front; length 4.4^{mm} (0.17 inch).—Leconte.

41. The boring hylurgus.

Hylurgus terebrans (Olivier).

Order Coleoptera; family Scolytidæ.

Perforating larger holes in the bark than any of the preceding bark beetles, and mining curved galleries in every direction in the inner layers of the bark, and slightly grooving the outer surface of the wood; a cylindrical light chestnut-red or yellowish

fox-colored beetle 0.23 to 0.33 long, bluntly rounded at each end, thinly clothed with yellowish hairs, its thorax narrowed anteriorly and with coarsish shallow punctures, and a slightly raised line along the middle, at least on the posterior half, a faint blackish line along the middle of the upper part of the head, and its wing-covers rough, with rather shallow furrows, in which are coarse indistinct punctures. Appearing abroad early in May, numerous in pine forests and in lumber and mill yards. Its larvæ common under the thick bark of pine logs and stumps; a yellowish white footless grub thinly clothed with yellowish hairs, and divided into thirteen segments, its head polished and horny, of a tawny yellow color, with the mouth black, and the neck having on each side, above, a large polished spot tinged with tawny yellow. (Harris's Treatise, page 75.)

With this account taken from Harris, our own observations agree. The cells are smaller than those of *Pissodes strobi*. We have found the larvæ and immature beetles in abundance in Brunswick, Maine, in the middle of March. The burrows are very irregular, winding about under the bark, while the very irregular cells are from half an inch to an inch long, and nearly a quarter of an inch wide, and surrounded with the white woody chips made by the larva before pupating.

Leconte states that in this species the prothorax is very densely and coarsely punctured; the hairs of the elytra not being very long. It has been collected in Canada, Georgia, Oregon, and California, as well as the pine woods of New England and Northern New York. "The specimens from the Pacific slope are larger, and the punctures of the prothorax are rather smaller and more dense, but these differences do not seem to me worthy of specific distinction. Some specimens from New Hampshire and Canada have the prothorax more sparsely punctured, almost as in the next species (*D. similis*), from which they are only distinguished by the shorter hairs of the elytra. Length 5.2^{mm} to 8^{mm} (.2 to 3.2 inch).

42. The stout pine-borer.

Dendroctonus rufipennis Kirby.

Boring irregular galleries under the bark of the pitch pine, somewhat like those of *Tomicus pini*, but much less regular and twice as wide and deep, a reddish brown bark-borer.

This beetle, abundant in the New England States, is not uncommon in Colorado. I met with it at Blackhawk and at Manitou. It probably bores in the pines and spruces of the Rocky Mountains. It is short and stout, reddish brown, the head and prothorax smooth and shining, though finely punctured, while the wing-covers are coarsely punctured and dull-colored, being a little darker than the rest of the body. Length 0.35 inch.

Fig. 78.—Dendroctonus rufipennis.—From Packard.

Leconte states that he has received specimens from Alaska, Canada, and Anticosti. It is a common northern species. It is only to be distinguished from *D. similis*, says Leconte, by the declivity of the elytra being smoother and more shining, and almost without asperities; and by a slight difference in the punctures of the prothorax, which are of

unequal size. The dorsal line of the prothorax is sometimes narrow and elevated, sometimes obsolete. Length 6^{mm} (.24 inch). The distinctive characters given by Leconte are these: prothorax punctured, with smaller punctures intermixed; hairs of elytra long. We have found it at Providence, R. I., in its burrows under the bark of the white pine.

Allied to these two species of Dendroctonus, and undoubtedly infesting coniferous trees, are the following:

Dendroc'onus similis Leconte, Colorado. "A smaller and somewhat more elongate form occurs in Canada, Texas, and Colorado, but I do not think it capable of being separated as a distinct species."

Dendroctonus punctatus Lec. New York.

Dendroctonus simplex Lec. Canada.

Dendroctonus brevicornis Lec. Middle California.

Dendroctonus frontalis Zimmerman. Lake Superior to Georgia.

43. The Pine hylastes.

Hylurgops pinifex Fitch.

Order Coleoptera; family Scolytidæ.

A beetle which closely resembles the preceding, and is frequently met with in company with it upon pine lumber in mill yards early in May, requires to be noticed in this place. I am unable to find any description of this species, although it is so common it can scarcely have been overlooked by authors till this time. It is the *Hylastes pinifex*, or the pine-destroying Hylastes of my cabinet. Its habits are doubtless very similar to those of the boring Hylurgus, but the beetle is always slightly smaller measuring 0.20 in length, and is darker colored, being deep chestnut red or sometimes black, tinged with chestnut. It moreover is destitute of the hairiness of that species, having only a thin fine short beard on the hind part of its wing-covers. Its thorax and wing-covers have the same sculpture with that. Its head shows no line along the middle, except upon the upper lip, where is a slender short elevated one, which ends before it reaches a slight transverse depression which crosses the lower part of the face. Its body beneath is black, the legs dark chestnut, with the thighs commonly black. It moreover differs generically from the preceding in having seven, instead of but four, small joints in its antennæ, between the long club-shaped basal joint and the knob at the tip, which knob is shaped like an egg, and is divided by transverse lines into four short joints. Its shanks also have only fine denticulations along their outer edge near the tip, in place of the coarse saw-like teeth, which are seen in the foregoing insect. It thus pertains to the genus *Hylastes* of Erichson. (Fitch.)

I have found several beetles of this species (identified by Dr. Horn) under the bark of a white pine stump, at Brunswick, Me., August 15–20, 1881. The tree was felled in November, 1880. The beetles had evidently recently transformed from the pupa state, as they were with one exception pale red, the color of the fully mature beetle being black-brown.

44. The coal-black hylastes.

Hylastes porculus Er. (*carbonarius* Fitch).

A beetle so closely like the preceding that it merits to be noticed in connection therewith is the *Hylastes carbonarius* of my cabinet. It is 0.20 long, of a pure black color, except its feet and antennæ, which are chestnut red. Its face shows no transverse depression inferiorly, but has an elevated line along the middle, reaching a third

of its length. The smooth line along the middle of the thorax is less distinct than in the foregoing species, being slightly if at all elevated, and the punctures of this part are more coarse. Its wing-covers are not bearded posteriorly, and its general form is plainly more narrow and slender than that of the Pine Hylastes. The only specimen I have seen was captured the middle of July in the yard in front of my dwelling. (Fitch.)

45. The pales weevil.

Hylobius pales Herbst.

Order Coleoptera; family Curculionidæ.

A large dark-chestnut colored or black weevil, 0.30 to 0.40 long, sprinkled over more or less with dots, whereof one on the middle of the outer side of the wing-covers is more bright, these dots being formed by fine short yellowish gray-hairs. Quite common in May and June among pine trees, and in mill yards, and on piles of pine lumber; with its long cylindrical snout perforating the bark and crowding an egg into the hole, the larva from which, similar in its appearance to that of the white-pine weevil, burrows beneath the bark, loosening it from the wood. (Harris's Treatise, p. 61.)

This is a very common pine insect, which ranges from Maine and Lake Superior to Florida. Leconte states that the head is very densely, though not coarsely, punctured, and is nearly opaque; the prothorax is coarsely and rugosely punctured. The pubescence of the clypeal spots is sometimes yellow, sometimes gray. Length 6.8^{mm} to 10.2^{mm}; .27–.4 inch. There are several closely-allied species which probably will be found to depredate on the pine.

Our own observations on this borer were made many years ago at Brunswick, Maine. The burrows run under the bark of the trunk of the white pine; they extend irregularly over the inner surface of the bark, sinking down into the sap wood, where in the autumn the larva makes a cell nearly a quarter of an inch deep, arched over at the top with a thick roof of "sawdust" or chips it had bitten off from the wood; over a surface of four square inches were eight or ten cells. Each cell in the middle of March contains a yellowish-white footless grub, half an inch long. Two weeks later we found two pupæ and two perfect beetles, one apparently having just thrown off its pupa skin.

The history of the *pales* weevil seems, then, to be somewhat as follows: In May and June the beetle bores its way out from the cell, partially creeping out of the old larval burrow; flies about on sunny, warm days in April and May, then lays its eggs either on the sides of the opening of its old burrow, or in the crevices of the bark. Early in summer the young worm hatches, and burrows under the bark throughout the summer, until it matures in the autumn, and makes the cell deep in the sap wood, where it hybernates, and about the first of April changes to a pupa.

The cycle of its life is completed when the beetles fly forth early in May, and seek their mates, preparatory to laying the eggs from which a third generation are born. We have found the weevils flying about in Providence, R. I., during the middle of May.

46. The two-forked southern timber-beetle.

Carphoborus bifurcus Eichhoff.

Inhabiting the southern pine; mine consisting of a long, sinuous, narrow, primary gallery, from which rather short secondary galleries run out at nearly right angles; the beetle being minute.

Leconte states the species of this genus are next allied to Dendroctonus, but are minute in size and with long bodies. The elytra are striate with large approximate punctures. The funicle of the antennæ is 5-jointed; first joint large and rounded, the others closely united, forming a short, conical mass, as in Phlœosinus; club large, slightly pubescent, moderately compressed; rounded, obtuse at tip, and divided by two straight sutures; the first joint of the club is more shining than the others. There are three species of the genus, *C. simplex* inhabiting the Mohave Desert, California. *C. bifurcus* differs from *C. bicristatus* in having the first and third interspaces of the elytra all moderately elevated, the second not much narrowed on the declivity or inclined end of the elytra. The punctures of the elytral striæ are also larger. Leconte seems to suggest that the two eastern species may eventually be united. Length, 1.5mm (.06 inch).

Fig. 79.—Mine of Carphoborus bifurcus; natural size.—Packard, del.

The mine of this beetle I found under the bark of the southern pine at Montgomery, Ala.; the beetles taken thereform having been submitted to Dr. Horn for identification. The figure well represents an average mine. The primary gallery is nearly four inches long, very narrow, somewhat sinuous, ending at one end in a broad cell from which three or four secondary galleries pass off. About twenty secondary galleries pass off on each side at right angles to the main gallery, but not all in the same plane, as the figure shows; they are rather short, less than an inch in length, and sometimes end in a broad, irregular cell; the round dark spots in the figure indicate the holes in the bark for the exit of the insect. It appears to be a common pest in the Gulf States.

47. The two-crested southern timber beetle.

Carphoborus bicristatus Chapins.

In Georgia occurring under pine bark, according to Leconte. Length, 1.8mm (.07 inch).

The five following Scolytids also occur on the pine. The notes are

taken from Leconte's essay on the Rhynchophora, or weevils of the United States.

48. *Hypomolyx pinicola* Leconte.

This species was originally described by Couper (Trans Lit. and Historical Society of Quebec, 1864), under the name of *Hylobius pinicola*. The body is elongate, ovate, broader behind, the eyes small, elytra oval, convex; the beak is as long as the prothorax, rather stout, slightly curved; the prothorax is rather small, subserrate on the sides, very coarsely punctured, thinly clothed with coarse hair, carinate in front; the elytra are densely punctured, mottled with small spots of yellow hair; striæ composed of large elongate deep punctures. Length, 13.5mm (.5–.3 inch).

49. *Hilipus squamosus* Leconte.

The genus *Hilipus*, says Leconte, largely developed in tropical America, is represented by a single rare species found in Georgia and Florida, where it occurs under pine bark. It differs from Hylobius in the body being ornamented with small scales instead of spots of fine pubescence. It is a beautiful black insect, with a broad white lateral vitta on the prothorax, and a very irregular one on the elytra, with many scattered small spots, densely clothed with depressed, very small, round, chalky white scales. Punctures of elytra very large, distant; interspaces smooth, shining, except where covered with scales. Length, 14.4mm (.57 inch).

50. *Crypturgus atomus* Leconte.

Canada, Massachusetts, New York; under bark of dead pine branches. Length, 1mm (.04 inch).

This species, though common in white pine bark, is especially destructive to the spruce, and is more fully described under the head of spruce insects. It occurred in abundance at Brunswick, Me., in all stages of development, from the fully-grown larvæ to the beetle under the bark of white pine stumps (the trees having been felled the previous November), from the middle of July until the 1st of September, and probably still later.

51. *Ernobius tenuicornis* Leconte.

Order COLEOPTERA; family PTINIDÆ.

According to Leconte this beetle has been detected in the boughs of *Pinus rigida* in Massachusetts by Mr. Blanchard. (Trans. Amer. Ent. Soc., viii, xxiii, 1880.)

52. THE PINE ÆGERIAN.

Ægeria pini Kellicott.

Order LEPIDOPTERA; family ÆGERIADÆ.

Boring in autumn under the bark and into the superficial layers of wood, usually just below a branch, a white smooth caterpillar an inch long, transforming to chrysalids late in May, the moth appearing from the middle to the end of June. (Kellicott.)

Mr. Kellicott gives the following account of this insect:

"When studying the larval habits of *Pinipestis zimmermani* in 1878–'79, I met with the larva and pupa skins of two moths evidently different from the pine pest, yet having quite similar larval habits. During the past summer I succeeded in getting the moth of one of them; it is an Ægerian, as I think, undescribed, but I would not venture upon describing it had I only the imago; but as I am able to give mainly its history, and having done so much tramping and climbing for its sake, that I have come to feel a proprietary right, I undertake to name and describe it as new. As its proposed name implies, the larva inhabits the pine, boring under the bark and into the superficial layers of the wood. From the wounds thus made pitch exudes, which, through the action of the larva and the warmth of the sun, forms hemispherical masses over its burrows; in these masses the pupa cells are finally prepared and the inactive stage passed. The larva occurs more frequently than elsewhere just below a branch; sometimes about the border of a wound made by the axe, or where a limb has been wrenched off by the wind; rarely in the axil of the branch. It appears to attack larger trees than the Zimmerman's pine pest, and more frequently occurs at considerable altitude. I have taken them thirty to forty feet from the ground. While they sometimes, perhaps as a rule, take advantage of the broken cortex, I have found them where it appeared that they had worked through the same into the soft layer.

"I have found the larva in the following localities: Hastings Center, N. Y.; Portage, N. Y., Buffalo, N. Y. (?); Point Abino, Ontario. At the first-named place they were found in several instances numerous enough to seriously injure trees of moderate growth. I have taken the larvæ in autumn from 0.25 to 0.75 of an inch in length; they finally attain a length of 1 to 1.1 inch; diameter quite uniform, 0.18 of an inch. Color white; head light brown, flattened; first thoracic ring slightly clouded with brown, smooth; no trace of an anal shield; true legs scarcely colored, pro legs prominent, crowned with two rows of about eight hooks each. The brown hairs arise from papillæ, the base of each hair being surrounded by a brown annulation. The spiracles are but slightly elliptical, last pair large, placed sub-dorsally.

"Before transforming they prepare a cell in the extruded pitch mingled with their *débris;* this they line with silk, but spin no other cocoon. While in their burrows they move through the soft pitch with impunity, but if removed from the same they soon die from the encumbrance of the hardening pitch adhering to them.

I have found the pupa the last of May; the moth appears from the middle to the end of June. It may be that others come in July and August, for I have found larvæ apparently full grown in July. On the 15th of July I brought to my rooms, devoted to the rearing of insects, some blocks of wood containing such apparently mature larvæ, expecting them to complete their transformations in a few weeks at most;

they are still in their pitch cells unchanged (Nov.). Is it a case of retarded development, due to the drying of the bark and wood?

The pupa has a length of 0.73 of an inch. Color light brown with the extremities dark. Over the dorsal portion of the abdominal rings are the usual rows of teeth; those on the anterior margins scarcely extend below the spiracles. The clypeus is without a pointed process; the medio-dorsal ridge of the thorax is unusually prominent.

When about to transform it bores through the pitch wall and escapes, leaving the pupa skin protruding.

The moth (female) expands 1.2 inch. Fore wings opaque; hind wings transparent. Color blue-black, as follows: fore wings, the clothed portions of hind wings, head, palpi, thorax, upper part of abdomen, antennæ, and legs. The neck fringe and the sides of the collar are orange, also the ventral side of the abdomen and the tail fringes. The antennæ are long, slightly enlarged toward the end; there is a decided orange line on the under side of the antennæ for one-third their length; the tarsi are smoky. The male not seen. (Canadian Entomologist, xiii, p. 5–7, 1881.)

53. The pitch-drop moth.

Nephopteryx (*Pinipestis*) *Zimmermanni* Grote.

Order Lepidoptera; family Pyralidæ.

In June and July wounding the trunk of the red and white pine below the insertion of the branches, the presence of the larva being detected by the exuding pitch; the larva livid or blackish green, eating on the inner side of the bark and making furrows in the wood; in July spinning a papery cocoon, the moth appearing from 10 to 14 days afterwards.

Mr. A. R. Grote has called attention in the *Canadian Entomologist* (vol. ix, p. 161) to this pest of the red pine (*Pinus resinosa*) and white pine (*Pinus strobus*). The caterpillar occurs in the months of June and July, when the trees affected show by the exuding pitch that they are suffering from the attacks of this insect. The wound occurs on the main stem below the insertion of the branch. The worm in July spins a whitish, thin, papery cocoon in the mass of exuding pitch, which seems to act as a protection to both the larva and the chrysalis. The moth appears in ten to fourteen days after the cocoon is spun.

Mr. Grote adds that the worm usually infests the main stem at the insertion of the branches; and from the fact that the pitch of the trees protects the caterpillars no wash would injure the insect; hence extermination with the knife is the only remedy.

In vol. x of the same journal (p. 20) Mr. C. D. Zimmerman, the original discoverer of this pest, gives some further account of it. He writes that there is scarcely a pine more than four feet high on his grounds which is not more or less affected by this borer. "I have found it on *Pinus strobus*, *P. rubra* or *resinosa*, *P. austriaca*, *P. sylvestris*, *P. cembra*, Corsican, lofty Bothan and Russian pines. *P. sylvestris* seems to suffer most, as the limbs, and often the main stems, are constantly breaking off. Only a few days ago one of our finest specimens of *P. strobus* (a

tree over 30 feet in height and almost perfect in shape) had about 6 feet of the top broken off—the effects of this borer. I am in hopes the small parasitic flies I found in the larva will soon get the upper hand, so as to keep them in check."

Additional observations have also been made by Mr. D. S. Kellicott, who states* that the moth is pretty widely spread, as it occurs not only in foreign and native pines in and about Buffalo, but that he has "found it quite abundant in small white pines of the forest at Cheektowaga, Erie County, New York. At this place I found many plants had been dwarfed and ruined by their ravages. It also occurs, to what extent I am unable to say, at Hamburg and Clarence Center, in the same county. I recently visited a portion of this State, Oswego County, formerly clad to some considerable extent with white pine, and there are yet standing some virgin forests of this splendid tree. In divers places in that county I found our borer; it is so abundant, in one locality at least, that it proves a grave enemy to the young pines of second growth where the primitive trees have been removed by the lumbermen. There is near Hastings Center an old slash in which at least one-half of the many such small pines have been injured; indeed, in one neglected corner, among scores, scarcely one tree had escaped. In this instance, also, many pines were stunted, while some thus weakened had been broken off by the wind." * * * "In a clump of pines, whose trunks were from 6 inches to 1 foot in diameter, many of the larger ones had been 'boxed,' *i. e.*, inclined incisions had been cut by the axe through the sap wood in order to catch the pitch exuding from the wound. Around the borders of these 'boxes' the galleries with both pupa skins and living larvæ were plentiful. It appears that the larva cannot penetrate the outer bark of other than quite tender trees; nor could I find evidence of their attacking the branches of larger trees, although I had opportunity to examine such that had been felled during the winter just past. Since the larva so readily takes advantage of a wound, may it not stand related as a messmate to other borers?" * * * "I have found the moth's galleries in both trunk and branch, both above and below the whorls (usually below), sometimes completely girdling the stem, thus killing the portion above; in one instance I found a gallery passing from one whorl to the one above."

Larva.—When fully grown, 16^{mm} to 18^{mm} in length. The head is shining chestnut-brown: the mandibles black. The body is livid or blackish green, naked, with a series of black dots, each dot giving rise to a single, rather stout bristle. The prothoracic shield is blackish. The larva has three pairs of thoracic or true-jointed feet, and four pairs of abdominal or false feet, besides anal claspers.† (Grote.)

* Canadian Entomologist, xi, p. 114, 1879.

†Mr. Kellicott found that the larva hybernates, as April 12 he found the caterpillars of various sizes from 0.25 to 0.7 inch in length. "None of those taken were 'livid or blackish green,' but dull white; nor do the hairs arise from a 'series of black dots,' but from light-brown ones. I take it to be a case where a naked hybernating larva is lighter than during the warm summer. Otherwise the caterpillars were as described by Mr. Grote."

Chrysalis.—Cylindrical, smooth, narrow, blackish-brown, about 16mm in length. The head is pointed, there being a pronounced clypeal protuberance; the segments are unarmed; the anal plate is provided with a row of four spines, and two others, more slender, on either side of the mesial line, below the first. (Grote.)

Moth.—The wings expand 30mm. Blackish-gray, shaded with reddish on the basal and terminal fields of the fore wings. There are patches or lines of raised scales on the basal field, and on the anterior and darker portion of the median space. The median lines are prominent, consisting of double black lines inclosing pale bands. The inner line at the basal third is perpendicular, W-shaped or dentate. The outer line at the apical fourth is once more strongly indented below the costa. The black component lines do not seem to be more distinct on one side than on the other of the pale included bands or spaces. The median field is blackish, becoming pale towards the outer line; it shows a pale, sometimes whitish cellular spot, surmounted with raised scales. The terminal edge of the wing is again pale or ruddy before the terminal black line. Wings blackish. The hind wings are pale yellowish white, shaded with fuscous on the costal region and more or less terminally before the blackish terminal black line; fringe dusky. Beneath, the fore wings are blackish, marked with pale on the costa; hind wings as on the upper surface. Body blackish-gray, with often a reddish cast on the thorax above and on the vertex. The eyes are naked, the labial palpi long, ascending, with a moderate terminal joint. Tongue rather long. The gray abdomen is ringed with dirty white; the legs are dotted with pale. The species differs from the European *abietella* by the raised scale tufts on the wings, and Zeller declares it to be distinct from any European species. (Grote.)

54. The pitch-eating weevil.

Pachylobius picivorus (Germar).

A black weevil very similar to *Hylobiuspales*, but destitute of any spots or dots, and having the same habits. This occurs in the southern part of our State, and becomes common farther south, but I have never met with it to the north of Albany. (Fitch.)

Leconte separates as a distinct genus from Hylobius, *H. picivorus*, which differs greatly from the other allied species of Hylobius by the tibiæ being much shorter and stouter, and expanding at the tip. It is abundant under pine bark, adds Leconte, in the Southern States, less frequent in the Middle States.

55. The white-horned urocerus.

Urocerus albicornis Fabricius.

Order Hymenoptera; family Uroceridæ.

A large black four-winged fly an inch long, having some resemblance to a wasp, but with a stout cylindrical body having the head and abdomen closely joined to the thorax, the base of the shanks and of the feet white, and also the antennæ except at their ends, and a spot behind each eye and another on each side of the abdomen, the wings smoky transparent. The abdomen ends in a point shaped like the head of a spear, below which is a straight awl-like ovipositor, about 0.40 long, with which it bores into the tree to deposit its eggs, the worm from which forms winding burrows in the wood, and is of a thick cylindrical form, divided into thirteen nearly equal segments, including the head, which is small, polished and horny, the last segment being largest of all and ending in a conical horn-like point, and the under side with three pairs of very small legs anteriorly.

These insects vary considerably in their colors and marks, and the two sexes are very dissimilar. The male, according to Dr. Harris, is black, with a white spot behind each eye, and a flattened rust-colored abdomen. (Harris's Treatise, p. 427.)

56. THE YELLOW-BANDED UROCERUS.

Urocerus abdominalis Harris.

A four-winged fly similar to the foregoing, about 0.80 long, of a blue-black color, with from two to four of the middle segments of its abdomen bright orange yellow, and also a broad band on the antennæ and the four forward legs except at their bases, its wings hyaline, tinged at the tips with a smoky color. There is sometimes a yellow spot behind each eye, and the hind knees and some or all of the joints of the hind feet are usually yellow. My specimens are males, nor has any female answering to this been found, and I am forced to entertain suspicions it is the true male of the preceding species. These insects are not common. (Harris's Treatise, p. 428.)

57. THE PINE BLIGHT.

Coccus pinicorticis Fitch.

Order HEMIPTERA; family COCCIDÆ.

Externally, upon the smooth bark of young trees, patches of white flocculent down-like matter, covering exceedingly minute lice invisible to the naked eye. (Trans. N. Y. State Ag. Soc., 1854, p. 871. Compare also an article by Dr. H. Shimer in Trans. Amer. Ent. Soc., ii, pp. 383–385.)

AFFECTING THE TWIGS.

58. THE WHITE-PINE WEEVIL.

Pissodes strobi Peck.

Order COLEOPTERA; family CURCULIONIDÆ.

In May, depositing numerous eggs in the bark of the topmost shoot of young trees, the larvæ from which mine in the wood and pith, causing the shoot to wither and die; hereby occasioning a crook or fork in the body of the tree at this point; an oblong oval and rather narrow weevil about a quarter of an inch long, of a dull dark chestnut-brown color, with two dots on the thorax; the scutel and a short irregular band back of the middle of the wing-covers milk white, the wing-covers also variegated with a few patches of tawny yellow.

This is a common insect in New York, and specimens of it may be found around and upon pine trees at all times of the year, but it is in the month of May that they are abroad in the greatest numbers, and it is chiefly at that time that their eggs are deposited. Young thrifty-growing pines are its favorite resort, and among these it selects those that are most vigorous, and whose topmost shoot has made the greatest advance the preceding year. But I have seen it so numerous that not only the topmost shoots of every tree in the grove, but many of the lateral ones also were invaded and destroyed by it.

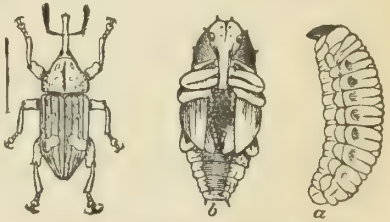

FIG. 80.—White-pine weevil: *a*, larva; *b*, pupa, enlarged nearly three times.—From Packard.

It is in consequence of its smooth straight growth to such a lofty height that the pine has been prized beyond any other timber for large buildings and bridges, and is especially valuable for the masts of ships.

So very highly were the American pines esteemed for this last purpose, at an early day, that they were ranked with the precious metals, and a large portion of the lands of the State of New York were originally granted by the British crown, with an explicit reservation of "All mines of Gold and Silver, and also all White and other sorts of Pine trees fit for Masts, of the growth of twenty-four inches diameter and upwards at twelve inches from the earth, for Masts for the Royal Navy of us, our heirs and successors," under the stringent condition that "If they, our said grantees or any of them, their or any of their heirs or assigns, or any other person or persons by their or any of their privity, consent or procurement shall fell, cut down or otherwise destroy any of the Pine trees by these presents reserved to us, our heirs and successors, or hereby intended so to be, without the Royal Lycence of us, our heirs or successors for so doing first had and obtained, that then, and in any of these cases, this our present grant, and everything therein contained, shall cease and be absolutely void, and the lands and premises hereby granted, shall revert to and vest in us, our heirs and successors, as if this our present grant had not been made, anything herein before contained to the contrary in any wise notwithstanding." Now the perfect straightness of the pine, which has adapted it so eminently for this important use, and has caused it to be thus valued, depends upon the healthy growth of its leading shoot for a long succession of years. If this leading shoot is destroyed the onward growth of the tree is checked until one of the lateral shoots starts upward and becomes the leading shoot. But this causes a crook in the body of the tree at the place where this lateral shoot originally arose, and thus the main value of the tree is destroyed. And it would appear to be a spirit of pure malevolence that instigates the white-pine weevil to select the leading shoot of this tree in which to deposit its eggs, when its young can be nourished equally well in the lateral shoots, where they would do little injury, or perhaps would be a direct benefit to the tree by cutting off the ends of the branches, and thus promoting the upward growth of the main trunk.

The weevil deposits her eggs in the bark of the topmost shoot of the tree, dropping one in a place at irregular intervals through its whole length. The worm which hatches from these eggs eats its way inwards and obliquely downwards till it reaches the pith, in which it mines its burrow onwards a short distance farther, the whole length of its track being only about half an inch. But such a number of young weevils are usually placed in the affected shoots that many of them are cramped and discommoded for want of room. The worm on approaching the pith often finds there is another worm there, occupying the very spot to which he wishes to penetrate. He hereupon, to avoid intrusion upon his neighbor, turns downward and completes his burrow in the wood outside of the pith. Those also which enter the pith are often unable to extend their galleries so far as is their custom without running into those of others. When its onward course is thus arrested the worm feeds

upon the walls of its burrow until it obtains the amount of nutriment it requires and is grown to its full size.

The tree that is attacked continues its growth upward during the fore part of the season as usual, sending out from the summit of the shoot that is infested a leading shoot, with a number of lateral branches around its base. But the growth of these new succulent twigs is arrested, and they begin to wilt and wither about the middle of July, the worms having by this time become so large and mined and wounded the stalk below to such an extent that its juices are exhausted, and it fails to transmit any nourishment to these tender green shoots at the summit, which consequently dry up and perish.

If the affected shoot be now examined, little oval cells about 0.30 long, placed lengthwise of the stalk, will be discovered all along its center, so close in some places that their ends are in contact, and in other places more or less widely separated, with the intervening space stuffed with sawdust, whilst here and there in the wood on each side of the pith similar cells show themselves. In each of these cavities lies a white glossy worm, its body soft, plump, and curved into an arch, 0.30 long, and not quite a third as broad at its anterior part where it is broadest.

This *larva* is divided by transverse constrictions into thirteen segments, including the head, with the breathing pores forming a row of small round tawny yellow dots along each side. Its head is about half the width of the body, round, flattened, polished and horn like, tawny yellow, with an impressed line along its middle, a faint whitish line on each side parallel with this, and a more distinct transverse arched white line anteriorly, and a minute black dot on each side representing the eye; the mouth darker colored, with the points of the mandibles slightly projecting, these organs being black, triangular, and with exceedingly minute sharp teeth along their inner edge. The neck has two smooth pale tawny-yellow spots above. It has no feet, but their places are supplied by roundish elevations of the skin on the under side of the three segments next to the head. The surface shows a few very fine short hairs, particularly on the ends.

These larvæ change to pupæ and to perfect insects in their cells, the latter coming abroad mostly early in the spring. The short description at the commencement of this account will suffice to distinguish this weevil from all our other species. It varies in its length from 0.20 to 0.30. Dr. Harris thinks they are more than a year in obtaining their growth, but I am quite confident the eggs deposited in the spring become mature beetles by the following spring or earlier.

In midsummer, as soon as the shoot in which these insects are nestling becomes withered and dry, the thin bark covering it is commonly seen to be broken and peeled off in spots, or all its lower part is torn away, and newly perforated holes, larger than the mouths of the burrows of this insect, may be observed here and there in the wood. This is

the work of small birds, which are very efficient and serviceable in ferreting out and devouring the larvæ and pupæ of this weevil. And, in addition to these, it has several insect enemies which aid in restraining it from becoming excessively numerous. But notwithstanding the great inroads which are hereby made upon its ranks, this is quite a common insect in every part of our State and country where the pine abounds, deforming these valuable trees and retarding their growth. The proprietor of every grove of young pines should therefore make it a rule to examine them every year, in August or September, and cut or break off the top of every tree that is blighted by these weevils and commit it to the flames. With every shoot that is thus treated, from ten to fifty or more of these weevils will be destroyed, which otherwise will come abroad the following year to dwarf and deform a number of the other trees in the same manner. No one, on casting this subject over in his mind for a moment or two, will doubt but that a few hours devoted to such work, or a whole day, should it be required, will be time well spent, and labor that will be amply rewarded.

To the foregoing account, copied from Fitch's Fourth Report, we will only add that we have observed the weevil in all its stages of growth at Brunswick, Maine, under the bark of white pine shrubs, the last of April, the larvæ at this date being more numerous than the pupæ or beetles. Our larvæ were .32 inch long. The pupa is white, the tip of the abdomen being square, with a sharp spine on each side. It is .30 inch in length. There are often to be seen in the forests of Maine trees, from two to four feet in diameter, variously distorted by the attacks in early life of this weevil; one in particular, at Brunswick, we are familiar with, nearly four feet thick at the base, and which subdivides into eight shafts, the central one wanting.

We have also found the insect in abundance in September, on the ornamental pine bushes on the grounds of the Massachusetts Agricultural College, at Amherst, Mass.

59. The white-pine aphis.

Lachnus strobi Fitch.

Order Homoptera; family Aphidæ.

Colonies of plant-lice on the ends of the branches, puncturing them and extracting their juices, the bark of the infested trees having a peculiar black appearance; numbers of ants in company with them, and traveling up and down the trunks of the trees which they inhabit. The winged individuals 0.20 long to the tips of their wings, black, hairy, and sometimes slightly dusted over with a white meal-like powder, with a row of white spots along the middle of the abdomen, the thighs dull pale-yellow at their bases, and the fore wings hyaline, with black veins, of which the forked one is exceedingly fine and slender. The wingless individuals far more numerous, 0.12 long, brownish black with a white

line along the middle of the thorax and white spots along each side of the abdomen, which are sometimes faint or wanting, the antennæ pale, with their tips black.

60. THE PARALLEL SPITTLE-INSECT.

Aphrophora parallella Say.

Order HEMIPTERA (Homoptera); family CERCOPIDÆ.

In June, a spot of white froth, resembling spittle, appearing upon the bark near the ends of the branches, hiding within it a small white wingless insect having six legs, which punctures and sucks the fluids of the bark, and grows to about a quarter of an inch in length by the last of that month, and then becomes a pupa of a similar appearance, but varied more or less with dusky or black, and with rudimentary wings resembling a vest drawn closely around the middle of its body; the latter part of July changing to its perfect form, with wings fully grown, and then no longer covering itself with foam, but continuing to the end of the season, puncturing and drawing its nourishment from the bark as before. The perfect insect a flattened oval tree-hopper, 0.40 long, with its wing-covers held in form of a roof, its color brown from numberless blackish punctures upon a pale ground, a smooth whitish line along the middle of its back, and a small smooth whitish spot in the center of each wing-cover, its abdomen beneath rusty brown.

The reasons why I regard this species as pertaining to the genus *Aphrophora*, to which Say had assigned it, instead of the genera in which it has recently been placed, will be found stated under a kindred species in my Third Report, No. 98. (Fitch.)

What I suppose to be this insect is also very common on the pitch pine at Brunswick, Me. The pupæ are common late in July, but early in August the insects acquire their wings.

61. THE SARATOGA SPITTLE-INSECT.

Aphrophora saratogensis Fitch.

A similar insect with the same habits with the preceding, but differing from it in having the punctures uncolored, and the head above with its anterior and posterior margins parallel. It is of a lighter color than the foregoing, being pale tawny-yellow varied with white. It is much more attached to the pitch-pine than to the white pine, and is very common upon the small trees of that kind growing upon the sandy plains of Saratoga County. (Fitch.)

62. THE PITCH-PINE TWIG TORTRIX.

Retinia (?) *comstockiana* Fernald.

Boring into the twigs and small branches of the pitch-pine (*Pinus rigida*), causing an exudation of resin; yellow-brown larvæ, about 10mm (.39 inch) long, transforming within the burrow, and giving forth small brown and gray moths. (Comstock.)

An examination of the pitch-pines in the vicinity of Ithaca, N. Y., in the early part of the past summer,* revealed the fact that they were infested to a considerable extent by a heretofore undescribed pest. Upon the smallest twigs and limbs and upon the terminal shoots of the trees were observed exuding at intervals masses of pitch, mixed with

*The account is copied textually from Professor Comstock's Report, 1879.

the excremental pellets of some larva. In most cases there were two distinct layers of the resin to be seen, the lower dry, hard, whitish, weather-beaten, having evidently been exposed during the winter, while the upper mass was fresh, softer, and of a hoary, bluish color on the surface, yellowish beneath, having the appearance of a comparatively recent exudation. These resinous lumps, when occurring upon twigs or limbs, were, in the great majority of cases, upon the upper side, and were seldom found upon a larger limb than the one represented in the cut.

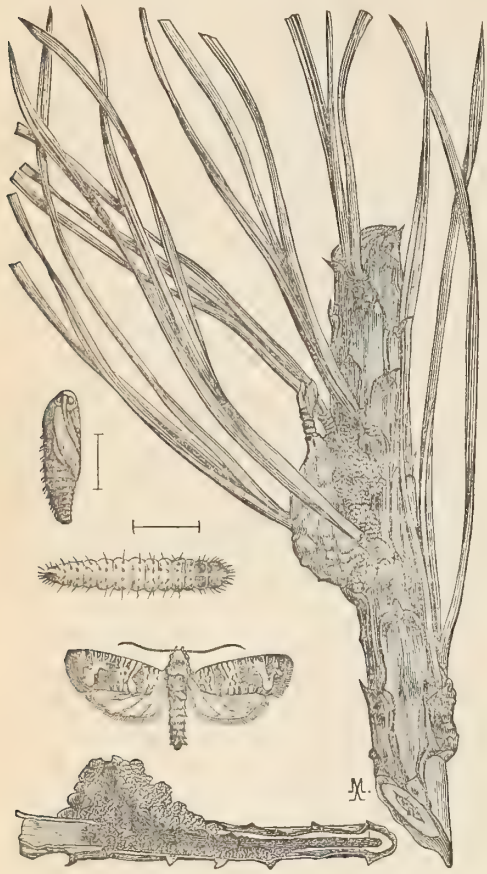

FIG. 81.—*Retinia comstockiana* Fernald, larva, pupa, adult and work.—From Comstock.

A longitudinal section through one of these lumps showed a channel of greater or less size leading directly to the heart of the twig, and extending along toward its base for a distance of from 25mm to 50mm (1 to 2 inches.) In this burrow was found a rather stout, yellowish-brown larva, apparently nearly full grown, and measuring about 10mm (.39 inch) in length. In other burrows the short, stout, brown pupæ were found. They were quite active, and retreated to the bottom of the mine when the resin was cut into. A ring of strong spines surrounded the posterior border of each segment and enabled them to move about in the mine with considerable rapidity. From other lumps the empty pupa skin was protruding for half its length, the pupa having worked itself to that position before giving forth the moth.

Some of the burrows examined extended in both directions from the point of entrance. Occasionally, also, the twig at the point where the resin exuded was completely girdled, and in other cases eaten out to such an extent that a very slight force would suffice to break it off. The larvæ were in some cases found with their heads at the mouth of the burrow, but in the majority of instances the opposite was the case.

The moth which issues from the burrows is quite small and soberly colored. In the figure it is represented natural size; the darker shades

are dark rust color, and the lighter light gray. It belongs to the family Tortricidæ, the larvæ of which are usually leaf-rollers.

From what we have been able to learn, we conclude that there are two broods of this insect in a year, and that the second brood hibernates in the larva state. May 25, burrows were found from which the moths had already issued. In the breeding cages at Washington the moths issued until June 20, when the last one made its exit. August 23, larvæ were received which were nearly full grown, and were presumably of the second brood. In the following January nearly all the larvæ found were only about half grown; none were more than two-thirds grown.

At the approach of winter the larvæ prepare their burrows for hibernation by lining them with delicate layers of white silk, which often form tubes closed at the lower end. The larva remains through the winter with its head at the posterior end of the mine. Before the change to the chrysalis state, however, this position is reversed and the head is towards the opening.

Wherever a twig is pierced and bored by one of these larvæ the leaves begin to turn yellowish and the twig often dies. In many cases, however, more than one of the larvæ are to be found in a single twig, and this of course more certainly insures its death. It seems probable that the principal damage done is the disfiguring of the shape of the tree by the destruction of terminal shoots.

It is probably this caterpillar which in the summers of 1873–'74 proved very destructive to the pitch pine bushes in and about Brunswick, Me., causing the upper part of the bush to turn yellow and die.

The moths bred from the burrows were submitted to Professor Fernald, who decided that they represented a new species, probably belonging to the genus *Retinia*. This species he describes in the Canadian Entomologist, vol. xi, p. 157. We quote Professor Fernald's description of the moth, and append descriptions of the larva and pupa so that the insect may be recognized in whatever stage it is found.

The moth.—Head in front, basal joints of antennæ, and palpi white; last joint of palpi and a few scales upon the outside of the middle joint dark gray. Eyes black, vertex light sulphur-yellow to straw-yellow. antennæ dark brown, annulated with whitish. Thorax above white, with a few scattered gray scales; beneath silvery white. Abdomen above light brown, with a silvery luster; lighter at the end of each segment; beneath lighter; last segment in the females darker brown above and beneath, and without the silvery luster. Anal tuft in the males light straw color. Fore and middle legs light brown, femora and tibiæ of hind legs white, tarsi of all the legs brown, ringed with white. Fore wings ferruginous brown, the extreme costal edge from base to near the apex dark brown. A number of small white spots rest upon the costa, four hairs beyond the middle, from all of which stripes composed of

white and leaden-hued scales extend, more or less irregularly, across the wing at nearly right angles with the costa, and having something of a wavy appearance in some specimens, with some indication of a basal patch, a central and subterminal band composed of the leaden and white scales. Fringes light brown above and beneath; fore wings light brown beneath; ferruginous apically, with the white spots of the costa well indicated. Hind wings above and beneath grayish brown, with a tinge of ferruginous in some specimens and with darker irrorations on the costa and outwardly; fringes long at the anal angle, somewhat lighter and with a darker line near the base.

Expanse.—Female, 18–20^{mm}; male, 18–20^{mm}. *Habitat.*—Ithaca, N. Y. Described from two males and three females.

I have provisionally referred this species to the genus *Retinia*, for although it agrees with the definition of the genus as given by Heinemann in other respects, the venation of the fore wing differs in the origin of veins four and five, which are not from the same point, but a little remote from each other; the distance between veins five and six at their origin is about twice the distance between veins four and five.

The moth has also been taken by Mr. Otto Lugger at Baltimore, Md.

Larva.—Length, when full-grown, 12^{mm}, cylindrical, tapering very slightly at the ends. General color yellowish; head, thoracic plate, and piliferous spots brown and highly polished; anal plate dusky and somewhat polished, under a high power covered with shallow pits. The piliferous warts are large and quite prominent, each bearing a stiff hair. Their arrangement is normal. The anal shield is furnished with two transverse rows of four hairs each; the posterior row, from a dorsal view, appearing to fringe the end of the body. The stigmata are light colored, surrounded by a dark-brown chitinous ring. Thoracic legs and bases of prolegs brownish.

The young larvæ differ in being darker colored. The head and thoracic shield are lighter; the piliferous spots are hardly discernible; the stigmata are much larger in proportion to the size of the larva, and their dark circumference is very strongly marked.

Pupa.—Length, 7^{mm}. General color dark shining brown, darkest on dorsum of thorax and head; wing-sheaths broad, extending to third abdominal segment. The posterior border of each abdominal segment dorsally elevated to a spiny ridge, bearing many strong backward-directed spines. Anal segment somewhat truncate, with a number of slender hooked filaments. Eyes very black and prominent. Between the eyes two pairs of the hooked filaments, having their origins close together and spreading. (Comstock.)

Two species of Ichneumonid parasites have been bred from the larvæ, both furnished with long oviporitors to pierce the resinous mass. One is a species of Agathis; the other is *Ephialtes comstockii* Cresson described in Mr. Comstock's Report.

64. THE PINE TWIG TORTRIX.

Retinia frustrana Scudder.

Order LEPIDOPTERA; family TORTRICIDÆ.

Infesting the new growth of *Pinus inops* and pitch-pine (*P. rigida*) (and perhaps of other species), spinning a delicate web around the terminal bud, and mining both the twig and the bases of the leaves; one or several small yellowish larvæ which transform within grayish cocoons, either in their burrows or fastened to the twigs, and become small copper-colored moths, with wing expanse of 12mm (0.47 inch).

"About the middle of May, 1879, the scrub-pines (*Pinus inops*) in Virginia, near Washington, were found to be greatly injured by small lepidopterous larvæ. On many trees there was scarcely a new shoot to be found which was not infested at its tip by from one to four yellowish black-headed caterpillars. They were so completely concealed while at work that their presence would scarcely be noticed, and the effect of their work was hardly visible until the twig was almost completely destroyed. Upon close examination a delicate web was seen inclosing the base of the bud, and the surrounding new leaflets, resembling much the nest of a small spider. When this web was removed, one or several little yellow caterpillars were seen retreating into a mine in the bud or into the bases of the leaves, which were also mined, or, not infrequently, they dropped from the twig, suspending themselves by a silken thread. The bud was often so hollowed that it dropped to pieces almost at a touch.

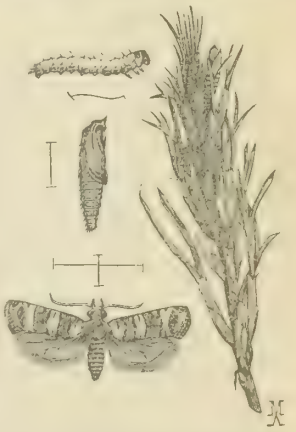

FIG. 82.—*Retinia frustrana* Scudder, larva, pupa, adult and work. —From Comstock.

"At the time when they were first noticed larvæ of almost all sizes were to be found. Some were apparently almost full-grown, while others had evidently not been long hatched. The nearly full-grown specimens measured 8mm (0.31 inch) in length. The first pupæ were obtained early in June. Most of the larvæ transformed within the burrows which they had made, first spinning more or less of a silken envelope about themselves. Others, however, issued from their mines, and spun rather tough grayish cocoons between the leaves. The pupæ were short, stout, and brown in color, with each segment furnished dorsally with two serrated lines, one consisting of large and the other of fine teeth.

"The first moths issued June 13, the pupæ having previously worked their way, by means of the spines just mentioned, into such positions that they could give forth the moths without injury to the latter, and a few weeks later almost every shoot had one or more of the empty pupa skins protruding from it. Specimens of the moths were sent to Professor Fernald, who determined them as identical with Mr. Scudder's manuscript species *Retinia frustrana*. In August Mr. Scudder gave a short account of this insect before the entomological section of the

American Association for the Advancement of Science, at Saratoga. He had found it in such numbers upon the island of Nantucket, in the young trees of *Pinus rigida* planted there some years ago to repair the damage done by burning during the war of 1812, as to seriously threaten the success of the experiment. Mr. Scudder intends publishing an account of the workings of the insect in that locality very shortly.

"In the latter part of July specimens of the twigs of *Pinus rigida* were received from Mr. S. H. Gage, of Ithaca, which had evidently been infested by the same insect, although no living inhabitants were to be found. In September other specimens were received from the same gentleman, and this time pupæ and one larva were found. According to Mr. Gage the insect is not very common in that locality.

"In the latter part of August individuals of the second brood were very abundant in the scrub-pine in the vicinity of Washington. As before, they were found in almost every stage of growth, and the difference was even more marked. In one instance five larvæ of greatly differing sizes were found in one shoot. The smaller ones were boring into the bases of the leaves, and the larger ones into the twig proper. The largest of the five had made quite a long channel from the tip of the bud down into the heart of the twig. Pupæ were also found at this time, which did not give forth the moth until late in the winter.

"The usual mode of hibernation is in the pupa state. A thorough search in January in the field showed only pupæ. The pupæ collected in August and September did not begin to give forth the moths in the breeding cages before early January, February, and March, and were greatly hastened without doubt by the heat of the room. On February 15, however, a few twigs were collected, from one of which, on February 28, a full-grown larva had emerged and was found crawling about the cage. This would seem to indicate occasional larval hibernation.

"As to remedies, the only one which I can suggest at present is that involving the somewhat arduous task of picking off the infested twigs in early winter and burning them. Whether the salvation of the trees will be worth this labor in greatly infested regions will depend entirely upon their value to those interested.

"As Mr. Scudder has prepared descriptions of all stages, we will not trespass upon his ground by appending further descriptions than we have already given. Our figure will assist in the recognition of the species."

65. The pitch-pine retinia.

Retinia rigidana Fernald.

Order Lepidoptera; family Tortricidæ.

Inhabiting terminal shoots of *Pinus rigida*, and of similar habits to the Frustrating Retinia, a gray, brown, or blackish larva 8mm (⅓ inch) in length, which in its perfect form becomes a small moth with dingy white wings, marked with dark red and silvery gray. (Comstock.)

"In the summer and fall of 1879 Mr. S. H. Gage, of Ithaca, N. Y., sent to the department specimens of the pitch-pine containing Tortricid

larvæ and pupæ, which in their work resemble *Retinia frustrana*, but differ from that insect in coloration and in being slightly larger. These developed into a moth intermediate in characters between *R. frustrana* and *R. Comstockiana*, and which has been described by Prof. C. H. Fernald as follows:

The moth.—Head sordid white, with a yellowish tinge; front and palpi inclining more to ashy; antennæ brown, annulated with white: thorax above very light gray, washed with dull ocherous, deepening to a coppery tint on the front of the patagiæ.

Thorax beneath, abdomen and hind wings above and beneath, and fore wings beneath light gray, with a silky luster; fringes of the hind wings lighter, with a line near the base concolorous with the wings.

Fore wings above sordid white, with a basal patch occupying the basal fourth of the wing, composed of about four irregular cross-streaks of dark red, alternating with similar streaks of silvery gray, the outer red streak sending out a tooth on the fold. The light space following the basal patch has several small gray costal spots, from which light ocherous streaks extend across the wing. A dark-red band extends across the wing beyond the middle, divided on the costa by a geminate white spot. Below the cell the basal half of the red band is replaced by stripes of light ocher-yellow and silver-white; the remaining portion of the red band below the cell is curved outwardly, making this part convex on the outside and concave on the side towards the base.

The apical portion of the wing is dark red, changing to bright ocher-yellow inwardly, and towards the anal angle divided by a subterminal geminate broken line of silvery scales, extending from the costa to the anal angle.

Fringe reddish-purple. The costa from the basal patch to the terminal band is marked with geminate white spots, alternating with gray.

Posterior femora and tibiæ very light silky gray; fore and middle femora and tibiæ gray, with coppery reflections, the tibiæ banded with white. All the tarsi gray, with whitish tips.

Expanse.—Female, 18mm. *Habitat.*—Ithaca, N. Y. Described from two females, one in the collection of the Department of Agriculture, the other in my collection."

AFFECTING THE LEAVES.

66. Abbot's white pine saw-fly.

Lophyrus abbotii Leach.

Order Hymenoptera; family Tenthredinidæ.

From mid-summer until October, and sometimes as late as November, clustering on the twigs and smaller branches of the white pine, soft, smooth-bodied, yellowish-white worms about an inch long, with three, and posteriorly four, longitudinal rows of large black dorsal spots; late in the autumn transforming in tough brown pod-like cocoons attached to the twigs, within which they hybernate, changing to pupæ (in Illinois) about the middle of May, the 4-winged fly with broad pectinated antennæ appearing about the first of June. (Riley.)

By far the most destructive insects to the foliage of the pine and fir are the different species of false-caterpillar or larvæ of the pine saw-fly or *Lophyrus*. When present at all these larvæ exist in colonies, keeping together until they are ready to undergo the chrysalis state; and after stripping the leaves of one twig or small branch pass on to adjoining twigs until a large branch or nearly one side of a tree will be denuded

of leaves. Such effects we have often seen in isolated pitch-pine trees in the woods of Maine. Still more destructive are these larvæ to plantations of young pines on Cape Cod, where, if not prevented, they may strip tree after tree of a young growth of seedling pines. Moreover, an allied species (*L. lecontei*) is annoying to the ornamental Austrian pines and Scotch firs on lawns and in shrubberies, so that we have placed these insects near the head of those destructive to the leaves of coniferous trees.

FIG. 83.—Abbot's white pine saw fly; 1, female, enlarged; 2 and 3, pupa, enlarged; 4, larvæ, natural size; 5, cocoon, natural size; 6, male, 7, female, antenna enlarged.—After Riley.

Mr. W. C. Fish writes me that worms which I have identified as being of this species do "much mischief among the pines on Cape Cod. These pines are small, having been growing but from six to twelve years from seed planted by the farmers in order to renew the soil on their poorer lands. Whole acres of these small pines are (1868) being destroyed by this insect. Their habits are very similar to those of the fir saw-fly, *Lophyrus abietis* of Harris, though they are more gregarious than he describes that species to be. They eat the needles down to their insertion, thus stripping one twig after another. The larvæ spin their cocoons among the leaves, and the flies appeared about the middle of August. Out of thirty-one individuals but one was a male."

Professor Riley, in his Ninth Report, states that this saw-fly in its larval state is destructive in Indiana, Illinois, and Wisconsin. He states that the perfect insects are quite irregular in coming out of the ground, many of them issuing in May, but others not until toward the end of summer. "On opening cocoons that had passed the winter I have found many yet containing the larva the latter part of June, while others of the same brood had become flies six weeks before. * * * In ovipositing the female saws beneath the epidermis on one of the flat sides of the leaflets, and pushes into the slit an egg, which is whitish, ovoid .08^{mm} long, on an average. As the egg swells it forms a conspicuous bulging of the epidermis, and the mouth of the slit opens and exposes more and more a portion of the egg." It is preyed upon by an ichneumon fly (*Limneria lophyri* Riley).

Larva.—Average length 0.80 inch, though many will measure an inch. A soft, dingy-white worm, having often a greenish or bluish line superiorly. On all joints but the first, which is entirely white, two oblong square black spots along the back, and another somewhat rounder spot each side; these become somewhat diffused on the three latter joints, forming on the last a single black patch. Three black thoracic legs; fourteen abdominal and two caudal prolegs. Thoracic joints largest; the three last smallest and tapering. Some are marked very regularly, while in others the white

space on the back between the spots on segments 5, 6, 7, and 8, is much wider than between the others. This is probably a sexual difference, since those thus marked are shorter, thicker, and of a yellower white than those regularly marked. After each change of skin the head is at first white like the rest of the body, with the usual eye-spots black. No markings while young.

67. The fir saw-fly.

Lophyrus abietis Harris.

Defoliating the leaves of the fir, spruce, as well as the pitch-pine, larvæ similar to the foregoing, the flies appearing late in July and also early in May. (Harris.)

The following account of the fir saw-fly is taken from Harris's Treatise: "For some years past many of the fir trees, cultivated for ornament, in this vicinity, have been attacked by swarms of false-caterpillars, and, in some instances that have fallen under my notice, have been nearly stripped of their leaves every summer, and in consequence thereof have been checked in their growth, and now seem to be in a sickly condition. My specimens of this kind of saw-fly, which were raised from the caterpillars in the summer of 1838, came out of their cocoons towards the end of July in the same year; but I have also found them on pines and firs early in May."

To this account Dr. Fitch makes the following comments:

"I suspect Dr. Harris's observations upon this species were not full, and that like the analogous saw-fly which we have noticed on the pine, No. 273, there are two generations of this species annually; for we are informed that the perfect insect appears in May, producing a crop of worms in June and July, from the cocoons of which the perfect insect come out the last of the latter month. But Dr. Harris supposes that most of these cocoons remain unhatched through all the hot weather of August and September and the winter succeeding, to give out the flies which appear in May. It is much more probable, however, that the flies all come out of their cocoons about the beginning of August, and like the species we have seen on the pines, produce another brood of worms in autumn, which has escaped the notice of Dr. Harris; and it is these which lie in their cocoons through the winter and give out the flies which are met with in May."

The male saw-fly is smaller than the female, with broadly pectinated antennæ, and is ⅓ inch in length; body black above and brown beneath, legs dirty leather-yellow color.

The female is about three-tenths of an inch long; body yellowish brown above, with a short blackish stripe on each side of the middle of the thorax; body beneath and legs paler, of a dirty leather-yellow color; antennæ short, tapering to a point consisting of 19 joints, and toothed on one side like a saw. (Harris.)

68. Le Conte's saw-fly.

Lophyrus Lecontei Fitch.

Clusters of dirty yellowish, black-spotted false caterpillars on the outer branches of ornamental pines and firs on lawns, stripping the leaves and disfiguring the shrubs.

Dr. Fitch described under the above name this saw-fly, but did not rear it from the larva, though inferring that it was the parent of certain

false caterpillars, of which he found two broods on "pines, particularly those set in our yards for ornaments, stripping the limbs which they invade of their leaves." He further says, "When nearly mature these worms are so large that the end of a single leaf of the pine probably furnishes them a very insufficient mouthful, hence two worms often unite, standing face to face, and thus hold the five leaves which grow from each sheath on the white pine pressed together in a bundle as they eat them, commencing at the tip and gradually stepping backward as the leaves become shorter. It is only the old leaves of the previous year's growth which these worms consume, never touching the new ones at the outer end of the limb; hence they injure the tree much less than they would were they to strip the limbs they invade of the whole of their foliage. At least two broods of these worms appear annually, the one in July, the other in September and October, the latter often remaining on the trees after frosty nights have occurred. Having finished feeding, they leave the tree and inclose themselves in cocoons under fallen leaves or other shelter on the surface of the ground, in which they remain during their pupa state."

The female.—Length, 0.38 inch to the tip of the abdomen and 0.48 inch to the end of the wings. It may at once be distinguished from all our other described species by the joints of its antennæ, which are 21 in number. It is shining dull, tawny yellow, with the antennæ black, and also the abdomen and base of the thorax. The under side is paler yellow, with two broad black stripes on the abdomen. The wings are smoky hyaline, their veins black. Captured the middle of May. (Fitch.)

Riley states that this saw-fly has been found feeding on the Scotch and Austrian pines in New Jersey. The larva he describes as an inch long, dirty or yellowish white, with dorsal black marks wider before than behind, and usually broken transversely in the full-grown individuals. They are further apart than in *L. abbotii*. The lateral spots are somewhat square, with an additional row of smaller black marks below them, and the last segment is entirely black above.

The antennæ of the male fly are twenty-one-jointed, and have on one side seventeen large and on the other seventeen small branches, there being eighteen on one side and fifteen on the other in *L. abbotii*. The female may at once be distinguished from *L. abbotii* by her abdomen being jet black above, with a small brown patch at the end and a transverse line of the same color just below the thorax.

Besides the species of *Lophyrus* above mentioned there are four other species of this genus, which probably live on coniferous trees, and also the following species known to infest the pine.—*Lophyrus pinetum* Norton (female, with 19 antennal joints, on pine, Norton in Packard's Guide, p. 226).

Remedy.—These saw-flies, living as they do in societies in large masses of coarse castings like sawdust, are easily detected by the eye, and can readily be removed by hand, especially in the case of ornamental shrubs.

69. The pitch-pine saw-fly.

Lophyrus pini-rigidæ Norton.

With the general habits and appearance of the preceding species, but so far as yet known confined to the pitch-pine.

This saw-fly was described by Mr. Norton in our "Guide to the Study of Insects." The larvæ are allied to those of *Lophyrus abietis*, and during one summer ravaged the young pitch-pines, which had been raised from the seed on a plantation at Eastham, Mass., on Cape Cod. The female lays her eggs singly in one side of a "needle" of the pine, though sometimes an egg is inserted on each side of the leaf.

Female.—Length, 0.30; expanse of wings, 0.65 of an inch; antennæ 17-jointed, short, brown; color luteous brown, with a black line joining the ocelli; a black stripe down each of the lobes of the thorax above and the sutures behind; body paler beneath; the trochanters and base of the tibiæ waxen; claws with an inner tooth near the middle; wings very slightly clouded; cross nervure of the lanceolate cell straight.

Male.—Length, 0.25; expanse of wings, 0.55 of an inch; antennæ fifteen-jointed, black, quite short, with twelve branches on each side, those at the base nearly as long as the sixth and seventh; apical joint simple, enlarged at base; color of insect black, with the abdomen at apex and beneath yellow-brown; legs the same color at base; below the knees whitish. The male looks precisely like that of *L. abietis*, but the form of the antennæ is different, being much shorter. The female looks much like *L. abdominalis* Say, taken on the pine near New York. (Norton.)

Mr. W. C. Fish wrote me some years ago from Eastham, Mass., as follows regarding this insect and the attacks upon it by the white-winged crossbill: "In the fall of 1868 there was a second brood of the larvæ of *Lophyrus pini-rigidæ* Norton. On the 16th of September I noticed a few nearly grown, but the greater part of those seen at that date were very small. On the 15th of October I noticed large flocks of the white-winged crossbill hovering over and alighting upon the young pines that were infested with these larvæ. There were certainly three or four hundred birds in some of these flocks. I soon learned that they were feeding upon the larvæ, as I had many opportunities to watch them while feeding among the trees. I also took numbers of the larvæ from the stomachs of several individuals that I shot.

I had one in confinement several days, feeding it with these larvæ. Those out of doors seemed to discard the head and harder legs of the larvæ, but the one in confinement swallowed the insect entire. These birds were abundant through November and December, and more or less common all winter. Some of the larvæ were found quite late in November after we had experienced severe freezing weather. I saw them frozen stiff several times.

On the 27th of November, I took several into the house, where they

spun their cocoons and the saw-flies came out the next spring. So well did the crossbills do their work that the *Lophyrus* was rare the next summer (1869). If this wholesale destruction of the larvæ had not occurred, there would have been acres of young pines destroyed.

"I did not meet with the red crossbill until January, when I met a flock at Sandwich; in February I met a flock here (Eastham). Neither of these birds are common visitors to the Cape. I have not known of any visiting us the past winter. I never met with one until 1868, but residents of Eastham informed me that the white-winged species was with them in the fall of 1867. An old lady in East Falmouth informed me that a number of years ago they visited her orchard and damaged her apples by cutting them off to get the seeds."

70. The lyda saw-fly.

Infesting the Austrian pine, tying the needles together with a silken web filled with castings, forming a mass about six inches in diameter, with the needles of the pine scattered through the mass, the leaves being separated by the false-caterpillars from the branch.

We have noticed this false-caterpillar on but a single occasion, and then failed to rear the worms to the winged state. The following account is taken from our article entitled "Injurious Insects, New and Little Known," in the Report of the Massachusetts Board of Agriculture for 1870:

Late in September of 1869 Dr. William Mack, of Salem, Mass., brought into the museum of the Peabody Academy of Science, some singular false-caterpillars which had assembled on a single branch of an Austrian pine, on his place, and had tied the needles together with a fine silken web filled with castings, forming a mass of castings about six inches in diameter, with the needles of the pine among them, the leaves being separated by the larvæ from the branch.

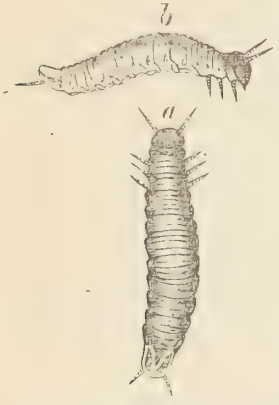

Fig. 84.—Lyda saw fly larva on Austrian pine, enlarged.—From Packard.

The larva is that of a species of Lyda, and while doing little injury to the tree, so far as known, yet merits a short description. Dr. Ratzburg figures a similar species in his work on forest insects, and states that the *Lyda campestris* of Europe, to which our species seems closely allied, is sporadic in its attacks on the pine and never proves very destructive.

The larva.—The body is cylindrical, a little flattened, and thickest in the middle, with small thoracic slender legs, which are not used much in walking, the larva wriggling along when placed on a smooth surface. The head is pale reddish with a black spot between the antennæ; the prothorax is black above and the body reddish olive-green, with a rather broad purplish line along the middle of the back. There are no abdominal legs, and the end of the body is somewhat flattened, with a black round spot on each side of the anal plate; beneath is a broad transverse incision.

Below, and arising from each side, is a long, corneous, three-jointed, slender outstretched appendage of the size and form of the antennæ. The under side of the body is mottled with greenish and reddish as above, with a reddish medium line. On the side of the thorax are two rows of dots, and two rows along the middle on the ventral side of the three thoracic wings.

71. The pine thecla.

Thecla niphon (Hübner).

Order Lepidoptera; family Papilionidæ.

Feeding upon the leaves in summer, a flattened oval worm, 0.75 long when full grown, of the same deep green color as the leaves, with a light yellow stripe along the middle of its back and a white one on each side, and a brown head; changing to a short thick grayish pupa with two rows of small blackish spots, and outside of these a row of more conspicuous rust-red ones, which is attached by its tail and by a thread around its middle in form of a loop; giving out a smallish butterfly which comes abroad in April and the fore part of May; 1.00 to 1.15 in width across its wings, which are of a dusty rust color and without spots above, paler grayish beneath, the fore ones with a dislocated black band beyond the middle, edged on its hind side with snow white, and beyond this a row of black crescents, each with a white spot in its concavity, and the hind wings similarly but more complexly variegated. (Fitch.)

Boisduval says, "This insect lives in Georgia and Florida, on several species of pine, and is very rare and seldom seen in collections." It, however, is a common species in the State of New York, in all our forests where pine trees abound, coming out with the first warm days of spring, before collectors are much abroad in search of insects, and continuing but a short time. (Fitch.)

72. The southern pine hawk-moth.

Ellema coniferarum (Smith).

Order Lepidoptera; family Sphingidæ.

Feeding on the pine in the Gulf States, a caterpillar with a short caudal spine, the body checkered with brown and white spots, with a dorsal whitish line; entering the earth to transform into a small gray sphinx moth, closely resembling the two following northern species. (Harris.)

73. Harris' pine hawk-moth.

Ellema harrisii Clemens.

A grass-green caterpillar with no caudal horn, but a caudal plate granulated and edged with white, with yellow subdorsal and lateral bands, and a white stripe bordering the stigmata; becoming fully bred and leaving the white pine about the middle of September, the pupa subterranean, and the moth appearing about the middle of June in New York. (Lintner.)

The different pine hawk-moths are of little economic importance, as they are of great rarity both in the caterpillar and moth states; but from a scientific point of view these moths possess much interest.

Larva.—2 inches long, .23 inch broad. Subcylindrical, tapering slightly anteriorly, and the last two segments quite tapering. Head, size of first segment, granu-

lated, flattened anteriorly, subtriangular, with an impressed medial line, and straight yellow lateral lines terminating at the apex in two black granulations, and bordered interiorly above with black. Body grass-green. Subdorsal and lateral bands yellow. Substigmatal stripe bordering the stigmata, white, enlarged on the central portions of the segments. Between the subdorsal and substigmatal stripes, on the fourth and fifth segments ventrally, and exteriorly to the legs and prolegs, dotted on the segments with paler green or yellow. On the vascular line a series of crimson spots on the front of the segment, beginning usually on the fourth, the first small, sometimes double, the anterior ones triangular or lozenge-shape, regularly increasing in size and extending over more of the segment, the posterior ones quadrangular, and uniting on the last two segments in a stripe. A ventral stripe of rose color, beginning at the third pair of legs, widening as it proceeds, and embracing the prolegs. No caudal horn. Caudal shield granulated and edged with white. (Lintner, Proc. Ent. Soc., Phil., iii, 669.)

Pupa.—Chestnut-brown, with a rough, not produced head-case. Tongue-case buried, parting the leg-cases, but terminating just before reaching the tips of the wing-cases. Incisures rounded. Posterior segments tapering. Stigmata black, terminal spine black, contracted at base, minutely bifid. Length, .95–1.10 inch. (Lintner.)

74. The checkered pine sphinx caterpillar.

Ellema pineum Lintner.

A caterpillar like the foregoing, but with a dorsal row of squares, and transforming to a moth which is readily distinguished from *Ellema harrisii* by the darker ground-color of its wings, the absence of the gray shades, and its much less distinct markings. (Lintner.)

Mr. Lintner, in his Entomological Contributions contained in the 23d Report of the New York State Cabinet, describes the male and female of this pine sphinx, and also describes the larva as follows:

Larva.—Length two inches. Color grass green. Head subtriangular, green, bordered with bright yellow, within which, at the apex, is a ∧ of black. Body subcylindrical, tapering at the extremities, and without a caudal horn. Dorsally, a reddish-brown line interrupted on the hinder portion of each segment by a square of green traversed by diagonal lines; a subdorsal yellow line borders the above; lateral stripe yellow; substigmatal stripe white, interrupted at the sutures by light green; ventral stripe and prolegs rose-red. Feeds on the white pine, and matures about the middle of September, when it enters the ground and forms a cell, where it becomes a chrysalis.

75. The large spiney caterpillar.

Eacles imperialis (Drury).

Order Lepidoptera; family Bombycidæ.

Among the leaves of the white pine in the Northern States, late in August and through September, a large, thick, pale-green caterpillar between three and four inches long, with the head and legs pale orange, with six thorny, yellow knobs behind the head; pupating in the ground and changing late in June to a large, handsome, yellow moth, speckled with brown, and with a very light purple-brown band across the outer margin of each wing.

The transformations of this moth were first described by Harris, but the earlier stages have more recently been fully described by Mr. Lintner, in his Entomological Contributions, No. II. Though usually feeding on the white pine in the New England States, where we have seen it in the breeding-cages of entomological friends, it also feeds on the oak, buttonwood, etc., and will eat the leaves of the chestnut. It is too rare to be of any economical importance, but will always attract the attention of lovers of fine, rare insects. The moth lays its eggs late in June, hatching in about a week or ten days; the larva, according to Lintner, molting at least four, if not five times.

Larva.—Three or four inches long and more than half an inch in diameter, and for the most part of a green color, slightly tinged with red on the back, but many of them become more or less tanned or swarthy, and are sometimes found entirely brown. There are a few very short hairs thinly scattered over the body; the head and the legs are pale orange colored; the oval spiracles are large and white, encircled with green; on each of the rings, except the first, there are six thorny knobs or hard and pointed warts of a yellow color, covered with short black prickles: the two uppermost of these warts on the top of the second and of the third rings are a quarter of an inch or more in length, curved backwards like horns, and are of a deeper yellow color than the rest: the three triangular pieces on the posterior extremity of the body are brown, with yellow margins, and are covered with raised orange-colored dots. (Harris.)

The pupa.—Subterranean, not contained in a cocoon, about two inches long, of a dark chestnut-brown color, rough, with little elevated points, especially in front: the end of the body with a long forked spine, and surrounded, on each ring, with a notched ridge, the little teeth of which point towards the tail. Three of the grooves or incisions between the rings are very deep, thus allowing a great extent of motion to the joints, and these, with the notched ridges and the long spine at the end of the body, enable the chrysalis to work its way upward in the earth, above the surface of which it pushes the fore part of its body just before the moth makes its escape. (Harris.)

The moth is ocher-yellow, spotted with purple-brown, with a large patch at the base, a small round spot near the middle, and a broad, wavy, light purple-brown band toward the outer edge of each wing; in the males there is another purple-brown spot covering nearly the whole of the outer hind margin of the fore wings, and united to the band near that part: the body is yellow, washed with purple-brown along the back. It expands from four and a half to over five inches. (Harris.)

76. *Citheronia sepulcralis* Grote and Robinson.

Closely allied to *C. regalis* is the above named species, whose caterpillar feeds on the pine. It is closely allied to the larva of *C. regalis*, but the horns on the three thoracic segments are paler, slenderer, and unicolorous, "the lower lateral pair on the third and fourth segments apparently greatly reduced; the specimens not being quite perfect prevents certain accuracy as to this latter statement." (Grote.) It is possible that this will be found to be a variety of *C. regalis*.

77. The white pine tufted caterpillar.

Platycerura furcilla Packard.

Found rarely in September on the white pine, a dull-red caterpillar, banded with brighter red; a white lateral line, with reddish hairs in clusters, and on the 1st, 3d, 4th, and 11th segments two long pencils of red hairs: spinning a cocoon among fallen leaves, the gray moth appearing about the middle of June.

This is another interesting caterpillar, whose history has been traced by Mr. Lintner. The worm, when in the attitude of feeding, with its terminal pair of legs clasps the leaves at the sheath, and extends its body along a leaf until it commences to bend, when, by detaching successively the first and following pair of prolegs, it forces the leaf through its legs until its tip is held between them. The caterpillars spin their cocoons beneath leaves lying in the bottom of the breeding-cage, the moth emerging June 12. It is interesting to see that this, like several other caterpillars of the pine in this country and Europe, are colored red like the pine shoots, and are thus perfectly protected from their enemies.

The caterpillar is an inch and five-eighths long. Head round, of about the diameter of the body, red, with conspicuous markings upon the front of lighter red, somewhat in the form of a script *x*, and less distinct reticulations of the same. Body presenting a peculiarly mottled appearance from its irregular and broken stripes; its general color dull red; on each segment an irregular band of brighter red; a whitish vascular line within a broken gray stripe; a better defined lateral stripe just above the stigmata, within which, on each segment from the third to the eighth inclusive, are four black depressed spots arranged in a right angle, the upper three in line, the largest of which rests on the crown of the segment, with two behind it and one before; the substigmatal fold is white on the anterior portion of each segment and red on the remainder; rows of tubercles, from which clusters of red hairs of unequal length proceed, which, on the anterior segments, incline to yellow; on the 1st, 2d, 4th, and 11th segments each, superiorly, are two pencils of red hairs, nearly ¼ inch in length, darker at the tips, and slightly feathered. These pencils made their appearance after the last molting. Stigmata encircled with brown. Legs red. (Lintner.)

The moth has, compared with other Notodontians, rather broad triangular fore wings, rounded hind wings, the front of the head being rather broad and smooth, while the antennæ are rather long and pectinated. It is ash-white, peppered with dark scales; the fore wings are crossed by a twice angulated basal black line, and near the insertion of the wing is a black spot. A second straight line crosses the wing just before its middle, and from it branches at nearly right angles a line which becomes straight above the second median nervule and parallel to the inner line, thus inclosing a large square area which is concolorous with the rest of the wing. There is a submarginal obscure line shaded with white externally, which is irregularly zigzag, and runs down more than usual in the second median interspace toward the margin of the wing. Length of body, .65 inch; expanse of wings, 1.50 inches.

78. The pine parorgyia.

Parorgyia parallela Grote and Robinson.

Order Lepidoptera; family Bombycidæ.

Occasionally found feeding during June and also in October on the pine, a caterpillar tufted like the vaporer moth (*Orgyia leucostigma*), but with mouse-colored feathered hairs; the pencils black; cocooning July 5 and the moth appearing July 21. (Lintner.)

The following account of this not common insect is taken from Lintner's Entomological Contributions, iii. He has found it on the plum, and on one occasion (September 24) on the pine. His description was based on specimens reared in the breeding-cage from eggs laid July 25 in confinement. They developed fully by the first week in November,

when they assumed a fixed position on newly-spun thin webs a little larger in extent than their bodies, on which they went into their winter rest.

The caterpillar is as briefly described above. The moth, when at rest, folds its wings like the roof of a house, with its front legs extended, giving it an attitude like *Eudryas grata*.

The moth (female) is a large thick-bodied moth, with short, broad wings and heavily pectinated antennæ. It is named from the dark parallel longitudinal stripes on the upper surface of the fore wings. The fore wings are pale olive-ash, much clouded with brown and with scattered dark scales. The basal half of the front edge of the wing is olive-ash; the median vein is dark; below a broad black longitudinal stripe runs from the base of the wing out towards the outer edge. The inner median line is dentate, while the outer is distinct, black and scalloped. Marginal line brown. It expands 2 inches. (Grote and Rob.)

79. THE YELLOW BEAR.

Spilosoma virginica Fabricius.

This omnivorous caterpillar I have found feeding on the pitch-pine the first of September in Maine.

80. THE PINE MEASURING WORM.

Paraphia subatomaria Guenée.

Order LEPIDOPTERA; family PHALÆNIDÆ.

Feeding on the pine, a brown measuring worm, the moth appearing June 24. (Saunders.)

The caterpillar of this moth is not known farther than that its color is brown.

The moth is a delicate species with deeply serrated and angulated wings. The present species differs from the others of the genus by its whitish color, being rarely somewhat ocherous, while the base and outer edge of the fore wings are as pale as the middle portion; the under side of the wings are rather pale. The wings expand 1.30–1.70 inches.

81. THE RED STRIPED PINE MEASURING WORM.

Cleora pulchraria Minot.

Occurring on the pine, a red striped measuring worm, changing to a delicate whitish moth with full rounded wings. (Saunders.)

This caterpillar is probably another instance of protective mimicry, being striped with red, and thus assimilated, probably in color, to the red twigs of the pine among which it feeds. It, like the foregoing, has been reared by Mr. Saunders, of London, Canada.

The pupa is rather thick, white, with a broad light-brown band along the back, becoming widest in the middle of the body. There is also a narrow brown band along the side of the body, and on the under side of the abdomen are four longitudinal stripes of the same color. The wings are slashed with light brown, and the antennæ

and fore legs are concolorous, while the middle and hind legs are white. Length, 0.44 inch.

The moth has unusually broad transparent wings, which are white or pale ash. Head deep yellow. Fore wings crossed by two black lines, the inner with four scallops, the outer line sinuous, scalloped, with a great curve outward between the subcostal and the third median venule. Opposite the discal dots are three acute, smaller scallops, all of equal size. Fringe whitish, distinctly checkered with black on the ends of the venules. Hind wings with a scalloped outer line, often obsolete toward the costal edge, varying in its distance from the outer edge; beyond this line the wing is darker than at the base. Expanse of wings, 1.30 inches. Its range as far as known is from Maine and Canada to the Middle States.

82. The 10-lined pine span-worm.

Order Lepidoptera; family Phalænidæ.

Larva.—Body ¾ inch in length, dull green, darker than the leaves; body very slender; head large, considerably wider than the body, deeply divided by the median line; pale greenish yellow. Body on the upper side with ten narrow linear wavy dull purplish livid lines, which disappear before reaching the supra-anal plate, which is small, flattened, not prominent; it is subtriangular in form, the apex not sharp. Similar purplish lines on the under side of the body. Thoracic and first pair of proplegs purplish; the last pair greenish. This though not a strictly mimetic form, is sufficiently so to escape ordinary detection, not being much darker than the leaves. Observed, August 17, on leaves of the pitch-pine at Brunswick, Me.

83. The red and yellow striped pine span worm.

Feeding in September on the leaves of the pitch-pine, a stout reddish brown measuring worm, striped with straw-yellow; the moth unknown.

This is another reddish caterpillar which is somewhat assimilated in color to the pine twigs among which it feeds. Unfortunately the moth is unknown. We have found it the first of September, at Brunswick, Me., and also September 20, at Amherst, Mass.

The caterpillar is thick-bodied and rather short. Head large and smooth, not tuberculated above, but swollen somewhat on both sides. The sides of the body are swollen, and there is a lateral tubercle on the side of each segment; the anal lateral plates are large and spreading; the dorsal anal plate large, rounded at the end, and semi-elliptical rather than rounded. It is reddish brown, with minute straw-yellow lines; a pale straw-yellow median dorsal line dilating on each wing; a pair of dark brown dots on the hind margin of each segment; on the sides an irregular deep yellow line. Head reddish, dusted with yellow and dark brown speckles. Length not quite .70 inch.

84. The pine-needle span worm.

Feeding on the leaves, a small measuring worm, closely mimicking the form of a dead red-pine needle.

This is the most striking case of mimicry we have seen on the pine; the caterpillar, as it stands out stiff, holding on to the twig with its hind feet, after the manner of measuring or span worms, would easily be mistaken for a dead, dry, red pitch-pine needle! We have found one specimen on the pitch-pine at Brunswick, Me., September 1. On the 5th it made a slight silken white cocoon and assumed the semi-pupa condition.

The caterpillar is slender and unusually flattened, tapering more than is common towards each end of the body. The head is small and narrow, but rather full. The

color and form of the body is surprisingly like a dead red needle of the tree; it could readily be mistaken for it, since the end of the body suddenly tapers like the pine-needle itself. Color rust red, a darker dorsal line.

85. THE SNOUT MOTH CATERPILLAR.

Order LEPIDOPTERA; family PYRALIDÆ.

Larva.—Body with ten pairs of proplegs; body pale green, concolorous with the leaves on which it feeds; head small, much narrower than the body, of a very pale amber color; a faint dorsal and two subdorsal linear pale lines. Lateral ridge pale yellow. Each segment above with four black minute papillæ arranged in a trapezoid, and two on the side. All the legs concolorous with the body. Occurred August 17, on pitch-pine at Brunswick, Me.

86. Another span worm, living on the moss on pine trees, and found alive in Cambridge, Mass., in January, by Mr. Hill, is closely assimilated in color to the moss itself. Also we have found a handsome noctuid caterpillar (87) on the pitch-pine at Salem, Mass., which is red, marked with yellow, and would be readily overlooked from its mimicry of the red twigs of the pine. It may be the larva of a species of *Trachea*, and may represent the *Trachea piniperda* of Europe.

88. THE PINE TUBE-BUILDER.

Order LEPIDOPTERA; family TORTRICIDÆ.

Cutting off the ends of white pine needles, and spinning together a tube of the stumps, in September, and also to be met with probably early in summer, a pale-green leaf-roller, pupating late in September.

About ten years ago I found, in September, on the young white pines in the grounds of the Massachusetts Agricultural College, at Amherst, Mass., numerous pretty tubes such as are figured in the adjoining engraving. The larva, probably in August and early in September, gathers together about fifteen needles of the white pine, tying them into a bundle by silken threads; then, usually eating off about one-third of the ends, forms a tube, within which the worm lives. Some full-grown larvæ were found September 22 which had gathered the leaves together without cutting them off, the tube extending the whole length of the leaves. It is possible that the larvæ of the first brood early in summer cut off the ends of the tube, while the approach

FIG. 85.—Tubes of the pine tube-building leaf-roller: natural size.—After Packard.

of cold late in September prevents those of the second brood from giving the finishing characteristic touches to their tubular domiciles.

The larva is .30 inch long, pale green, a little paler than the pine leaves; darker over the region of the digestive canal. Body with minute warts of the same color as the body, from which arise short, slender, pale hairs. Head pale horn color, with a darker somewhat reddish patch on each side of the head; on the clypeus just behind the labrum a triangular spot; labrum reddish horn color. It is very active, climbing out of its tube and letting itself down by a thread when disturbed. The worms found at the end of September were about fully grown. There must be two broods of worms, as the dead chrysalids were found in some of the tubes. When about to pupate the worm spins a slight web within its tube. One larva pupated in confinement September 21. Mr. Emerton informs us that he raised the moth, which we failed to do, but the specimen was unfortunately lost.

We have found the young larvæ one-quarter grown on the white pine at Brunswick, Me., in August. They had not cut off the ends, but had merely drawn the leaves together with silken threads.

89. The pine leaf miner.

Gelechia pinifoliella Chambers.

Order Lepidoptera; family Tineid.e.

Mining the leaves of different species of pine, a minute, brown, narrow, cylindrical larva.

"For several years the leaves of the common pitch-pine (*Pinus rigida*) in the vicinity of Ithaca, N. Y., have been seen to be extensively mined by the larvæ of a Tineid, the life history of which we have first studied the present season. The end of the leaf, and in many cases the entire leaf above its base, becomes dead and brown, and when opened it is found to be entirely eaten out, and to contain, in the proper season, the larva or pupa of the above-mentioned insect.

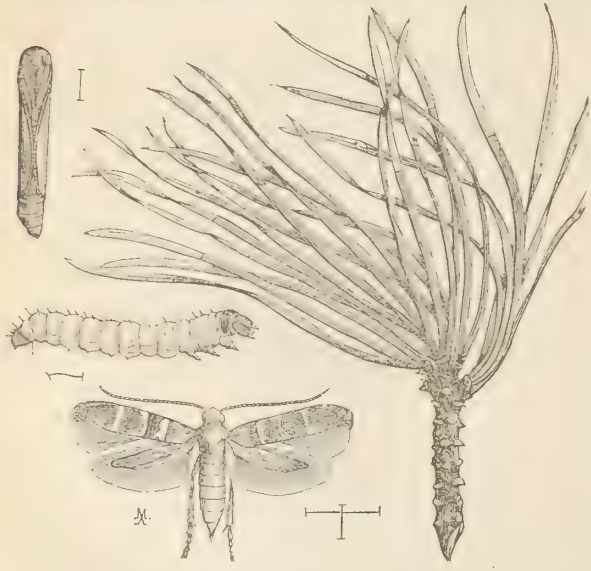

Fig. 86.—The Pine-leaf miner, larva, pupa, adult, and work.—After Comstock.

"What are in all probability the eggs of this insect have been found deposited singly near the base of the leaves. They are nearly round,

flattened on the side of attachment, and slightly so on the opposite side. Their average diameter is 1.4mm (.05 inch). The general color is reddish brown, differing in intensity with the stage of development. The surface of each egg is marked with numerous delicate carinæ, which meet at the center, somewhat resembling those of the cotton and boll worms figured in the article on cotton insects. We have not proof positive that these are the eggs of this leaf miner, but their size, appearance, and place of deposit seem to indicate that they are.

"The work of the growing larvæ is well shown in the plate, and also the larva itself, highly magnified. From a study of the mines, the larva appears to burrow towards the end of the leaf first. Should it arrive at the end of the leaf (and it almost invariably does) before attaining full growth, it reverses its position and mines towards the base. The hole of entrance and of future exit is apparently in all cases enlarged and the excrement pushed through, as there is but little frass to be discovered in the mine, while it can always be found in a greater or less quantity at the opening or on the leaves below. No instance has been observed in which one larva has injured more than a single leaf of *P. rigida;* but a specimen of this insect was found in Virginia upon the common scrub-pine (*P. inops*), the leaves of which are shorter and more slender than those of the pitch-pine, and, from observations made upon it, it would seem that one leaf, if small, does not afford all of the food needed by a larva.

"When found on the 1st of January this specimen was hibernating, the mouth of its burrow being covered with a thin silken curtain. Six days after, being transferred to a warm room, it was found that this curtain had been broken and the insect had left its mine. It was soon found on another leaf, and the same day formed a new burrow, where it continued to eat until January 23, at which time it had completely excavated the leaf. After this date all operations appear to have been suspended, and there were no signs of life in the burrow until March 3, when a Proctotrupid parasite issued.

"Leaves of *P. rigida* are frequently observed to be completely mined out, and nearly full-grown larvæ are occasionally found crawling about over the leaves and twigs; so it seems probable that with this species of pine also two leaves may sometimes be successively mined by the same larva.

"The full-grown larva is nearly 5mm in length (.19 inch). Its color is light brown, with the head and prothoracic shield and the anal plate black. The body is clothed with a few delicate hairs. The form of the larva is shown in the figure. Upon reaching full growth the larva spins a slight covering to the mouth of the mine and retreats a short distance above it (from 10mm to 15mm). There, after spinning a few supporting lines of silk, it transforms to a long and slender chrysalis, light-brown at first but afterwards nearly black. When removed from the mine the pupa is very active, jerking the short end of the abdomen (which ex-

tends below the wing cases) from side to side with rapidity. The duration of the pupa state is from ten to fourteen days. The moth makes its exit from the pupa shell without disturbing the position of the latter, leaving it attached by its threads some distance up the mine, and works its own way to the entrance.

"There are certainly two broods of this insect each year, probably three, and possibly more in exceptional seasons. Of the general hibernating habits of the genus, Stainton says: "Of a few species the young larvæ live through the winter, but I believe the greater number pass the winter in the egg and pupa state." With the present species the nearly full-grown larvæ have been found during the winter, but not in great numbers. What we consider to be the egg of this species has also been found in apparently healthy condition in midwinter, and the insect, without much doubt, hibernates in both of these forms, and possibly in either of the others. The moths of the first brood issue during the entire month of June, the difference between the earlier and later ones probably depending upon the form in which they hibernate.

"As we have stated before, larvæ almost identical in appearance with those found on *Pinus rigida* in New York have been discovered on the scrub-pines (*P. inops*) around Washington. These larvæ were bred to the perfect state and proved to be the same species.

"A leaf-miner of precisely the same habits and of almost the same appearance was found the past winter in the leaves of the southern pine (*P. australis*) at Macon, Ga., a point where, owing to a sudden fall of some 400 feet in altitude, the northern and southern floras meet in a remarkable manner. Progressing southward, a careful search was made for additional specimens of this leaf-miner, but none were found except in this one locality. Assuming the identity of the two forms (they have since been bred and proved identical), it puzzled us for some time to discover how the species could have reached *P. australis*, since the southernmost limit of *P. inops* is South Carolina, and *P. rigida* is essentially northern. It was not until we discovered the same miner in leaves of the yellow pine (*P. mitis*) that we were able to solve the problem. The yellow pine is not only found north, but also extends south until at Macon, Ga., we can see it mingling with the northernmost specimens of *P. australis*.

"*The moth.*—Palpi simple; hind wings excised beneath the tips. Head white, flecked with scales of the general hue of the insect, which may be called a brownish-yellow. Palpi white; the second joint longer than the third, brownish-yellow flecked with fuscous scales on the outer side; third joint white, with a brownish-yellow annulus about its middle, and another near the tip; antennæ white, each joint crossed by a brownish band. Thorax and fore wings of the general hue above mentioned, flecked with fuscous scales. On the fore wings are three white fasciæ, placed respectively at about the basal, middle, and apical fourths of the wing length; the apex is densely dusted with fuscous on a white ground,

and the dorsal margin is sparsely flecked with brown. The fasciæ also are more or less margined with brown scales, and the third one is sometimes interrupted in the middle; and the fuscous scales which margin the first and second fasciæ (especially along the second, near the fold) form minute tufts of raised scales. Cilia grayish, with interspersed black scales, which are tipped with white. Under side of the fore wings brownish. Hind wings pale grayish with white cilia; abdomen brown above, whitish toward the apex beneath. Expanse of wings $\frac{3}{8}$ inch. (Chambers, in Comstock's Report.)

"*Egg.*—Seen from above, appears globular, with a diameter of 14^{mm}; seen from the side, appears so compressed that its long diameter is nearly twice the length of the short. Color reddish brown. Surface marked with delicate, close, meridional carinæ, meeting at the center above and below. (Comstock).

"*Larva.*—Length when full-grown, 4.2^{mm}; average width, .58^{mm}. Subcylindrical; all segments except head and anal segment nearly equal in diameter, the exceptions smaller. Color yellowish brown; head, prothoracic and anal plates dark brown; mouth-parts yellowish; prothoracic shield strong, completely divided longitudinally in the middle by a moderately wide suture. (Comstock.)

"*Pupa.*—Length, 4.4^{mm}; average width, .71^{mm}. Head obtusely rounded; wing-sheaths extending to sixth abdominal segment; antennal sheaths reaching nearly to end of wing-sheaths, all compactly soldered. General form very nearly cylindrical; sixth and seventh abdominal segments spreading at posterior borders; dorsal side of anal segment furnished with a cluster of from 10 to 15 delicate tentacular or hook-formed filaments. Color: when first transformed, light yellow brown, soon changing to very dark brown, almost black, on head, thorax, wings, and crural sheaths; abdomen of a lighter brown, growing still lighter towards the anus.

"*Parasites.*—A minute chalcid parasite was bred from the specimens found in *P. rigida*. From 8 to 12 of the larvæ of this parasite are usually found within the body of one of the leaf-mining larvæ. They are pale milk-white in color, and the alimentary canal blackish; they are long and slender in form. A very small Tachina fly was also bred, both from the northern and southern specimens." (Comstock in Agricultural Report for 1879.)

We have found at Brunswick, Me., young pitch-pine trees the leaves of which had been attacked by this larva; the injury was quite local, not general.

83. The pitch-inhabiting midge.

Diplosis resinicola Osten-Sacken.

Order Diptera; family Cecidomyiadæ.

Feeding early in May, and again towards the middle of June, in companies of thirty or forty, in the pitch exuding from wounds in the bark of the pitch-pine, small slender, footless, orange larvæ, changing to two-winged midges or gall-flies late in May and the middle of June. (Comstock.)

The following account of this interesting fly is taken from Professor Comstock's Report for 1879:

In 1868, Mr. Sanborn exhibited before the Boston Society of Natural History specimens of a "Cecidomyious larva," which he had found feeding in companies of thirty or forty in the pitch exuding from wounds in the bark of *Pinus rigida*. "Whether they were the prime cause of the injury to the tree was not plainly apparent." (See Proceedings Bost. Soc. Nat. Hist., xii, 93.) In the Proceedings of the Entomological Society of Philadelphia, 1871, p. 345, Osten-Sacken records the discovery of similar larvæ in the exuding resin of *Pinus inops* at Tarrytown, N. Y. These he reared to the perfect state, and gave the species the name of *Diplosis resinicola*.

Early in May the two or three year old branches of *Pinus inops* in the vicinity of Washington were observed to be quite extensively infested by these insects, which were then in the larva state and actively feeding. They shortly turned to pupæ, and the first midge emerged May 26. On June 11 larvæ of the same species were found upon the twigs of *Pinus rigida* at Ithaca, N. Y. Pupæ were also found in the same twigs, and June 13 the first midge issued. In February, 1880, I collected specimens of similar larvæ at Orange Lake, Florida, on twigs of *Pinus tæda*, which, upon the appearance of the adults on March 1, were found to be of the same species.

Fig. 87 (from Comstock) shows well the work of this insect. The lumps of exuding resin may contain from two to thirty of the larvæ, which, when full-grown, measure on an average 6mm (about one-quarter of an inch) in length. While still feeding they are pale-orange in color, but after ceasing they become of a bright orange. The spiracles of the anal segment are at the summit of two protruding tubercles, and around each is a small whorl of four fleshy papillæ. The other spiracles are small and black. The larvæ are much elongated, and are widest at the 6th segment; the under sides of segments 1 to 7 are furnished each with two transverse rows of short black or brown spines, probably for locomotive purposes. While burrowing in the bark and resin the anal tubercles are always at the surface. When, however, the larva contracts to pupate, the end of the body is drawn in, but an open channel is left so that the air has free access. When about to give out the adult, the pupa works its way to the surface of the resin and protrudes half its body, so that there is no danger of the midge becoming fastened in

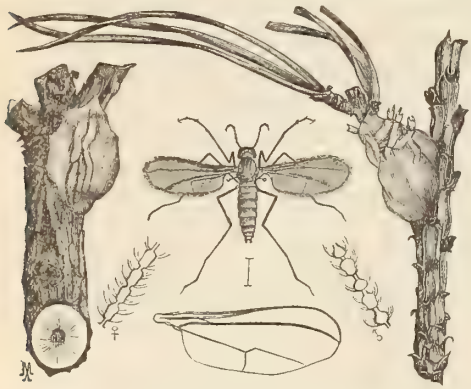

Fig. 87.—The pitch-inhabiting midge.—After Comstock.

the sticky gum. Dried lumps of resin, fairly bristling with protruding pupa-skins, are a common sight on trees affected by these insects. The adult insect is large, measuring 9^{mm} (.354 inch) in wing-expanse. The head is blackish, the thorax gray, and the abdomen dark red. The male antennæ are 26-jointed, with alternate single and double joints, all pedicelled; the female, 14-jointed. The main peculiarity of the adult form is in the remarkable gibbosity of the head, the eyes joining together at the summit and covering nearly the whole head. The wing-venation and other points are shown in the plate. The resin exuding from the wounds in *P. inops* is perfectly clear, and permits one to count the number of the larvæ and to watch their every motion.

Upon the loblolly pine (*P. tæda*), however, it is milky, and the presence of the insect cannot be ascertained without opening the mass.

We have as yet no data upon which to state definitely whether the eggs of the midge are laid upon the uninjured bark, and it is the work of the larvæ in the bark which causes the resin to exude, or whether it is only in resinous exudations, caused by a bruise or by the work of some other insect that the eggs are laid. In the clear lumps on *Pinus inops* the larvæ are always observed with their heads applied to the abraded bark.

Somewhat similar, though evidently distinct, larvæ were found feeding in the resin exuding from the wounds made by the larva of *Retinia comstockiana* in the twigs of *Pinus rigida*. It is probable that they may be Osten-Sacken's *Cecidomyia pinis-inopis*, but it is difficult to say positively as his description of this species is so very indefinite. (Comstock.)

We have noticed the work of this gall-fly at Providence, the cast pupa skins being found protruding from the masses of pitch June 28. We have also observed it for many years past at Brunswick, Me.

84. The pitch-pine needle gall fly.

Diplosis pini-rigidæ Packard.

Shortening and deforming the needles of the pitch pine, in Maine, early in May, orange-colored larvæ, which spin a cocoon towards the end of May; the fly appearing probably in June, as the second brood of larvæ occur late in September.

* In the year 1862 or '63 I observed in an isolated young pitch pine (*Pinus rigida*) at Brunswick, Me., that many of the leaves or needles were less than half as long as usual, and much swollen at their base, as seen in the adjoining cut. These deformed needles were quite numerous on the tree, and, so far as I am aware, have not been previously noticed.

Fig. 88. — Pitch-pine needle shortened and deformed by the pitch-pine-needle gall fly.— From Packard.

The larva is situated at the base between the inner two of the three needles, which grow from one-third to one-half of their normal length, and by the irritation set up by the worm the united base of the leaves swells into a

* The following account and figure are taken from Hayden's Tenth Annual Report of the U. S. Geographical and Geological Survey of the Territories for 1876. Washington, 1878, p. 527.

bulbous expansion about the size of a pea, or four times the original thickness of the needle, while the third or outer needle is sometimes not altered in size, but simply shortened and aborted. The bud-scales of the primary leaves are burst and hang down in shreds about the bulbous swelling of the secondary leaves or needles. The larva, which was found in the autumn of the same year (September 22), does not apparently bore into leaves, as it has no means of making its exit unless it works its way out of its prison through an oval hole between two of the leaves. It has to do so in some way, however, for when fully fed it makes its exit, ascends to the terminal buds, and pupates on one of them, exposed to the air. Sometimes there are two larvæ, one on each side of a leaf.

The cocoons are pale, oval, and covered with the pitch which exudes from the buds of the tree, and were found May 20. When the fly issues from the cocoon it creeps half way out of its cocoon, leaving its pupa-skin partially remaining, with the old pupal integument of the antennæ, wings, and legs separate.

On the 10th of June I opened the cocoon and found the pupæ of a chalcid fly, and afterwards found specimens of the adult, which, on making their exit, bore small holes through the sides of the cocoon.

The history of the species is apparently somewhat as follows: The eggs are probably laid at the base of the needles early in May, or possibly in the preceding autumn, or possibly the larva winters in the gall, though this is not probable. At any rate the worms pupate within spun silken cocoons about the middle or the third week in May, and the fly probably appears in the early part or about the middle of June, when the eggs are laid for the second brood of worms, which we have found September 22. A large percentage are destroyed by the chalcid fly.

Larva.—Deep orange in color, with the "breast-bone" retractile. The lateral swollen region of the body is well marked, convex, and the segments are short, quite convex.

Female described from life.—Antennæ 14-jointed, about half as long as the body, brown, with sparse, irregular verticils of gray hairs, the ten terminal joints twice as long as broad, and pedicellate. Clypeus and epicranium testaceous brown, the clypeus (hypostoma) having a few long gray hairs curving over and downwards. Palpi concolorous with the ends of the antennæ.

Thorax shining black, with four lines of white hairs, as in *C. pini* DeGeer; the sides including the prothorax, reddish; scutellum reddish-brown, while the trochanters are much darker, the first pair being nearly black, the two posterior pairs reddish-brown. Legs brown, paler beneath, with gray hairs, the tarsal joints darker at the articulations, covered with fine silvery hairs.

Wings rather short and broad, with scarcely any pubescence; fringe long, veins dark brown; the subcostal (first longitudinal) vein terminates at the middle of the wing (in *C. salicis* it terminates much beyond this point); the median vein terminates at or perhaps a little below the apex; it curves around rapidly, following the curve of the margin; cross-vein very minute, very oblique, almost obsolete, situated a little before the middle of the first longitudinal vein; third longitudinal vein straight, but turning down to the inner margin at nearly a right angle. The venule which, in continuation of the main vein, is bent upwards at its origin, thence goes straight to the outer edge, inclosing a triangular space. The halteres are pale flesh-colored.

Abdomen blood-red, with slight sparse hairs. The segments on the terminal half of the abdomen are edged with black, and the tip of the abdomen is blackish, while the genital armature is flesh-colored. Length, .10 inch.

This species differs decidedly from *Diplosis pini* Loew, ♀, in that the basal joints of the antennæ are not yellow, but pale brown. The clypeus (hypostoma) is reddish-brown, not reddish-yellow. The abdomen is blood-red, and the hairs are too few to give a silvery reflection; the legs do not seem whiter beneath than above; the wings are not densely pubescent as in Loew's description of *D. pini*, but are sparingly so. The cross-vein is difficult to find, and then is only seen in certain positions. It is smaller, being only a tenth of an inch long.

In its habits it seems to differ from Osten-Sacken's *Diplosis pini-inopis* in that the apparently similar pale, oval, resinous, pitchy cocoons are placed on the buds of the pine-needles, which were somewhat deformed, and could thus be easily distinguished from others not affected; as well as by the resinous pitchy exudation covering them. (This was observed May 20.) The food-plant is also different, *Diplosis pini-inopis* living on the Jersey or scrub pine (*Pinus inops*), which does not extend so far north as New England, particularly Maine.

86. The pine sawfly (Lophyrus sp.).

Order Hymenoptera; family Tenthredinidæ.

Body pale yellowish-green, segments with numerous fine transverse wrinkles; head black; thoracic legs black. Observed August 17 on pitch pine at Brunswick, Me.

87. The philadelphia chrysomela.

Chrysomela philadelphica Linnæus.

Order Coleoptera; family Chrysomelidæ.

Feeding upon the leaves from May till September, a very convex broad-oval beetle about 0.30 long, of a dark bottle-green color with white wing-covers sometimes tinged with yellow and having on them numerous spots and dots of dark green with a black line on the suture widened anteriorly and a second line parallel with this on each side, the antennæ and legs rusty red. This is also common upon willows, with other species closely similar to it. (Fitch.)

88. The pine chrysomela.

Glyptoscelis hirtus Olivier.

Order Coleoptera; family Chrysomelidæ.

Feeding on the leaves in May and June, a thick cylindrical beetle resembling the Cloaked Chrysomela, No. 27, but with the pubescence much thinner than in that and the other American species of this genus. Its color is brassy, more brilliant on the under side and tinged with coppery. The male is usually 0.28 and the female 0.35 long. (Fitch.)

89. The saratoga leaf-hopper.

Aphrophora saratogensis Fh. var.

Order Hemiptera; family Cercopidæ.

The larvæ form masses of froth on the leaves of the white pine in June, acquiring wings the last of July and in August in Maine. Common. (Named by Mr. Uhler.)

90. The white-necked pine-beetle.

Dichelonycha albicollis Burmeister.

Order Coleoptera; family Melolonthidæ.

A small beetle half an inch long or somewhat less and resembling the Rose bug, No. 50, in its shape but with wing-covers of a shining brilliant green, becomes quite common upon pines about the middle of May, eating the leaves, and continues about a month. It may be distinguished from the several other species of the genus to which it belongs by its thorax having a more distinct but a very shallow groove along its middle. (Fitch.)

The beetle.—This species has a black head with its fore part dull pale yellow. Its thorax is black and is covered with incumbent ash gray or yellowish hairs, but not so close as to hide the ground beneath, whilst the scutel is densely coated with white hairs. The bright green wing-covers are dull pale yellow along their outer margin and also on their inner edge. They are rough from confluent punctures and show three smooth raised lines on each, running lengthwise. The legs are pale yellow with the hind feet and inner side of the hind shanks black or blackish, and the fore shanks have at their outer tips two projecting teeth with a small tubercle indicating the place of a third tooth. Its length varies from 0.40 to 0.50. (Fitch.)

91. The pine anomala.

Anomala pinicola Melsheimer.

Order Coleoptera; family Melolonthidæ.

Feeding on the leaves in June and July, beetles resembling the common May beetle, No. 76, but of a much smaller size, being only 0.35 long, black, shining, their wing-covers slightly tinged with chestnut with the suture and outer margin broadly black, their antennæ pale dull yellowish, and their feet pitchy black. I only know this species from specimens from the South, but as it occurs in Pennsylvania it will probably be found also in our own State. (Fitch.)

92. The pine clastoptera.

Clastoptera pini Fitch.

Order Hemiptera; family Cercopidæ.

Puncturing the leaves and sucking their juices, in July, a small shining broad oval tree-hopper 0.14 long, of a black color, its head pale yellow with a black band on its anterior margin, its thorax prettily sculptured with fine transverse lines and with a pale yellow band anteriorly, its wing-covers with a broad hyaline white margin on the outer side, interrupted with black back of the middle and having a shining black dot near the tip, its under side and legs pale yellow. (Fitch.)

93. The testaceous clastoptera.

Clastoptera testacea Fitch.

A similar insect to the preceding, but of a pale yellow color, 0.20 long, its scutel darker tawny red or yellow, its wing-covers with a shining black dot near the tip, and often with a black dot upon each side of the breast. Appearing upon pines and also on oaks the latter part of July and in August. (Fitch.)

94. The white-pine leaf-hopper.

Bythoscopus strobi Fitch.

Order Hemiptera; family Cercopidæ.

Puncturing the leaves and sucking their juices in May, an oblong tawny yellow or yellowish brown leaf-hopper, 0.20 long, its wing-covers inscribed with numerous black-

ish lines and dots, with a few small spots mostly on the outer margin, and crossed by three broad bluish-white bands, its legs pale yellowish with numerous black dots from which arise small spines. (Fitch.)

95. The pine louse mimic.

Camaranotus confuses Hirschl. var. *occidentalis?*

This bug closely resembles the pine Tachnus, or a dark ant, and is common running about the terminal twigs of the pine. (Named by Mr. Uhler.)

96. The green pine tettigonia.

Order Hemiptera; family Cercopidæ.

Occurring in August in Maine on the pitch pine, a pretty, delicate green Tettigonia-like form, exactly of the color of the pine leaves. Pupa with some faint yellow markings.

97. The pine cixius.

Cixius pini Fitch.

Order Hemiptera; family Fulgoridæ.

Puncturing the leaves and sucking their juices in May and June, a brownish black four-winged fly, 0.23 long, its thorax diamond-shaped, with three elevated longitudinal lines, its fore wings transparent but not clear and glassy, stained with smoky yellow forming a few transverse spots, their veins white alternated with numerous black dots, its legs pale with the thighs brown. (Fitch.)

98. The vernal diraphia.

Diraphia vernalis Fitch.

Order Hemiptera; family Psyllidæ.

Upon the leaves, puncturing them and sucking their juices, a small orange yellow four-winged fly, 0.15 long, with a square flattened head concave on its upper side and with a slight impressed line along the middle of its whole length and a small notch in the middle of the anterior edge; the antennæ projecting forward from the anterior corners of the head, short and thread-like, of the same length with the head, their basal joint largest and forming one-fourth part of their total length, their tips black and ending in two short fine bristles of unequal length; the fore wings thick and leathery, feebly transparent, dull pale brownish yellow; the breast and hind breast coal black, and the legs dull whitish. (Fitch.)

99. The white pine schizoneura.

Schizoneura pinicola Thomas.

Order Hemiptera; family Aphidæ.

Feeding on the tender shoots of the young white pines in Illinois, their presence indicated by slender snow-white silky webs, and usually covered with a clear white, cottony secretion which appears to shoot out from the body in little ribbon-like flakes; the insects pale green. (Thomas.)

100. PINE-LEAF CHERMES.

Chermes pinifoliæ, new species.

Order HEMIPTERA; family APHIDÆ.

Stationary upon the leaves, usually towards their ends, puncturing them and sucking their juices, a very small black fly 0.08 long to the tip of its abdomen, and 0.12 to the end of its wings, which are dusky gray, its abdomen dusky red and slightly covered with fine cottony down. (Fitch.)

The females of these insects do not extrude their eggs. Clinging closely to the leaf with their heads towards its base, they die, their distended abdomens appearing like a little bag filled with eggs. The outer skin of the abdomen soon perishes and disappears, leaving the mass of eggs adhering to the side of the leaf, but completely covered over and protected by the closed wings of the dead fly. I have met with the dead females thus adhering to the leaves the first of July, and have noticed the same insects on the leaves in full life and vigor the middle of May.

The rib vein of the fore wings runs straight to the outer margin forward of the tip, and gives off from its middle on the outer side a very oblique branch which runs to the outer margin, its tip producing a slight angular projection of the edge of the wing, and the whole space on the outer side of the rib vein beyond this branch is more opake than the rest of the wing and of a smoky yellowish color. From its inner side the rib vein sends off three simple oblique veins, the last one of which ends in the extreme tip of the wing. The hind wings have an angular point on their outer side beyond the middle, and a longitudinal rib vein, which, forward of its middle sends off a branch almost transversely inward, its tip curved backward. The antennæ are short, thread-like, and composed of four or five small joints. It will hence be seen that this insect is a true Chermes—the first species of this genus that has been discovered in this country. (Fitch.)

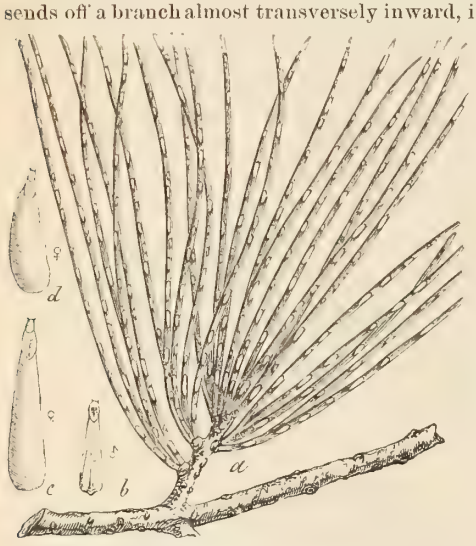

FIG. 89.—Pine-leaf scale-insect; *a*, natural size in pine leaf; *b*, male; *c*, *d*, female scale.

101. THE PINE-LEAF SCALE-INSECT.

Mytilaspis pinifoliæ (Fitch).

Order HEMIPTERA; family COCCIDÆ.

Fixed upon the sides of the leaves of young trees, exhausting them of their juices and causing them to turn yellow; small oblong flattish white scales, with a pale yellow spot upon their pointed end. (Fitch.)

This insect is injurious in the Western States, according to Riley, who describes and figures it in his Fifth Report. The disease to which it gives rise is sometimes called the "white malady." Riley states that it produces two broods a year in Missouri, *i. e.*, one in July and again in October. It occurs on the white pine, red pine, Bhotan pine, yellow pine, and cembra pine, and sparsely on different species of imported pines. I have also noticed it at Brunswick, Maine.

102. THE CLUB-HORNED CAPSUS.

Capsus claratus Linnæus.

Order HEMIPTERA; family CAPSIDÆ.

In July and August, common on the leaves of this and other trees, puncturing them and subsisting on their juices, a small oblong black bug, 0.20 long, with three silvery white transverse lines on its wing-covers, the middle one longest, the middle joint of its antennæ long and towards its tip thickened and black, the last joint slender and white with its tip black, and the hanches of its legs also white. This bug is equally common here as in Europe. Its marks are so peculiar as to remove all doubts of its being one and the same species which inhabits both sides of the Atlantic.

Several other species of bugs occur upon the pine, but as they are found in greater numbers upon other kinds of vegetation, it is scarcely necessary to notice them under this head.

INSECTS INJURIOUS TO THE SPRUCE (*Abies nigra* and *alba*).

The destruction of spruce and firs in Northern New England in 1878–'81.—The forests of spruce and fir in Maine, Northern New Hampshire, and New York were, about the year 1879, destroyed by the wholesale, the coast of Maine from Portland to Eastport and Calais, on the Saint Croix river, having especially suffered. In the summer of 1880, during a hasty visit to Brunswick, Me., and the shores of Casco Bay, I noticed the great destruction that had been effected in the spruce growths on Mere point and on some of the adjacent islands of Casco Bay; but failed to detect the cause of the disease, supposing that it was too extensive to be attributed to the attacks of insects, and that some meteorological cause, such as severe winters or the attacks of some fungus, would better account for a destruction so widespread and apparently sudden.

During the last half of the summer of 1881, spent in Maine, I was enabled to make a more careful examination into the causes of the disease, and think that without much doubt it was wholly due to the attacks of various beetles, and, perhaps, in some cases, of caterpillars.

About the middle of July I went from Brunswick, Me., to the White Mountains, and observed a good many dead spruces and firs in the woods on either side of the road from Gorham, N. H., to the Halfway House upon Mount Washington. The dead spruces and firs were in nearly all cases, especially those which had evidently been cut down during the preceding winter (1880–'81), riddled by the mines or burrows of the spruce bark-borer (*Xyloterus bivittatus*).

The spruces were also infested by the common pine longicorn borer, *Monohammus confusor*, the larvæ being found to have bored the tree in all directions.

Living hemlock trees, 15 to 20 inches in diameter, were infested by large unknown longicorn borers under the bark, while the bark itself was mined in all directions by *Hadrobregmus*, whose burrows were very abundant in logs cut down during the past winter near the Glen House,

and in bark stripped from the logs; and the mines also occurred in the bark of living trees.

About the 1st of August, during a visit to Peak's Island, in Portland Harbor, large numbers, sometimes entire clumps or groups, of dead spruces were found to have been perforated by small bark-borers, not only the trunks but the larger and smaller branches, the beetles being still at work. Some of the spruces were partly killed, the upper branches retaining their leaves.

At Brunswick, Me., the dead spruce trees were found to be infested with myriads of three common borers (*Xyloterus bivittatus*, *Xyleborus cælatus*, and *Pityophthorus puberulus*), the bark being mined in every direction, the beetles occurring in the larva and pupa, as well as adult or beetle condition. Some of the trees, only partly dead, had the bark of the trunk and branches filled, so to speak, with these mischievous borers, and the results of their united labors were equivalent to barking or girdling the tree not only in one spot, but the entire tree; the deadly nature of the attacks of such a host of bark-borers mining and feeding upon the inner bark and sap-wood, the most vital part of the tree, was sufficiently obvious. The stumps of firs and spruces, as well as of white pines, which had been cut down the previous November, were swarming with these small Tomici in all stages of development, their numbers being astounding. In two hours I took 1,000 specimens of *Xyleborus cælatus* from one pine stump.

But if there had been any doubt as to the nature of the disease which carried off the spruces at Brunswick, in the woods southeast of the college grounds, in the course apparently of a single year; my visit to Merepoint demonstrated satisfactorily to my own mind that large, healthy firs, a foot in diameter, may be killed by the attacks of longicorn borers (*Monohammus confusor*), assisted by the smaller and far more numerous bark-borers, aided, perhaps, by caterpillars, with the final assistance of the common longicorn, *Rhagium lineatum*. Several living firs with only the lower branches dead were observed with the bark perforated with the holes made by the common longicorn pine-borer (see p. 152) and a *Buprestid* borer, while the boughs were tenanted by bark beetles and their young. Fir trees along the road to Harpswell from Brunswick were also observed to be perforated in the same manner; and if a dozen longicorn borers can not only injure but kill outright large, healthy sugar maples, as has been observed in Brunswick, Me. (see p. 103), there is no reason why firs from six inches to one foot in diameter should not perish from a similar cause; or if multitudes of small timber beetles or bark-borers girdle the tree from top to bottom with their mines, we do not see why this is not an efficient cause of rapid decay and death.

We next visited Harpswell Neck, and found from our own observation and by inquiry from others that a large proportion of the spruces and firs for a distance of about ten miles have died within about four years. The pleasure of driving over this picturesque road, with its

striking northern harsh, wild scenery and frequent glimpses of Casco Bay, in former years greatly enhanced by riding through bits of deep dark spruce forests, has been not a little marred by the acres and even square milse of dead spruces which border the road, stripped of their dark sea-green foliage, reduced to skeletons, and presenting a ghastly, saddening, and depressing sight. And, indeed, judging from accounts, one may travel through the spruce forests of the coast from Portland to Rockland, and farther east to New Brunswick, and meet with similar sights.

We visited late in August, in company with A. G. Tenney, esq., the farm of Mr. William Alexander, passing, before reaching the road leading to his house, an area of several acres from which the spruce growth had been cut off in consequence of their widespread destruction by insects. Mr. Alexander informed us that the spruce trees were, in his opinion, killed by small caterpillars which have been at work for five years, but which were most destructive in 1879. These caterpillars he described as being the young of a small brown moth which laid its eggs in autumn; the caterpillars hatching from them were not inch-worms, but when fully grown the body tapered towards both ends, and were about three-quarters of an inch long. They were most destructive June 20, when they are seen among the buds at the ends of the branches, where they drew the leaves together, eating the buds and not the leaves. He had also seen borers in the trees, but he thought the death of the tree should be attributed to the bud-worms, rather than to the borers. As will be seen further on, a number of caterpillars were found by us late this summer feeding upon the leaves of the spruce and fir, but the worm observed by Mr. Alexander was probably one of the leaf-rolling caterpillars, a species of the family *Tortricidæ*. A number of spruces and firs, with their leaves still on, but of a bright red, were observed scattered along the roadside; but no signs of leaf-worms or borers were observed in such trees, although the dead, leafless trees were infested with bark-borers.

That the operations of borers and bark-beetles may be aided by caterpillars in the buds as well as on the leaves seems also corroborated by observations in other localities. I was informed by C. J. Noyes, esq., of Brunswick, who is a summer resident at Mere point, that in June and the first week in July, 1878, the spruces and firs were attacked by great numbers of "little measuring worms, like the currant worm in shape," which eat the buds at the ends of the branches; since 1878 they had mostly disappeared, and this summer (1881) he had noticed only four or five.

From Harpswell Neck we traced dead spruces and firs around to West Bath, where extensive forests had been destroyed and numbers of dead hemlocks were observed, while the wood was attacked and the bark undermined and perforated by Buprestid borers, bark-borers, and the pine-weevil (*Pissodes strobi*). We have nowhere seen hemlock trees,

which are more exempt than any other coniferous trees from the attacks of insects, so much infested.

The death and destruction of spruce forests were reported to us at Rockland, Me., and at Calais, Me., the destruction having been observed by Mr. Sewall at the latter town in 1879. From these facts there is good reason to suppose that perhaps a third of the spruce and fir forests from near Portland to Calais have been destroyed by insects, most of the work of destruction having been accomplished four or five years ago, during 1878–'79.

Similar damage has been done at points ten or twelve miles from the sea and in the interior of the State. The injury was especially noticed in North Topsham, near the Bowdoinham line. According to the statements of Mr. Willis, the agent of the Feldspar works in North Topsham, forwarded by Dr. C. A. Packard, of Bath, Me., the spruces were in 1879 attacked by borers and also by small caterpillars, "not measuring-worms" (probably like those observed by Mr. Alexander at Harpswell). The trees thus defoliated leaved out, becoming green again; and in 1880 and 1881 the evil seemed to be diminishing, as has been noticed at other places.

We were also informed by A. G. Tenney, esq., who in August visited the Rangeley Lakes, that he observed many dead spruces about the shores of the lakes, and from him we learned that the evil had attracted the attention of the local press in Aroostook County in Northern Maine.

Mr. Tenney also kindly handed us the following extract from the Home Farm, for July 14, 1881, published at Augusta, Me.:

Some time ago two or three articles appeared in our journal concerning the injury to the spruce timber in the northern portions of our State, caused by a minute little insect about whose history little seems to be known. Since then we have received much information concerning them from a most intelligent gentleman resident in Northern Somerset, who has been extensively engaged in lumbering for many years, and who has visited the spruce forests summer and winter, and observed the working of this very destructive insect.

The gentleman informs us that the first appearance of the insect was in 1874, and he has reason to believe it is now much on the increase, as he thinks on some townships there are now thirty dead trees from this cause, where two years ago, on adjoining townships, there was but one. The insect appears about the 1st of June, and on landings and jambs of spruce; the air is full of them. They are about as large as a black fly, and are of a brownish, or dark snuff-color, the head half the size or length of the body. They are very tenacious of life, being hard and horny, and it is almost impossible to crush one between the thumb and finger. They are seen for about two or three weeks, during which time the logs and standing trees in the wood are bored full of holes about the size of a timothy straw, in which the eggs are laid, the larvæ of which appear the next summer. In felling trees in winter, thousands of these grubs drop out, from one-sixth to one-eighth of an inch long. The chickadees are very fond of them and may constantly be seen following the lumbermen and picking up their food. If the spruce are cut the first year they are attacked, they make very good lumber, but the second year, or after the sap-wood has turned black, they are quite worthless, unless the tree is two and one-half feet through, in which case the heart-wood is worth something for lumber, after the sap-wood is dead. The rapidity with which the wood of standing trees that have been punctured by these insects

decays is noticeable from the statement that in autumn, when parties are exploring, the blazing of an apparently sound tree with the axe reveals the fact that the sap-wood is thoroughly gone.

We have previously stated that Dr. Franklin B. Hough, the United States Commissioner of Forestry, visited this State last autumn and made an exploration of our northern forests, for the purpose of gathering information as to the extent of the ravages of this insect. In a letter to us, under date of May 6, 1881, he writes:

"I am well informed as to the extent of damages being done to the spruce timber in Maine and some places, and have been collecting information by circulars, correspondence, and personal inquiry for two or three years. The same mortality has been going on in the 'North Woods' of New York for five or six years, and has been made a special study under State authority. In 1868 there was published a report by the French Government upon the injuries done to spruce forests in that country, the principal part of which I have translated for use in my next report. I am under the impression that so far as the ravages of the insect are concerned, the worst is over—at least such is the opinion of lumbermen with whom I have corresponded—although the reality is sad enough. It has not been relatively greater in your State than in New York, but the losses reach to a fearfully great amount in your State on account of the great abundance of spruce in your forests. As for the remedies employed in Europe to check the ravages of insects in the spruce, they are altogether too expensive for us. We can only save what is dead, and the lumbermen are doing this as fast as possible: but notwithstanding this, a great deal will be lost. I have facts showing that like mortality has occurred long ago in other sections of the country, lasting a few years and then disappearing—as this will—perhaps being succeeded by a different growth of timber, as is observed in New York. The replies to circulars sent out last fall, indicate that the local extent of its duration will not last so long as apprehended."

Portions of the Adirondack region were, in 1876, visited by Mr. C. H. Peck, State botanist of New York, who thus reports on the evil in the Thirtieth Annual Report of the New York State Museum of Natural History for 1877 (Albany, 1879, pp. 23, 26):

While on a collecting trip in the Adirondack region, in July and August, my attention was repeatedly arrested by the extensive ravages of the spruce-destroying beetle, *Hylurgus rufipennis* Kirby, of which a partial account was given in the twenty-eighth report. The green slopes of Mount Emmons, commonly called Blue Mountain, and of several mountains to the north of it, had their beauty, and their value too, greatly impaired by the abundant intermixture of the brown tops of dead spruces. The destruction was also visible along the road between Newcomb and Long Lake, and on the mountain slopes far to the north of this road. Again, on the trail from Adirondack to Calamity Pond, there was sad evidence that the little destroyer had invaded also the forests of Essex County. From what I have seen at Lake Pleasant, in the southern part, and from information concerning the Cedar River region, in the central part of Hamilton County, there is reason to believe that much of the spruce timber of this county has already been invaded by the beetle. How much farther this destructive work has extended or will extend, it is impossible to say; but one thing is certain—it is still in progress. For the purpose of gaining more knowledge of the insect, I cut down, at South Pond, a tree that had recently been attacked by it. It was about 20 inches in diameter at the base; the foliage was still fresh and green, and there was nothing, except the perforations in the bark, to indicate that it was at all affected. The bark peeled from the trunk without much difficulty, the sap-wood was perfectly sound, and the heart-wood also, except a small portion in which there was a slight appearance of incipient decay. Longitudinal furrows, varying from 1 to 6 inches in length, were found under the bark, and each furrow was occupied by one or two beetles. The furrows are excavated from below upwards. In the short ones but one beetle was found, and but one perforation communicating with the external air.

In the longer ones two beetles (probably the two sexes) were usually found, and from two to four perforations afforded means of ingress and egress. The lowest perforation, which is the one by which the beetle first enters and commences its furrow, is often found closed or "blocked up" by the dust and *débris* thrown down by the excavator in the progress of the work. The second perforation is generally 1 or 2 inches above the first. I failed to discover whether it is made by the second beetle for the purpose of ingress or by the first beetle. The third and fourth perforations are in a nearly direct line above the other two, and are probably made from within outwardly, but for what purpose is uncertain. In one instance the two beetles were found at work making these perforations, boring through from the inner surface of the bark. In one instance the third was less than half an inch above the second, so that there would seem to be no particular necessity for it.

The eggs of the insect are deposited along both sides of the upper part of the furrow. They lie close together, almost or quite in contact with each other. When the larvæ emerge from the eggs they begin to feed upon the soft cambium and to work their way under the bark at right angles to the main furrow. They are at first so minute and work so close together that they make no distinct furrows, but seem rather to devour entirely a very thin layer of the cambium; but as they increase in size they begin gradually to form distinct furrows and to take directions more divergent from each other, and from their original course. In this way colonies from contiguous furrows at length run together, and in time the whole is surrounded by their multitudinous pathways, and the death of the tree is accomplished. Great care is taken by the parent beetles to keep their furrows separate. No instance was observed in which they ran together. In one instance the course of a furrow was changed to avoid running into the lateral furrows of a colony of larvæ just above. No furrows were found in the tree more than 10 or 12 feet from its base, thus indicating that the attacks are made upon the lower part of the trunk. The attacks are not made simultaneously. Some of the furrows in this tree were scarcely more than an inch long, and evidently had been just commenced. Others were fully excavated and contained eggs, and in others still the larvæ had hatched and commenced their work, but in none were they fully grown. In another tree, a few rods distant from the first, the attack had evidently been made earlier in the season, for the larvæ were further advanced in size and the bark on one side of the tree was well loosened, though, strange to say, the other side of the trunk was comparatively unharmed. I was unable to discover why, in this instance, the attack was limited to one side of the trunk. It is pretty evident, therefore, that the trees are attacked all along during the months of June and July, and possibly as late as August. I suspect, also, that the parent beetle, after having established a colony in one place, may emerge from her furrow to repeat the operation in another place, either in the same trunk or in a different one, but this I was not able to ascertain definitely.

A whitish fungus, *Polyporus volvatus* Pk., scarcely larger than a hickory nut, occurs in considerable abundance on the trunks of spruces killed by this beetle. The mycelium of the fungus grows beneath the bark, and the external plant is connected with it through the perforations made by the insect. Hence this fungus becomes a conspicuous indicator of the track of the beetle and tells the tale of its destructive power.

In a subsequent report, the thirty-first, Mr. Peck thus refers to the injuries by bark borers of the balsam fir:

The wood of the balsam is of little value for lumber, owing to the small size of the tree. It contains resin and burns freely, but with a crackling noise. The smoke is very penetrating and irritating to the eyes. Near the summits of the mountains, however, it is almost the only available wood for camps and camp-fires. The bark of this tree furnishes the well-known "Canada balsam," a clear viscid resin of considerable repute in medicine and much used in mounting objects for the microscope. The resin is obtained from small vesicles or "blisters" in the bark.

It is generally more abundant in the thrifty, smooth-barked trees of low damp lands, than in the stunted growths of the mountains. Because of the value of this tree as a producer of balsam, and because of its beauty and fitness to adorn parks and pleasure grounds, it ought to be cherished and preserved. But like its companion, the spruce, it has its insect and fungoid foes. While at Summit in Schoharie County, in September, I noticed in a small grove of balsams that a dozen or more of the trees had recently been killed or were then dying. The leaves had nearly all changed their color, but for the most part yet remained on the trees.

"An investigation showed pretty conclusively that an insect was the cause of the death of the trees. A minute bark-mining beetle, both in its mature and in its larval state, was found between the bark and the wood. The beetle perforates the bark, excavates its furrow along the inner surface in a horizontal direction, and deposits its eggs along the sides of the furrow, which is less than one-sixteenth of an inch in diameter. As soon as the eggs are hatched, the larvæ begin to mine furrows of their own at right angles to the original gallery, one part eating their way upward and another downward between the bark and the wood. These larval galleries are nearly parallel to each other, and are at their beginning so minute that they are scarcely visible to the naked eye; but as the larva advances in its course it increases in size and the diameter of its furrow increases in like manner. The larvæ were found (in some instances transformed to the mature beetle) each in the larger end of its own furrow. It will be observed from the direction of the original furrow, how powerful an agent for mischief this minute beetle is. Its work is carried on in the most vital part of the tree. Three or four beetles attacking the trunk at or about the same height and on different sides of the tree, would completely and effectually girdle it and destroy its life. Even a single beetle, by extending its furrow entirely around the trunk, would accomplish the same result, but no furrows were found thus extended. The length of the original furrows appeared to be less than 4 inches. The beetle itself is scarcely more than one line long, and belongs to the genus *Tomicus*. The species is probably undescribed. In the case of the spruce-destroying beetle more workers are necessary to kill the tree because the main furrows are excavated longitudinally or parallel to the axis of the trunk, while in the case of the balsam-destroying beetle the original furrow is excavated at right angles to this axis, and therefore cuts off or destroys the vital action over a much broader space.

"The destruction of the balsams was not limited to the single grove in which it was first observed. In several places along the road between Summit and Jefferson dead and dying balsams were noticed; but the affected trees were not very numerous, and it would not be a difficult matter, with prompt and united action, to arrest the progress of the mischief. If each man, on whose land the balsams grow, would, as soon as signs of the presence of the trouble are manifest, cut the affected trees, strip off the bark and burn it, he would, by so doing, destroy the colonies of larvæ and prevent the further spread of the mischief. It is not at all probable that trees once attacked and showing signs of death can be saved, and it would be far better to cut them immediately than to allow them to remain as nurseries for these tiny marauders."

The spruce and firs in the Adirondacks, however, seem in general less affected than in Maine. Mr. John H. Sears, an observing botanist of Salem, Mass., who made a trip there late in the summer of 1881, writes me that "the spruce and other coniferous trees are remarkably healthy, noticeably so from Ticonderoga, Essex County, through Clinton County to Rouse's Point; and in Canada northward to Montreal from Lyon Mountain to Chateaugay there are large and handsome specimens over 3 feet in diameter.

Similar destruction of spruces in Maine in 1818.—From Mr. William Alexander, of Harpswell, we learned that "about eighty years ago" there was a similar destruction of the spruce growth upon the same farm (his father's) as we visited, and it was his impression that his father ac-

counted for it by the ravages of insects. The following letter from Hon. R. H. Gardiner, of Oakwoods, near Gardiner, Me., written to Mr. A. G. Tenney, editor of the Brunswick Telegraph, will corroborate the idea that the visitations of bark-beetles are in a degree periodical:

OAKWOODS, *August* 27, 1881.

DEAR SIR: You requested in the last number of the Telegraph information about dying spruces, for the purpose of aiding Professor Packard in his investigation of the enemies of the spruce. I can render no aid in the matter, but would remind you of a fact that may be forgotten, that in the year 1818 every spruce tree west of the Penobscot was killed by an insect. I cannot remember this, but have often heard my father speak of it. From 1833 to 1836 I was interested in the lumber business on the Kennebec and no spruce were ever seen among the rafts of logs, though spruce from the Penobscot was sold in Boston. *Now*, little else than spruce is cut on the upper waters of the Kennebec, but every spruce tree has grown since 1818.

I would have written direct to Professor Packard, but thought it probable the fact I speak of was known to him and I only mention it now to you in case it may have been forgotten.

Yours, very truly,

R. H. GARDINER.

Similar destruction of forests in Germany and in Scandinavia.—Widespread devastations in spruce forests have occurred at intervals within the past century in Europe, and this has been generally attributed by entomologists and foresters to the operations of these timber beetles or more properly bark-borers. As bearing on this point we quote from an article which appeared in Nature, for October 14, 1880:

In an article in Danish, entitled "Om Grantörken og Barkbillen," by J. B. Barth, the author, who is one of the first authorities in Norway on questions of forestry and arboriculture generally, explains his reasons for differing from the opinion commonly received, that the desiccation and ultimate death of the Norwegian spruce (*Abies excelsa*) are due to the attacks of *Tomicus typographus* (*Bostrychus typographus*), which is usually regarded as the most pernicious of all the insect enemies of the Coniferæ. Herr Barth does not dispute the fact that this beetle is to be found often in large numbers on trees affected by abnormal drying up, whether still standing or cut down; but, in his opinion, although disease in the tree may be the cause, it is not the result of the presence of the Tomicus, which he believes to have absolutely no effect on the condition of the bark. According to this view the numerous agents employed in Germany and elsewhere to eradicate this beetle have no result but waste of labor and money, the only remedy against the drying up of the bark being a more scientific mode of clearing forests, in which the trees often perish either through overcrowding, or, more frequently, through reckless felling by which cold blasts are allowed to fall directly on the interior. Herr Barth's views are in opposition to those of the majority of the working foresters of Germany and Scandinavia, but his extensive acquaintance with home and foreign forests, his great practical experience, and his reputation as a naturalist, entitle them to all possible respect, although it is not to be supposed that his plea for the innocuousness of the *Bostrychus typographus* will be admitted without much sifting of the evidence, seeing that this insect is generally believed by German foresters to have been the cause of the destruction of the forests of the Harz Mountains, when between 1780 and 1790 two million trees died of desiccation.

The disease due to bark and timber beetles.—From the foregoing statements the reader will justly infer that the great destruction of spruce and forest trees throughout Northern New England in 1879, and four or five years following, was due to the attacks of beetles, chiefly the small

cylindrical bark-borers, belonging to the coleopterous family *Scolytidæ*; three species, *Pityophthorus puberulus*, *Xyloterus bivittatus*, and *Xyleborus cælatus*, being the principal aggressors.

That the disease was not due to fungi has been shown by a thoroughly competent botanist, Prof. Charles H. Peck, of Albany, N. Y. That it was not due to extremely cold weather in winter is probably certain from the fact generally observed by us that spruce and fir forests, over any given area, are not universally killed, as among groves of dead spruces and firs many living perfectly healthy trees exist, while the pines and hemlocks have been unharmed. By cutting down portions of forests and thus letting in cold severe winter blasts, general and widespread destruction of entire forests may ensue, as has been shown to have been the case in France. Why pine trees should have, in general, escaped the ravages of these beetles, all of which we have found in greater or less abundance under the bark of dead pines, and especially in dead stumps, we cannot explain, except from the well-known fact that most vegetable-eating insects prefer one species of tree and retain that preference for successive generations.

Remedies.—When a growth of these trees is invaded by insects boring in or under the bark, the loosened bark should at once be stripped off and burnt. If the tree is dead it should be cut down and the bark stripped off and at once used for firewood, even if the wood is kept for future use as fuel. Trees infested by caterpillars may leave out again and gradually assume nearly their original health and vigor. But the best remedies are those of a preventive nature. In the present case, though the evil is apparently diminishing in Maine, our observations taught us that the dead firs and spruces wherever examined are teeming with thousands and even millions of small bark beetles in all stages of growth. It would therefore be wise to prevent any further spread of the evil by cutting down dead spruce and fir timber and selling it off this winter for fuel. Forests should be thoroughly cleared, and even pine stumps should be barked and the bark burned, for, as already stated (p. 175), we have taken thousands of these spruce beetles from under the bark of white-pine stumps. In fact, stumps, in the summer succeeding the falling of the tree, are a general resort for all sorts of destructive boring insects; and should it be too expensive a matter to pull up such stumps, if the bark is torn off, the naked stump will be much less frequented by noxious insects.

We will now proceed to an enumeration of the insects known to be more or less destructive to spruce and fir trees.

AFFECTING THE TRUNK.

1. The pine longicorn borer.

Monohammus confusor Kirby.

Order Coleoptera; family Cerambycidæ.

This common and pernicious borer has been described and figured on pages 152–156. It occurred under the bark of dead spruces at Bruns-

wick, August 3 and 27. At the latter date three sets of the larvæ occurred—one measuring about 6mm, another 9mm, and a third from 16mm to 20mm in length. There were no fully-grown worms. It is possible that the eggs from which these came were laid in the early summer; but it is more likely that they were deposited by the female during the previous summer, as the beetle is not to be seen except from June to early September.

2. Unknown buprestid larva.

A species of *Dicerca* or *Melanophila*. (?)

Rather long and slender larvæ, with the segment next behind the head much narrower than in *Chrysobothris*, occurred in abundance under the bark of a dead spruce at Brunswick, August 27. They were nearly fully grown. The larvæ of either this or an allied species also occurred under the bark of a spruce near the Glen House, near Gorham, N. H., July 22.

3. The long-legged melanophila.

Melanophila longipes.

Order Coleoptera; family Buprestidæ.

Probably boring into the trunks, a flat-headed borer, changing to a small Buprestid beetle.

This beetle is thought by Mr. George Hunt to bore into the wood of the spruce, as he has found it on charred spruce timber under such circumstances as to lead him to believe that it depredates on this tree. Nothing is known of the habits of the larva.

The beetle.—Body deep black, immaculate; thorax with an obsolete indented line; scutel small, subangulated; elytra finely granulated; an obtuse, obsolete, elevated line from the shoulder to the tip; tip abruptly terminated by a small spine in the center; beneath polished, slightly tinged with violaceous. Tarsi of the intermediate and posterior feet elongated, as long or longer than the tibia; first joint equal to the three following ones conjointly; fourth joint bilobate, very short. Found in Pennsylvania and the Western States. (Say.)

Leconte states that it inhabits Pennsylvania, Kansas, and the Lake Superior region; that it is very closely related to the European *M. appendiculata*, but on comparison the thorax is less rounded on the sides, which are less sinuate posteriorly. As in that species, the sculpture is very indistinct at the middle and the small carina at the basal angles nearly parallel with the margin. The elytra are more gradually narrowed behind, and the apex is rectilinearly attenuated from the suture, while in *M. appendiculata* the inner outline of the tip is concave, though not so much so as in *M. atropurpurea*. The tip of the abdomen, as in the others of this group, is slightly emarginate, with the angles acute.

4. The white-pine weevil.

Pissodes strobi Peck.

This common weevil, which is described and figured on p. 185, we have found the past season from the 10th to the 15th August, at Brunswick,

under the bark of the spruce. The cells, like those found in the pine branches, were situated under the bark of the trunk of spruces 6-12 inches in diameter, and contained the pupa or more commonly the imago. The beetles were found flying about also at this date.

5. The ribbed rhagium.

Rhagium lineatum Olivier.

Already described on p. 162, this insect occurred in the larva state in abundance under the bark of spruce stumps and standing trees, loosening the bark, but never doing any mischief as far as we are aware to the living tree. Small larvæ, only 4 or 5^{mm} in length, occurred in spruce stumps August 25, while others were 14^{mm} long. Fully grown ones occurred in neighboring pine stumps, and one after having been kept in confinement until the last of September went into the pupa state. The eggs from which the smaller ones hatched were probably laid in the early summer; the trees containing these grubs were cut down in November, 1880, so that it is not probable that the larva lives more than one year.

6. The unarmed spruce bark-borer.

Xyloterus bivittatus Kirby.

Order Coleoptera; family Scolytidæ.

This is the most destructive pest of the spruce, the beetle most concerned in the ravages of spruce forests in northern New England from 1878 to 1881. We first observed it July 22, 1881, in spruce stumps near the Glen House, in the White Mountains, N. H., the tree having evidently been cut down within a few months; the beetles were very abundant, and though there were no perforations in the bark, there were small holes between the bark and the wood on the top of the stump, the beetles having availed themselves of the shrinkage of the bark due to drying of the wood, to effect an entrance between it and the wood itself; here they were congregated in abundance and were apparently engaged in making the primary galleries of their mines and laying their eggs. It was also found under the bark of dead standing or fallen spruces. Afterwards (July 27) this bark-borer was found in abundance, many larvæ, a few pupæ, and beetles in great numbers, under the bark of partly living and dead spruces at Brunswick. The burrows made were small and irregular, slightly larger than the size of the beetle, and were much like those made by *Xyleborus celatus*, with which it was commonly associated. It was also found at Merepoint. The trees at Brunswick teemed with them, and many fewer beetles than those observed would suffice to completely girdle and kill the tree.

This beetle has its insect enemy; we observed a green chalcid fly under the bark, July 27, and a month later, August 25, chalcid larvæ nearly fully grown were found under the bark so near the larvæ of this

beetle, that we feel justified in supposing that it must have been feeding on them.

In the genus *Xyloterus*, according to Leconte (Rhyncophora, p. 357), the club of the antennæ is oval, compressed, and solid, without articulations; the shining corneous part extends forwards in a narrow band as far as the middle, except in *X. politus*, where it is entirely basal, and the club is indistinctly divided by one round suture; the rest of the surface is opaque, finely pubescent, and sensitive. The funicle is composed of two parts, as in the two preceding genera; the first joint is large, and stout as usual, the remaining part is about equal in length, forming a pedicel to the club, and is divided by two not well marked transverse sutures, thus causing the funicle to be 4-jointed. The eyes are moderately finely granulated and completely divided. The head is large, exserted, and in the ♂ is deeply concave. The prothorax is broader than long, and strongly asperate in front in the ♀, less in the ♂. The tibiæ are dilated, finely serrate on the outer edge, rounded at tip, and very feebly mucronate at the inner angle; the tarsi have the joints 1–3 rather stout, nearly equal in length; fourth very small, fifth slender, as long as the second and third united, with simple divergent claws. The hairs are not serrate or verticillate, as in Pityopthorus, but slender and smooth.

The four species in our fauna are easily recognized:

Elytra with well defined striæ of punctures, interspaces nearly smooth..... 2.
Elytra with ill-defined distant rows of punctures, interspaces equally strongly punctured, pubescence erect, abundant..... 4, *politus*.
Prothorax finely and sparsely punctured at the sides towards the base..... 1, *retusus*.
Prothorax finely but less sparsely punctured at the sides towards the base. 2, *birittatus*.
Prothorax scabrous and granulate behind the middle..... 3, *scabricollis*.

X. birittatus Mannh., Bull. Mosc. 1858, 236; *Apate bir.*, Kirby, Faun-Bor. Am. IV, 192, pl. 8, fig. 5; *Bostrichus carifrons* Mannh., Bull. Mosc. 1843, 297 (♂); ibid, 1852, 359; *Xyloterus cav.*, Mannh., ibid, 1852, 385.

Maine, Canada, Alaska, Vancouver's Island; length 3–3.3^{mm}; .12–13 inch. Varies greatly in color. Usually the front part of the prothorax, the suture and the margin of the elytra are black; sometimes only a short, pale stripe is seen on each elytron. (Identified by Dr. Horn.)

7. The spined spruce bark-borer.

Xyleborus cælatus Zimmerman.

Order Coleoptera; family Scolytidæ.

As the foregoing species has smoothed unarmed elytra, we have named it the "unarmed spruce bark-borer," while the present species, which is also destructive to spruce, though abundant in pine trees (p. 175), being gouge-shaped at the end of the body with two prominent teeth on each side at the end, we would name "the spined spruce bark-borer." Its habits and mines are apparently like those of the foregoing species, but the mines are a little larger, as is the beetle itself. We noticed the beetles in great

numbers with several pupæ under the bark of the spruce at Brunswick, August 22, and under another tree, observed August 27, there were many pupæ, and numerous pale beetles which had only recently cast off their pupal skins. There were all stages between very pale beetles and the dark, black-brown fully mature beetles; some with a short, broad dark stripe on each wing-cover; this might be thought at first sight a different species, and indeed it is probable that from variations in age and size, too many species of these bark-borers have been described.

Leconte states that the genus *Xyleborus* has "the body stout, cylindrical; declivity of elytra oblique, scarcely flattened; funicle of antennæ with four distinct joints; tibiæ finely serrate on the distal half of their length and rounded at tip." *X. cælatus* ranges from Canada to Texas and California. In this species "the declivities of the elytra at the end of the body are with two prominent tubercles, and some smaller marginal ones; elytra strongly punctured in rows; interspaces with rows of distant punctures." (Identified by Dr. Horn.)

8. The least spruce bark-borer.

Crypturgus atomus Leconte.

Order Coleoptera; family Scolytidæ.

This minute bark-borer, though often occurring in white pine bark, must not be confounded with *Pityophthorus puberulus* of the white pine (p. 172), as its burrow is very different. The present species is $1.\frac{1}{5}^{mm}$ long, and $\frac{2}{5}^{mm}$ in diameter. The mine consists of a short sinuous primary gallery about $\frac{1}{2}$ inch long, which gives off at intervals about ten short secondary galleries from each side, but they are not made in the same plane, next to the sap-wood as in *P. puberulus*, but penetrate only the bark itself in all directions, so that no regular pattern is formed. The beetle is extremely numerous, a great many dense mines being situated within a square inch of surface. They were observed in great profusion in the larva, pupa, and beetle states at Brunswick, Me., during August; in standing dead trees as well as spruce stumps; also in white pine stumps. Many of our observations on this and the foregoing species, as well as the Rhagium, were made by the side of Maquoit street, Brunswick, on land from which timber was felled, as we were informed, in November, 1880, so that the period during which the insects had been at work was known quite exactly.

This species has been kindly identified for us by Dr. John L. Leconte, of Philadelphia, who has also prepared the following description, which is much more complete than the original description in the Transactions of the American Entomological Society.

The beetle.—Slender, dark piceous, shining, prothorax distinctly longer than wide, sparsely and coarsely punctured; elytra very finely not densely pubescent, striæ composed of shallow punctures, interspaces as well as the striæ without distinct punctulation. Length $1^{mm}+$. Head with a broad short beak, slightly convex, finely not densely punctulate. Prothorax distinctly longer than wide, slightly rounded on the

sides, gradually narrowed from the middle to the tip; disc transversely convex, not polished, but very imperceptibly granulate, sparsely and strongly punctured. Elytra cylindrical, not wider than the prothorax, convexly declivous behind; sparsely clothed with very short and fine yellowish pubescence; striæ composed of rather large shallow punctures, interspaces not narrower than the striæ, almost imperceptibly punctulate. Beneath nearly smooth, sides of metasternum with a row of punctures, sides of ventral segments feebly punctured. Legs piceous, front tibiæ with 5 distinct acute teeth on the outer edge, which is also sparsely fringed with long yellowish hairs, with a fine apical spine at inner angle; tarsi yellow, narrow, third joint not dilated. Antennæ with the scape long, the first joint of the funicle large, rounded, second indistinct, closely connected with the club, which is large, oval, not pointed, solid, polished, and corneous except along the apical margin, where there is a spongy sensitive band.

9. THE PINE TIMBER BEETLE.

Pityophthorus materarius (Fitch).

This bark-borer has been noticed on p. 173. We found numbers of them at Brunswick in August, 1881, which were identified as such by Dr. Horn, under the bark of a spruce, which had been cut down the preceding November; a few larvæ occurred with these.

10. *Hylurgops pinifex* Fitch.

This species, noticed on p. 177 as occurring in pine stumps, was also found mining under the bark of spruce stumps of trees felled in November, 1880. The track was made at the beginning of the roots, and is slightly sinuous, two or three inches long; 3^{mm} wide, while the diameter of the hole for the exit of the beetle is 2½–3^{mm} in diameter.

11. *Cupes concolor* Westwood.

Order COLEOPTERA; family CUPESIDÆ.

This beetle has been found by Mr. G. Hunt upon or among spruce boards in a tannery in Northern New York; hence he thinks it may be a spruce insect.

12. THE PINE NEPHOPTERYX.

Pinipestis Zimmermanni Grote.

This is said by Mr. Zimmermann to be destructive to young spruces in New York. (Can. Ent., xii, 59. See p. 182.)

AFFECTING THE LEAVES.

13. THE CHECKERED PINE MEASURING WORM.

Feeding on the leaves in August and early September in Maine, a geometrid caterpillar with the body very slender, gradually increasing in width towards the anal proplegs.

Head very small, much narrower than the body, deeply indented on the vertex, each side angular above. General color that of the bark of the spruce twigs, checkered with black and gray, with a lateral black

flattened and broad tubercle on each segment. This is a very pretty wood-colored caterpillar, congeneric with No. 9 on the fir. They vary in intensity of color, some being much darker than others; the small ones paler. Length, 12mm.

14. The livid green spruce measuring-worm.

Feeding on the leaves late in August in Maine, a peculiar very smooth slender larva; the head smooth, as wide as the body; the latter of uniform width. Above livid greenish, with a faint purplish tint. Lateral ridge pale green; body beneath pale greenish. Length 12mm.

15. The red and yellow-striped spruce measuring-worm.

Order Lepidoptera; family Phalænidæ.

Feeding on the leaves late in August, a small geometrid caterpillar, with the body flattened, reddish above, with a linear, very narrow delicate red dorsal line; lateral ridge straw-yellow. Anal plate short and broad, with two conical spines projecting behind it. Body beneath whitish yellow.

16. The spruce twig-mimicker.

Order Lepidoptera; family Phalænidæ.

This interesting geometrid caterpillar is over an inch (30mm) long, and closely mimics the dry twigs of the spruce and fir. The head is slightly wider than the body; rounded, the vertex on each side rather full. The body with four small, high, rounded dark tubercles on each segment; and low down on the side of each segment is a group of four irregular dark tubercles. Just behind the prothoracic stigmata is a dorsal, high, prominent transverse rough ridge. Supra-anal plate rounded at the apex, with four setiferous, slender, rounded tubercles, arranged nearly in a square, and projecting backward from the apex; while below the two anal tubercles are large, full, and rounded at the end. General color lilac-ash; head variously striped and mottled, and the body irregularly mottled and spotted with ash and black. Segments transversely wrinkled; the lateral ridge moderately prominent. In the young, two-thirds grown, the body is darker, and there is a row of irregular conspicuous white spots on the side of the body. It is distinguished from No. 9 on the fir by the rounded, less angular head, and by having four instead of two tubercles, but belongs to the same genus. It is also different from No. 9 on the fir in not having a lateral yellow line.

17. The cone-headed spruce caterpillar.

A noctuid or sphinx? larva, feeding late in August in Maine on the spruce, with ten abdominal feet. Head very large, vertex high, ending in a large cone. Supra-anal plate large, long, triangular, ending in two blunt conical tubercles. Head pale green, tipped with red on the point of the vertex, from which two faint white bands pass down by the eyes. Clypeus and labrum honey-yellow, black on the sides. Two dorsal and two lateral continuous linear white lines. A broken substigmatal broad snow-white line. Thoracic feet pale green; abdominal feet tipped with red. Moulted August 30. Length 20mm.

18. THE FIR HARLEQUIN CATERPILLAR.

This caterpillar, more commonly found on the fir, is described on p. 239.

19. *Eacles imperialis* Hübner.

This caterpillar is reported by Mr. Hulst to feed on the spruce. (Bulletin Brooklyn Ent. Soc., ii, 77.)

20. THE SPRUCE SAW-FLY.

Lophyrus abietis Harris?

Order HYMENOPTERA; family TENTHREDINIDÆ.

Occurring infrequently and not gregariously in Maine late in August on the spruce, a false-caterpillar; the body long, broader than the head; pale pea-green, the color of the leaves. Head smooth, concolorous with the body, with a dark patch extending upward behind each eye. Body with a dorsal dark green stripe, bordered on each side with whitish glaucous green. Along the body a lateral conspicuous broad white stripe, the stripe much scalloped below. Body beneath and proplegs uniformly green. Thoracic legs pale honey yellow, except at base. Length 17^{mm}.

No black spots on the body; though Harris says the larva of *Lophyrus abietis* is like that of Abbot's white pine saw-fly. (See p. 197.)

21. THE SPRUCE BUD-LOUSE.

Adelges abieticolens Thomas.

Order HEMIPTERA; family APHIDÆ.

Deforming the terminal shoots of the spruce, producing large swellings which would be readily mistaken for the cones of the same tree.

We take the following account and illustration from our Guide to the Study of Insects: "The genus *Adelges* was proposed by Vallot for certain broad, flattened plant-lice which attack coniferous trees, often raising swellings on twigs like pine and spruce cones. The antennæ are short, 5-jointed and slender; there are three straight veinlets arising from the main subcostal vein and directed outwards, and there are no honey tubes; otherwise these insects closely resemble the *Aphides*. A species closely related to the European *Adelges* (Chermes) *coccineus* of Ratzburg, and the *A. strobilobius* of Kaltenbach, which have similar habits, we have found in abundance on the spruce in Maine, where it produces swellings at the ends of the twigs, resembling in size and form the cones of the same tree. We would add that each leaf-bud is enlarged, having an *Adelges* under it. As those nearest the base mature first, and leave their domicile the deformed leaf-bud stands out from the axis of the shoot, thus giving the cone-like appearance to the end of the shoot." This has since been described by Prof. Cyrus Thomas in his Third Report on the Injurious Insects of Illinois, p. 156.

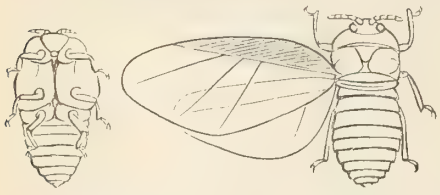

FIG. 90.—The spruce louse.—From Packard.

22. The European spruce bud-louse.

Adelges abietis Linn.

We observed this species in considerable numbers on the Norway spruces on the grounds of the Peabody Academy of Science at Salem, in August 1881. The deformation produced in the terminal buds and twigs were like those figured in Ratzeburg's Die Waldverderbniss, Bd. i, pl. 28, figs. 1, 2.

23. Spruce-tree plant-louse.

Lachnus abietis Fitch.

Occurring on *Abies nigra;* the wingless females pubescent, broadly oval, blackish, clouded with brown, with a faint ashy stripe on the back; under side mealy, with a black spot near the tip; antennæ dull white, with a black ring at the tip of each joint. Length to the tip of the abdomen 0.15 inch. (Fitch.)

It is probably this species which we have found in abundance on the terminal branches of spruces at Brunswick, Me., in July and August.

24. The spruce-tree leaf-hopper.

Athysanus abietis Fitch.

Order Hemiptera; family Tettigoniidæ.

Puncturing their leaves and extracting their juices the latter part of May and during the month of June, an oblong black shining leaf-hopper 0.20 long, tapering posteriorly, and broadest across the base of the thorax, with a light-yellow head, having the mouth black and also two bands upon the crown, the ends of which are often united, and commonly with a white streak on the middle of the inner edge of the wing-covers, its legs being pale yellowish varied more or less with black.

"I first met with several specimens of this insect eleven years since, upon the black spruce and fir balsam, on the summit of the Green Mountains, in an excursion hither with that martyr of science, the late Prof. C. B. Adams. Since then I have repeatedly captured this same insect upon birch trees, distant from any spruces, and it is possible it might have been accidently present on these latter trees in the instance first mentioned, there being numerous birch trees in the same vicinity." (Fitch.)

INSECTS INJURIOUS TO THE FIR TREE (*Abies balsamea*).

AFFECTING THE TRUNK.

1. The pine longicorn borer.

Monohammus confusor Kirby.

Fully grown larvæ, very large and long, and evidently ready to pupate, occurred under the bark of a dead fir near the Glen House, White Mountains, July 22. A fir tree was evidently killed by these borers at Merepoint, Brunswick, Me., as from the freshly cut stump a fully grown

dead larva and beetle were taken from the holes, several of which were in the tree. The holes were round and 7mm in diameter. Other trees were observed here and also on the Harpswell road with large round holes in the bark, evidently the work of this borer.

2. *Xyloterus bivittatus* (Kirby).

This beetle occurred, though not commonly, under the bark of the fir near the Glen House, July 22.

3. *Xyleborus cælatus* Zimmermann.

This beetle occurred in abundance in a fir stump, with the larvæ, August 27, at Brunswick.

4. *Crypturgus atomus* Leconte.

This minute species occurred frequently under the bark of a fir stump at Brunswick late in August.

5. THE WHITE PINE WEEVIL.

Pissodes strobi Peck.

This weevil, with the larva and pupa, was found under the bark of a fir tree on the Mount Washington carriage road, near the Glen House, July 22.

6. *Rhagium lineatum.*

Larvæ of this beetle, one-half grown, occurred August 27, at Brunswick, in a fir stump.

AFFECTING THE LEAVES.

7. THE FIR-TREE SAW-FLY.

Lophyrus abietis Harris.

Order HYMENOPTERA; family TENTHREDINIDÆ.

This pest of the fir which also infests pines has been described on page 197.

The specimens I found of this species, the females of which I raised from the larva and submitted to Mr. E. Norton for identification, had larvæ, of which the following description is taken from my notes. Much like that on the cedar and juniper, but darker green, with a black head and thoracic feet. Median dorsal stripe pale instead of dusky, and beside a pale subdorsal stripe, with a whitish green, lateral firm stripe. Beneath paler green than above. Of the same size. It spun a light silk cocoon August 23. The imago was found dead in the breeding box September 14, 1881, and must have left the cocoon during the first week in September. The antennæ are black, serrated. Body dull horn-yellow; abdomen a little paler, more amber colored; legs concolorous with the body. Wings smoky, with black veins. Length 7mm. Cocoon regularly oval-cylindrical; of a pale silken brown; length 8mm.

8. THE FIR NEEDLE INCH-WORM.

Order LEPIDOPTERA; family PHALÆNIDÆ.

Feeding in August on the leaves of the fir and very closely mimicing the reddish partly dead leaves or needles; a measuring or inch worm, with the body flattened from above downward and tapering at both ends, thus closely approximating the form of a fir leaf. Head small, narrower than the body; smooth, pale, mottled and spotted with reddish. Body reddish, covered with fine whitish papillæ; a faint blackish, somewhat broken narrow dorsal line; a fine pale whitish subdorsal line. Lateral line yellowish in partly grown caterpillars, obsolete in larger ones, becoming distinct on the sides of the not large, sharply acute supra-anal plate; two large acute spines below the plate. Body beneath of a peculiar glaucous greenish white, with a median reddish line. Thoracic and abdominal legs dull livid reddish. Length 20mm. Observed not unfrequently at Brunswick, Me., late in August; also found feeding at Brunswick on the low-bush common juniper (*Juniperus communis*) August 26–29, 1881.

This is one of the most remarkable cases of mimicry yet noticed among those feeding on coniferous trees. Often on beating them into an umbrella, which I used in collecting caterpillars, have I hesitated to pick them up, waiting to see whether or not they were simply dead fir leaves; in some cases the caterpillars themselves answering the question by walking off at their peculiar measuring gait.

The caterpillar changed to a chrysalis August 25, the pupa, at first greenish, became pale mahogany brown. Length 6mm.

9. THE ANGULAR-HEADED, MARBLED FIR INCH-WORM.

Order LEPIDOPTERA; family PHALÆNIDÆ.

Feeding on the leaves in Maine, late in August, a very slender inch-worm; the body tuberculated, blackish brown. Head angular; the vertex angulated above on each side. Body with five pairs of well marked small prominent tubercles; sutures between the segments not well marked, so that it is difficult to tell on which segment the tubercles are situated. Body wood-colored, the shade of the bark of the tree, mottled with black-brown, reddish gray and gray markings. Head marbled or mottled like the body, with a whitish line along the top of each side, and continued along the prothoracic segment, and in the form of two broken white faint lines along the sides towards the end of the body. Anal legs much larger than the other abdominal legs. Length about 20mm.

This caterpillar is not specially mimetic, though it is probably protected from the search of birds by its general resemblance to a dry fir twig. It may be recognized by its angular head, dark marbled body, colored like the bark of the branches on which it rests, and by the five pair of sharp, prominent small tubercles. It closely resembles in coloration the noctuid caterpillar (No. 14) on the same tree. It may be found to be identical with No. 16 on the spruce.

10. THE TEN-LINED PINE INCH-WORM.

Feeding on the leaves of the fir, hemlock, and spruce, an inch-worm with body very slender, with minute prominent tubercles, and a large, full, rounded head; the latter deeply divided in the middle, and much wider than the body. The general color a flesh tint, with 8–10 blackish-brown lines on top of the body. Head reddish, mottled

with dark brown. On the side of nearly each segment a pair of dark acute tubercles and below the bright straw-yellow lateral ridge (the line is broken in fully grown larvæ) is a black irregular flattened broad eminence. Supra-anal plate large, projecting far behind and, like the pair of anal legs, flesh red. Body beneath deep flesh-colored, with dark linear stripes. Length of body 20mm.

This caterpillar, which may be recognized by its slender body, with 8–10 dark lines, the broken lateral straw-yellow line, and the larger rounded deeply incised head, is common not only on the fir, but also on the spruce and hemlock late in August and early in September in Maine. In fully grown caterpillars on each segment of the body are two high rounded subdorsal and two larger lateral tubercles, which are reddish flesh-colored tipped with black, and there are two rounded supra-anal tubercles. This caterpillar is infested by a *Microgaster*, a single one of these small ichneumon larvæ issuing from the body and spinning a cocoon during the last week of August. The same caterpillar is described under Pine insects No. 78, p. 206.

11. The red-headed green inch-worm.

Order Lepidoptera; family Phalænidæ.

Feeding on the leaves in July and August in Maine, a green inch-worm, whose body is of the width and length of a fir leaf. Body rather thick and uniformly so. Head green in the middle, bright reddish on the sides, mottled with red-brown, and with two converging, narrow oval, pale red spots in front just below the vertex; clypeus tinged with red. Body pale green; a broad dorsal whitish green band of the same color as the under side of a fir leaf, and containing a median darker dorsal stripe. The band is whitish on the edges, next below which are two very narrow dark brown hair lines. A whitish line below the stigmata, and still farther below a narrow whitish line, and two parallel dark subventral lines. The thoracic legs reddish; the abdominal legs green. It also lives on the pitch pine and will feed on the white pine.

12. The 14-flapped fir inch-worm.

Order Lepidoptera; family Phalænidæ.

Feeding on the leaves of the fir late in August in Maine, a geometric caterpillar bearing a striking resemblance to the small reddish twigs of the fir with the leaf-scars. Body dull brick-red, with seven pairs of broad flat flaps on each side, those in the middle of the body being the largest. Head angular on the sides, deeply incised; when at rest retracted partly under the projecting prothoracic segment. The last segment with a large triangular thick lateral flap. Two dorsal dull yellowish sinuous lines, separated by a narrow median reddish line. Body beneath with dull obscure sinuous somewhat broken coarse yellowish lines. On the last segment are two high sharp tubercles. Supra anal plate rounded. Body roughly granulated. A light dull whitish yellow lateral stripe, extending down on the anal legs. Length 15mm. Perhaps a species of *Aplodes* or allied genus.

13. A noctuid larva.

Order Lepidopera; family Noctuidæ.

Feeding on the leaves in August in Maine, a cylindrical noctuid larva with 10 pairs of abdominal legs. Head of moderate size, as wide as the prothorax; body thicker just in front of the middle. Segments of the body rather convex; prevailing color pale horn-

brown, mottled with yellowish or reddish brown; with four black rounded button-like tubercles arranged in a trapezoid on the top of each segment. Length 18mm.

14. The fir harlequin caterpillar.

Order Lepidoptera; family Noctuidæ.

Late in summer in Maine, feeding on the leaves of the fir and spruce, a singularly humped and spotted caterpillar, with four pairs of abdominal legs. Body short, much swollen on the second ring behind the head and the first abdominal segment, and humped between the last and the penultimate abdominal legs. Head very small, striped with black. Ground tint a wood color mottled with gray and black, with scattered white spots. An irregular lilac dorsal band. A pair of conspicuous white dots on the hump behind the head, and another pair on the posterior hump. Body very much varigated in tints and it is difficult to describe briefly all the details of the markings. Length 12–14mm. This singular caterpillar is not infrequently beaten off from the fir and spruce. It was observed late in August.

15. The white-lined caterpillar.

Order Lepidoptera; family Noctuidæ.

Feeding on the leaves of the fir in August in Maine, a larva of the usual Noctuid form. Head nearly as wide as the body, smooth; body rather thick, smooth, pale pea green. A dorsal somewhat broken snow-white line, and two wider subdorsal ones. A broken bright red lateral line, edged below with white and yellowish. Ends of all the legs reddish. Length 22mm.

16. The tussock moth.

Orgyia leucostigma Smith-Abbot.

Order Lepidoptera; family Bombycidæ.

Feeding on the leaves of the fir in July and August in Maine, a hairy caterpillar with two black pencils of hairs in front; one median, one behind; four medio-dorsal short thick yellow tufts, succeeded by three dorsal coral-red tubercles on the back.

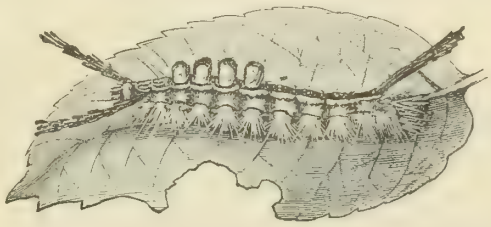

Fig. 91. The tussock caterpillar. Nat size.—After Riley.

Fig. 92.—The tussock moth; *a*, female: *e*, male: *c*, female pupa; *d*, male pupa; *b*, freshly-hatched larva Nat. size.—After Riley.

17. The pine leaf miner.

Gelechia pinifoliella Chambers.

The leaves of the fir were found at Brunswick, Me., to be affected by this miner much as in the pitch pine (p. 208), the terminal third of the leaf being paler than the rest. A dead pupa skin was found July 15.

18. The fir scale insect.

Lecanium.

On the upper side of a fir leaf a single specimen of *Lecanium* was found at Brunswick, which was low, flat, broad oval, blackish, almost as broad as the leaf.

19. The pine mite.

Order Arachnida; suborder Acarina.

Quite prevalent on the fir, working at the base of the leaves at the ends of the twigs, in summer and early autumn, in Maine; little dark mites, with rounded bodies, and quite active in their movements, causing the leaves of the fir especially to curl up, and to show the light under side. These little active mites spin a slight web in the axils at the end of the shoots. They are dark brown, with a yellowish head and thoracic region, while the legs and under side are of the same yellowish tint. They were observed from the middle of July until the first of September at Brunswick, Me., and occurred on the white pine as well as the fir trees.

INSECTS INJURIOUS TO THE HEMLOCK (*Abies canadensis*).

1. The canadian leptura.

Leptura canadensis Fabricius.

Order Coleoptera; family Cerambycidæ.

Probably mining the trunk of the hemlock, a longicorn larva changing to a rather large handsome black beetle, with the black wing-cases deep red at the base, and antennæ broadly ringed with reddish.

Dr. Fitch refers to the remarkable immunity of the hemlock from the attack of insects, and our experience of twenty years corroborates his opinion. He states, however, that the porter Hylotrupes (*H. bajulus* Linn.) is reported to sometimes attack this fortunate tree, and that the larvæ of the pine *Eacles imperialis* is said to occasionally feed on it, as well as a bug.

Mr. George Hunt, of Providence, tells me that he has found the pupa of *Leptura canadensis* in the stumps of the hemlock in July in the Adirondacks, New York. The beetle is rather a large one and is black, the surface coarsely and densely punctured. It may readily be identified by the base of the wing-covers being deep red, while the antennæ are broadly ringed with paler red, the joints in the middle being alternately red and black. It is three-quarters of an inch in length, and is

a common beetle. A few other borers are mentioned below which we have found the past summer in dead hemlock trees.

2. *A large longicorn borer.*

Order COLEOPTERA; family CERAMBYCIDÆ.

Mining under and loosening the bark of fallen hemlock logs near the Glen House, White Mountains, N. H., a large longicorn borer with the general appearance of *Monohammus*, but belonging to a different genus. Length of the different specimens from 7 to 17mm.

3. *A short, thick longicorn borer.*

Order COLEOPTERA; family CERAMBYCIDÆ.

Found under the bark of dead hemlocks at Bath, Me., July 30, a short, thick unknown longicorn borer.

4. *A Buprestid borer.*

Order COLEOPTERA; family CERAMBYCIDÆ.

Found under the bark of dead hemlocks at Bath, Me., July 30, a Buprestid larva of different sizes, perhaps a species of *Dicerca*.

5. THE WHITE PINE WEEVIL.

Pissodes strobi Peck.

This weevil and its cells were found in hemlocks among a number of small standing dead spruces, which had, like them, been killed by the attacks of longicorn borers, and by the following species of bark-borer:

6. THE LEAST SPRUCE BARK-BORER.

Crypturgus atomus Leconte.

This minute bark-borer was observed in considerable numbers in standing dead hemlocks at Bath, Me., July 30.

7. THE HEMLOCK BARK-BORER.

Hadrobregmus foveatus (Kirby).

Order COLEOPTERA; family PTINIDÆ.

The bark of hemlock trees and of hemlock logs, as well as the separated bark piled up by the roadside near the Glen House, in the White Mountains, last summer, was found to be perforated in all directions by this beetle, which has been obligingly identified by Dr. G. H. Horn, of Philadelphia. Not only the bark of dead trees, but that of healthy large trees had harbored great numbers of these beetles. They, however, had disappeared from the holes at the date (July 22) I was at the White Mountains, and but a single dead specimen was found. Similar mines were found in a hemlock at Brunswick, Me.

8. THE BROWN PRIONUS BEETLE.

Orthosoma brunneum (Forster.)

Order COLEOPTERA; family CERAMBYCIDÆ.

Mr. F. G. Schaupp writes me as follows concerning this beetle, which is not harmful to the tree, attacking it usually when in the last stages

of decay: "In a hemlock tree I found, July 20, in New York, hundreds of the larvæ of all sizes from 5–50^{mm} in length; the wood being exceedingly hard and tough, but although the new developed imagines (soft) were very abundant, and although I found some mouldy dead pupæ, I could not find a live pupa."

AFFECTING THE LEAVES.

9. The hemlock inch-worm.

Order Lepidoptera; family Phalænidæ.

Feeding on the leaves late in August in Maine, a slender-bodied measuring inch-worm of the general color of the terminal twigs, and not quite so wide as a hemlock leaf. Head not so wide as the body, with a moderately deeply impressed median line; pale flesh-colored, mottled, with pale reddish brown spots, and with long brown hairs. Body mostly greenish yellow, the tints pale and delicate. A dorsal row of diffuse elongated spots, extending backward from the transverse blackish stripes on the sutures between the segments. On each of the three thoracic segments is a transverse row of black warts and hairs, situated on the hinder edges of the second and third segments from the head; but nearer the middle in the segment next to the head. All the abdominal segments covered with fine whitish warts, giving a shagreened appearance to the skin. The lateral raised line very prominent, the body not being thick, but appearing as if partly shrivelled below a dusky lateral stripe. Supra-anal plate large, broad, flat, subtriangular. On the the underside of the body a median dusky linear stripe, on each side of which the body is whitish. Two faint dusky subdorsal lines, one on each side. This is very near to and is congeneric with No. 8 on the fir (p. 237).

10. The 10-lined pine inch-worm.

This was also found on the hemlock at Brunswick, August 27.

INSECTS INJURIOUS TO THE ROCKY MOUNTAIN SPRUCE (*Abies menziesii*).

AFFECTING THE TRUNK.

1. The rocky mountain spruce timber beetle.

Dryocœtes affaber Mannh.

Order Coleoptera; family Scolytidæ.

This beetle occurred (July 7, 1875) in abundance in all stages in a growth of *Abies menziesii*,* the common spruce of the Rocky Mountains,

* This tree was kindly identified for me by Mr. Sereno Watson, from specimens of the leaves and cones sent him for identification.

at Kelso's Cabin, 11,200 feet elevation, on the road to Gray's Peak. It bores into the bark and near the sap-wood in all directions, its burrows resembling those of *Tomicus pini*, with which it is associated, being irregular but much smaller.

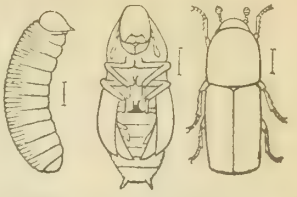

FIG. 93.—*a*, larva; *b*, pupa; *c*, beetle, of the Rocky Mountain spruce timber beetle.—From Packard.

The larva is of the usual form of those of the family, being cylindrical and of the same thickness throughout, with the end of the body full and suddenly rounded; segments convex, especially the thoracic ones, and slightly hairy. Head two-thirds as wide as the body, rounded, bone-yellow. Length, 0.15 inch.

The pupa is much like that of *T. pini*, with two anal soft, sharp tubercles. As my specimens are farther advanced than those of *T. pini*, the wings being free from the body, and the abdomen longer, it is impossible for me to draw up a good description. In one example the pupa had retained the larval head, but it was split behind so as not to interfere probably with the development of the adult beetle.

The beetle differs from *Tomicus pini* in its much smaller and slightly slenderer body. The head and prothorax are two-thirds as long as the rest of the body. The abdomen is not scooped out at the end as in *T. pini*, but truncated, moderately rounded, and the end of the abdomen reaches to the end of the wing-covers, which are square at the end instead of excavated as in *T. pini*. Color reddish-brown, much as in *T. pini*. The body is covered with fine, stiff, straight hairs. Length, 0.14. (Packard in Hayden's Report for 1875.)

This insect is said by Leconte to occur in the Lake Superior region, British Columbia, and Alaska.

2. The pine timber beetle.

Tomicus pini Say.

This insect, already described on page 168, is common in the timber region of the Rocky Mountains, boring irregularly into the inner bark of *Abies menziesii*. The burrows are like those made by the same insect in the white pines of New England. The main burrows of the mines observed in Colorado were 0.08 inch in diameter.

3. The common large red timber beetle.

Dendroctonus rufipennis Kirby.

This beetle, so common in Maine and British America, is also common in the coniferous trees of the mountains of Colorado, where I have met with it at Blackhawk and at Manitou.

4. The large timber beetle.

Dendroctonus terebrans (Olivier).

This common eastern form, which occurs from Maine to Georgia, and in California and Oregon, also probably infests the pine and spruce of elevated regions. I have a specimen from Tacoma, Washington Territory, on Puget Sound, a lumbering place, which was identified by Dr. G. H. Horn.

5. The western spruce longicorn borer.

Anthophilax mirificus Bland.

Order Coleoptera; family Cerambycidæ.

This beautiful beetle I found June 16, 1877, under the bark of a large fir-like spruce, probably *Abies menziesii*, on the side of a high hill near Virginia City, Montana. The small male was sexually united with the black female, and there were several other females near by. From these circumstances I have little doubt but that it bores into this tree. There is a great disparity in size and color between the sexes, and the male is much the smaller and is blue-black, with most of the elytra deep brick-red, the ends of the elytra being blue-black, as well as an oblong oval spot at the base of the united elytra; the terminal two-thirds of the abdomen is reddish; it is 16^{mm} long; the female is 21^{mm} long, and entirely blue-black. It was identified by Dr. Horn.

INSECTS INJURIOUS TO THE JUNIPER (Juniperus virginianus).

AFFECTING THE TRUNK.

1. The juniper bark borer.

Phlœosinus dentatus (Say).

Order Coleoptera; family Scolytidæ.

Making a short straight primary gallery, with about 15 to 50 longer secondary galleries branching from it at nearly right angles, often ending in round holes perforating the bark; a small white curved grub, changing to a light brown cylindrical beetle.

We have observed the depredations of this common beetle on the junipers about the city of Providence. The attacks were confined to sickly or dead trees; whether the cause of death was due to the attacks of this beetle or not could not be ascertained. The beetles were found May 2 and 13 alive in the burrows, which also contained the fully grown larvæ; but no pupæ were observed. In one fallen juniper tree, the trunk of which was about five inches in diameter, the mines were unusually close together and abundant, 15 occurring on one side of the trunk in a space about one foot long. Selecting a separate average mine for description, such as is figured in the accompanying engraving, the main or primary gallery is 18^{mm} to 25^{mm} (1¼ to 2¼ inches) long and 3^{mm} wide, widening at one end into a trilobed chamber twice as wide as the main gallery. In a gallery 25^{mm} long, including the three-lobed cell, from which no lateral or secondary galleries proceeded, there were 48 secondary galleries on one side and 51 on the other, the mouths of the opposing tunnels being alternately arranged. The secondary galleries being a little less than ½^{mm} in width; those arising at each end of the primary gallery are 45^{mm} long; those arising near the middle from one-third to one-half and two-thirds as long; the ends of the tunnels are

about 1.5^{mm} in width, and they often communicate with the hole made by the insect for its exit through the bark, which is 1.5^{mm} or a little less. These holes are indicated by the round black spots or large dots at the end of some of the galleries, as seen in the engraving. The holes may open out straight through the bark as usual, or sometimes obliquely. The galleries in May are closely packed with the excrement or castings of the worms, which is tan colored or the color of the bark, showing that the insects though sinking their galleries a little way into the wood, as proved by the shallow grooves they make in the wood, for the most part burrow through the inner bark, thus loosening it from the wood and causing it to peel off.

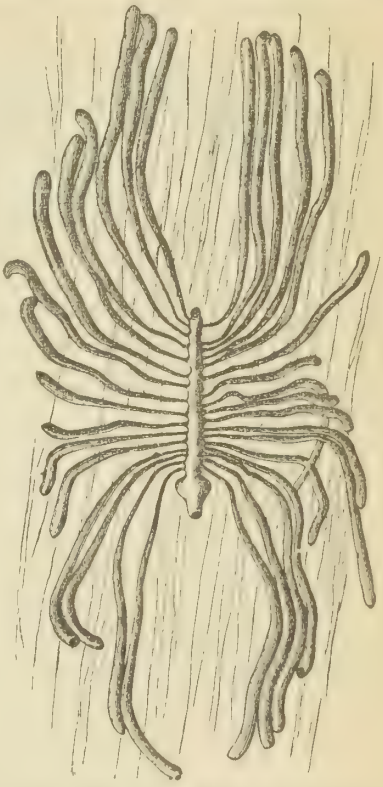

FIG. 94.—Mine of the juniper bark-borer.—Packard del.

The secondary galleries of the same cell rarely cross each other, unless owing to a knot in the trunk or to other irregularities in the wood; but, as seen on the right side of the engraving, one may make a turn and directly cross four or five others, or one from an adjacent mine may cross the galleries of another mine. As a rule, however, the mines of the juniper bark-borer are beautifully regular, and the wood very prettily sculptured.

I have little doubt but that this is the beetle, as it agrees with it in color and size, which I found in considerable numbers under the bark of the cedar or *Thuja occidentalis*, in Northern Maine in 1861. The dead cedars were much infested with these beetles, while they were not noticed in upright, healthy trees.

Leconte states that it inhabits the Middle and Eastern States and Canada, and gives the following description of it:

The beetle.—In the genus *Phlœosinus* the funicle or stalk of the antennæ is much shorter than the club; the first joint is rounded; the remaining four joints are closely united and gradually become broader; the club is large, oval, compressed, obtusely rounded, and divided by straight well-marked sutures. *P. dentatus* is rather smaller than the other species of the genus, except *P. punctatus*, with the declivity of the elytra more abrupt and flattened, and less convex; the striæ are impressed and scarcely punctured, the interspaces are wide, densely and strongly granulate and rugose; the rugosities becoming acute tubercles on the declivity of the alternate interspaces; second interspace not depressed on the declivity and furnished with a row of smaller tubercles in some specimens, but not in others. This difference is probably sexual. The head is granulate-punctate, and the front is not carinate.

2. The Prussian blue pine-borer.

Callidium antennatum Newman.

In company with the juniper bark-borer, mining dying and dead juniper trees; its mine a long, shallow, irregular sinuous gallery about 6mm wide in the broadest part; the beetles occurring under the bark early in May in Southern New England.

This common borer has already been noticed as infesting the pine (p. 159). It is nearly as common, perhaps, in the juniper; at least I have found it so in the vicinity of Providence, R. I., where it mines dead or dying juniper trees in company with *Phlœosinus dentatus*. In one small tree, three inches in diameter, nearly a dozen mines occurred, and as many of the beetles were taken from under the bark on the 2d and again the 13th of May, 1881. It is probable that the beetles had hybernated in their mines, having transformed into the pupa state the previous autumn. The mines may be recognized by their long sinuous shape, beginning very small and gradually widening and ending in a broader space or cell where the larva transforms into the beetle condition; just before the cell, at its widest part, it measures 6mm in width. The larva, as it eats its way along under the bark, does not sink deeply into the wood, simply scoring it, while the gallery is filled behind it with the tan-brown castings of the worm, consisting of partly digested bark, forming a fine paste which hardens and compactly fills the shallow groove. In general appearance the mine of this borer does not essentially differ from that of most of the superficial longicorn borers of other trees. The beetle is entirely deep Prussian blue, and may be readily identified by its color. It varies much in size.

3. The blue-clouded hylotrupes.

Hylotrupes ligneus Fabricius.

We have not personally observed the habits of this borer, which is said by Mr. George Hunt to bore under the bark of *Juniperus virginianus* in Rhode Island. The beetle may easily be recognized by its brown head, antennæ, prothorax, and legs; while the wing-covers are yellowish, with two large adjoining dark Prussian blue patches at the base; the patches rounded behind and extending to the middle of the wing-covers; the terminal third of the wing-covers are also deep Prussian blue, so that only the edges and a transverse copal-yellow band across the wing-covers are left. It is from 9mm to 12mm in length.

AFFECTING THE LEAVES.

4. The juniper twig inch-worm.

Drepanodes varus Grote and Robinson.

Order Lepidoptera; family Phalænidæ.

Very closely resembling the smaller twigs of the juniper, a rough-bodied span or measuring worm an inch and a half long, transforming to an ochre-brown moth.

The adjoining engraving well represents this singular mimetic form, which so closely resembles in form and color the smaller twigs of the juniper. Two of the caterpillars are represented, one holding itself out from the stem by means of its two hinder pairs of feet, while the other clings close to the stem. It is nearly an inch and a half long and less than a line in thickness. Its body is quite rough, with a few prominent tubercles, in size and form resembling the scales left by the falling off of the leaves of the juniper.

The moth may be known by the falcate fore wings, by the three dark spots at the inner angle of the fore wing, and the dark transverse lines; in the females the inner line of the fore wings is much curved and sinuate.

The caterpillar was received from Norwich, Conn., early in June, and on the 17th changed into a beautiful pea-green chrysalis, the moth appearing the 29th of the same month.

FIG. 95.—Moth, larva, and chrysalis of the juniper twig inchworm.—From Packard.

The moth.—It has unusually falcate fore wings. The ground color of the upper side of the wings is a pale fawn brown, with a rusty but no purplish tinge, as in some other species of the genus; but the body and antennæ are pale fawn brown. The fore wings at the base are fawn brown, but with rather thick-set black scales, especially towards the inner line. This line is curved zigzag, rusty fawn brown, and is very distinct; it begins at the basal third of the costa, and curving around opposite the discal dot, in a generally oblique direction, ends nearly as far from the base of the wing on the inner edge as on the costa; below the median vein the line is acutely zigzag, forming a tooth just below the lowest median veinlet, followed by a curve inwards on the submedian vein. The discal dot is small, black, but distinct. Just beyond the dot the wing inside of the outer line is rusty, becoming deeper in tone next the line. The outer line is straight, white, narrow, but sharply defined, and forms an acute angle opposite the apex, being reflected back on the costa. The line is shaded externally with dense black scales, becoming thinner towards the outer edge of the wing. From the apex of the bend on the outer line starts a black streak, which is interrupted in the middle, but ends on the lower side of the hooked apex of the wing, which is unusually long and large. The fringe is rust-colored, with the edge white. The outer edge of the wing is deeply hollowed out just below the apex, but below is full and convex. The hind wings are like the fore wings, but without the inner line. The discal dot is distinct, and the outer line is straight, ending just before reaching the costa. There is a broad costal white area. The legs and under side of the wings are fawn-colored, densely speckled with black, giving it a peculiar silky, glossy appearance, suffused with a very slight wine-colored tint. The surface of both wings is uniform; the discal dots are more diffuse than above, being more distinct on the hind wings. The outer line is white, distinct, broader than above, and bent at right angles upon the costa, but the line disappears before reaching the hind edge, which is whitish. The black stripe sent out from the angle of the line, and reappearing on the hinder edge of the apex of the wing, is much as above.

On the hind wings the line is straight, broader than on the fore wings, and extends upon the costa. The body is half an inch (.50) in length, and a fore wing measures .65 of an inch in length, expanding 1.30 inches.

5. The juniper basket worm.

Thyridopteryx ephemeraformis (Haworth).

Order Lepidoptera; family Bombycidæ.

Feeding sometimes in great numbers on the juniper and the white cedar, a worm living in a large case 1–2 inches long, covered with bits of wings, the female wingless and worm-like; the male dark brown, with small hyaline wings.

This remarkable worm we have found on the juniper tree in Virginia, and according to Harris it sometimes abounds so as to be very destructive to the white cedar (*Cupressus thujoides*) in lawns. The following brief account is taken from my "Guide to the Study of Insects." The male of the basket-worm is stout-bodied, with broadly pectinated antennæ and a long abdomen; the anal forceps and the adjoining parts being capable of unusual extension in order to reach the oviduct of the female, which is wingless, cylindrical, and in its general form closely resembles its larva, and does not leave its case. On being hatched from the eggs, which are, so far as known to us, not extruded from its case by the parent, the young larvæ immediately build little elongated basket-like shallow conical cases of bits of twigs of the cedar, and may then be seen walking about, tail in the air, this tail or abdomen covered by the incipient case, and presenting a comical sight. The case of the full-grown larva is elongated, oval cylindrical, and the fleshy larva transforms within it, while it shelters the female through life.

As a remedy hand-picking is an easy and thorough means of getting rid of these creatures if abundant enough to be annoying.

INSECTS INJURIOUS TO THE COMMON JUNIPER (Juniperus communis).

1. The low-bush juniper inch-worm.

Eupithecia miserulata Grote.

Order Lepidoptera; family Phalænidæ.

Feeding on the common low spreading juniper bush, a small pea-green span worm, with a narrow thread-like subdorsal, and a wider lateral white line, changing early in June to a chrysalis contained in a thin white cocoon, the small moth appearing at the end of the month and through the summer.

This small delicate common moth was reared by Mr. Cassino at Salem, Mass., and like its European congeners lives on the bush juniper (not on *Taxus baccata*, as stated in my Monograph of geometrid moths). The larva was found late in May, and June 4 began to spin, the pupa being inclosed in a slight white cocoon. It ranges from Maine to Texas.

Larva.—Of the characteristic form, being rather thick in the middle, the body seen dorsally decreasing in thickness from the tail to the head. Supra-anal plate

large, triangular, not acutely pointed, deep red, white on the edges. Head small, not so wide as the prothoracic ring, pea-green, color of the leaves on which it feeds, dorsal line dark-green; subdorsal white, and a wider lateral white line. Segments transversely wrinkled. Body provided with short, black, scattered hairs. Length, 0.50 inch.

Pupa.—Four abdominal segments project beyond the ends of the wings, the thorax and under side of the wings and limbs with a greenish tinge; the rest of the body pale horn-brown, as usual. Head full, convex between the eyes. End of abdomen with a long rounded spine, with three pairs of long hairs curved outwards at the end. Length, 0.28 inch.

Moth.—This is our most common pug-moth, and may be distinguished by the pointed fore wings, with the numerous transverse lines angulated sharply outward, the extra-discal line forming a sharp angle opposite the discal dot, and notched inward on the subcostal vein; by the distinct submarginal wavy white line ending in a large white twin-spot at the inner angle; by the fine dark lines on the hind wings, and by the heavy black costal spots and marginal lines on the under side. The fore wings expand 0.85 inch.

2. The Juniper Web-worm.

Dapsilia rutilana Hübner.

Order Lepidoptera; family Tortricidæ.

Ravaging imported junipers, webbing the leaflets, and living within a more or less perfect silken tube, in which the caterpillars hybernate, the twigs and branches presenting a seared and brown appearance.

The following account is taken from Professor Riley's report to the Department of Agriculture for 1878, with the accompanying illustration.

This leaf-roller has been found to seriously injure the imported Irish and Swedish junipers (*Juniperus communis* var.) in nurseries on Long Island, having first become known in this country in 1877; it has not yet been found on our native juniper. It is a well-known English and German moth. There is one annual brood of worms. The insect hybernates at different stages of larval development, and the chrysalis is found throughout the spring months. The moths begin to appear as early as April, but continue to issue during the summer. The worm from birth webs the leaflets together, and lives within a more or less perfect silken tube, this tube being more complete around the hybernating individuals. The sprigs and branches affected by the worm present a seared and brown appearance, and a tree badly affected may be recognized at a great distance.

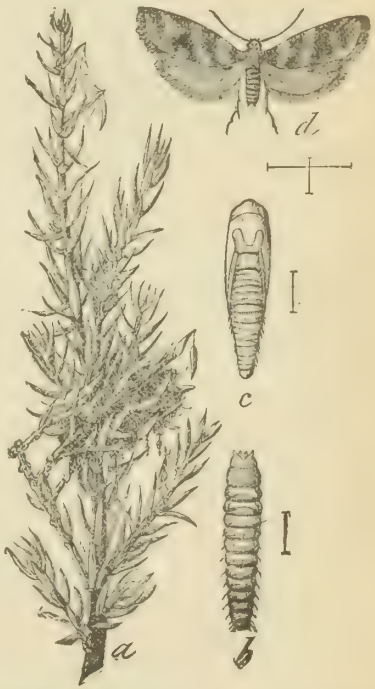

Fig. 96.—The Juniper web-worm: *a*, sprig of juniper, showing manner in which the larva works; *b*, larva, dorsal view; *c*, chrysalis, dorsal view; *d*, moth; *b*, *c*, *d*, enlarged.—After Riley.

The larva.—Of the usual shape, flesh-colored, the head and prothoracic shield highly polished, deep gamboge yellow. Body wrinkled, tapering very gradually from mesothoracic segment to the end of the body; body with small hair-bearing warts, which are extremely small, and indicated more by the short, pale, glistening stiff hairs arising therefrom. Hind borders of abdominal joints slightly thickened dorsally.

Chrysalis.—Color honey-yellow, the skin so delicate that the colors of the moth show clearly through it before emergence. Of the usual shape, long and slender; the abdominal segments having above two transverse rows of rather minute spines; the anus blunt and unarmed; the under side with a few blunt stiff hairs; the antennæ not reaching quite to the tips of the wings. Average length, 5mm.

The moth.—Average expanse of wings, 12mm. Fore wings bright glossy orange, crossed by four reddish-brown bands. The second band from the costa is slightly bent; the third band has the form of a letter K, the top of the K being usually closed, though occasionally open. The apical band is wedge-shaped, reaching nearly to the inferior angle. Frequently this coalesces with the lower part of the third band. Hind wings dark gray, with cilia of the same color. (Riley.)

As a remedy, Riley recommends showering the shrubs with Paris green or London purple, so as to kill the larvæ as they eat the leaves.

3. The six-spotted metachroma.

Metachroma 6-notata Say.

Order Coleoptera; family Chrysomelidæ.

Feeding on the leaves in July, an oblong pale shining beetle, 0.15 long, narrower anteriorly and punctured, the punctures in rows on the wing-covers becoming very faint towards their tips, and on each wing-cover three black spots, the forward one long and narrow, the other two situated on the middle, parallel and almost in contact, the inner one placed rather farther back.

4. The apple leiopus.

Leiopus facetus Say.

Order Coleoptera; family Cerambycidæ.

Feeding on the leaves in July, a small black long-horned beetle 0.18 long, with long slender hair-like tawny-yellow antennæ, their basal joint and the tips of two or three following joints black; its thorax with an ash-gray stripe on the middle and an oblique one on each side of this, the hind ends of these stripes sometimes uniting and forming a letter W; its wing-covers with a large ash-gray spot forward of the middle and almost reaching the suture, having in it an oblique triangular black spot, and towards the tip an ash-gray band concave on its hind side.

Mr. Say states that he obtained his specimens from the juniper, but its occurrence thereon was perhaps accidental, as I have found it on apple trees in a section of country where no juniper grows. (Fitch.) We may add that the European *Leiopus nebulosus* Linn., though usually living in the apple and other fruit trees, also in Europe, mines the *Pinus abies* and *P. picea.*

We extract the following account of this and the prickly ash Leiopus from our first annual report to the Massachusetts Board of Agriculture:

This new borer in the limbs of the apple was found June 11, in all its stages of growth, in the rotten limb of an apple tree in Chelsea, by Mr.

C. A. Walker. The grubs, or larvæ, were fully grown, and more numerous than the pupæ or adult beetles. How destructive it is, or what the habits of the grubs are, must be ascertained by further observation. It is evident from the facts already known that there is probably but one brood of beetles a year; that they fly about and lay their eggs in the bark of the tree late in June, and probably during July; and that the young larvæ bore in under the bark, and become fully grown in the autumn, spending the winter under the bark probably both in the larva and pupa states, the beetles appearing during midsummer.

The larva is rather long and slender, covered with fine hairs, and the end of the abdomen is rather blunt. The abdominal segments are very convex, and deeply separated by a wide suture. The thorax is about a third wider than the rest of the body. The three thoracic segments together are as long as they are wide. The prothoracic, or segment next the head, is somewhat lunate, and rather longer than the two surrounding segments; on the upper side is a slightly marked somewhat horny square plate, but there is no thickening of the skin on the back of the succeeding segments, as usual in the larvæ of the family (Cerambycidæ) to which this borer belongs. It agrees in all respects with the larva of *Leiopus xanthoxyli* Shimer, except that the head is considerably smaller, including the under side and the mouth parts, while the body is not so thick. In all other respects the description of the prickly ash borer (*L. xanthoxyli*) will agree with the present larva, for the larvæ of the two species, which differ very considerably in the beetle state, would be easily confounded. The same remedies may be used against this insect as against the well known striped apple tree borer (*Saperda candida*).

The beetle itself is a slender, smooth-backed species with no ribs on the wing covers. It is pale ash-gray, with a slight purplish tinge. The head and prothorax are blackish except on the hinder edge of the prothorax. The antennæ are yellowish brown, with the basal joint and articulations between the other joints dark brown. The wing covers are pale ash, with a purplish tinge, and an irregular rounded spot just behind the scutellum, united when the wings are folded with a similar spot on the other wing-cover. The shoulder of each wing cover is tipped with black, which extends backwards from a longitudinal large black spot, extending backwards and connecting with a broad black band which crosses the terminal third of the wing, leaving the tip pale gray. The front edge of this band forms an acute angle in the middle of the wing; this band is sometimes partially wanting, and is then broken up posteriorly into a few black spots. In front of this broad band is an oblique row of short (longitudinal) lines, the first and innermost being shortest; the second one nearly three times as long and parallel to the costal spot. It is a little less than a quarter of an inch (.20) in length.

The prickly ash borer (*Leiopus xanthoxyli* Shimer, Figs. 97, 99). In this

connection descriptions of the different stages of this species, which has only yet been found in Illinois by Dr. Shimer, to whom I am indebted for specimens, would seem necessary, inasmuch as they throw light on the structure of the apple Leiopus. According to Dr. Shimer it bores into the limbs of the prickly ash.

The larva (Fig. 99, *a*, larva; *b*, upper side; *c*, under side of the head) is

FIG. 97.—Liopus xanthoxyli.—From Packard.

FIG. 98.—Liopus facetus.—From Packard.

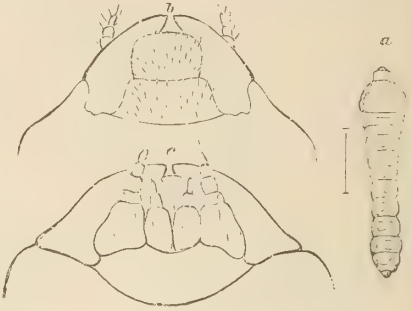

FIG. 99.—The prickly ash borer.—From Packard.

very much like that of the preceding species. The head is a little more than half as wide as the prothoracic ring. The basal (occipito-epicranial) region is transversely oblong, the basal piece (occiput) being very short, and transversely almost linear, and separated by a well-marked suture from the middle portion (epicranium) of the head, the latter being nearly four times as broad as long, with the front edge straight; it is white, with the front edge pitchy black. The clypeus is smooth, trapezoidal in form, and three times as wide as long. The upper lip (labrum) is thin, hairy, transversely elliptical, a little less than one-half as long as broad. The basal chin piece (submentum) is a large transversely oblong area, with the front edge piceous, and very slightly hollowed, while the posterior edge is very deeply hollowed out. The chin (mentum) is nearly square, widening at the base, which is continuous with the base of the maxillæ, the whole posterior edge being well rounded. The labial palpi are three-jointed, the basal joints of each palpus being large, and no longer than broad, and touching each other; the second joint is much slenderer, and about half as thick as the basal joint; the third joint is not quite so long, and is scarcely half as thick as the second; its tip is acute and reaches out as far as the end of the second joint of the maxillary palpi. The maxillary palpi are four-jointed, very broad at the base; the first joint is scarcely half as long as broad; the third is a little longer than the second, while the fourth is much slenderer than the others, and about the length of the second joint. The mandibles are large and powerful, when closed not reaching as far as the end of the maxillary palpi; the ends are truncated, gouge-like. On the prothorax is a large, obscurely marked, squarish, very slightly horny (chitinous) area, scattered over with hairs, especially on the anterior edge. On the upper side of each segment of the body is a

broad, oval area, with a series of oval gatherings or folds, on each side of the transverse mesial main fold; those on the three rings succeeding the head (thoracic) are the same, but broader. There are no rudimentary thoracic legs. The end of the abdomen is blunt, well rounded, with the extreme tip forming a rounded portion. It is .35 of an inch in length.

The pupa is white, and in the single specimen observed was quite far advanced, the body being covered with hairs. The wings were quite free from the body, and the antennæ curved around outside the wing-covers, their tips meeting at the base of the head. The first and second pairs of legs are folded at right angles to the body, the third pair being oblique to the body. The tips of the first pair of tarsi reach to the base of the second pair of tarsi; the tips of the second pair of tarsi do not reach to the base of the third pair of tarsi, the third tarsi not reaching to the tip of the abdomen by a distance equal to nearly their length. The prothorax is full and convex, the hinder portion being larger in proportion to the rest of the body than in the adult beetle. It is a quarter of an inch in length. The beetle is characterized by four raised lines on each wing-cover, with five or six black dots on each line or rib. An oblique black line diverges from each side of the scutellum. Just in front of the middle is a triangular, pale space, bounded behind by an oblique, dark line. In color it resembles the bark of the ash; it is a quarter of an inch in length.

5. The juniper salmon-tinted caterpillar.

Order Lepidoptera; family Noctuidæ.

Feeding on the leaves of the low-bush juniper, in August, in Maine, a small noctuid caterpillar with five pairs of abdominal legs. Body thickest a little in front of the middle. Head small, rounded, pale honey-yellow, as wide as the prothoracic segment. Body flesh-colored, finely striped with alternating reddish flesh-colored and whitish fine wavy lines; two subdorsal reddish lines broader and less waved than the others, there being about eight reddish lines on each side of the body. The body of this caterpillar is shorter and thicker but shaped somewhat as in *Leucania*. When observed, August 27 to September 12, the caterpillar was about 6^{mm} long.

6. The juniper white-striped inch-worm.

Order Lepidoptera; family Phalænidæ.

Feeding on the leaves of the low-bush juniper late in summer, in Maine, a rather short, cylindrical inch-worm, pale pea-green, the color of a juniper leaf. Head full, rounded, as wide as the body; segments a little wrinkled transversely. Lateral ridge sharp, white, the white line extending along the side of the obtusely triangular supra-anal plate. No other longitudinal stripes nor any other markings or tubercles.

7. The juniper twig inch-worm.

Drepanodes varus G. & R.

This caterpillar, found on the tree-juniper (No. 4), also appears to live on the low-bush juniper, as we beat from a bush the last of August a beautiful green chrysalis which agrees closely with that of *Drepanodes varus*. This chrysalis is of the size and exact form represented in Fig. 95, is smooth bodied, pale pea-green, the exact color of a leaf of its food plant. The body is paler than the wings, with two pale subdorsal yellow stripes; the tip of the abdomen red.

8. The fir-needle inch-worm.

This caterpillar was found feeding on the juniper at Brunswick, Me., August 26–29, 1881.

9. The juniper plant-louse.

Lachnus sp.

Common on the juniper in Maine at the ends of the branches.

INSECTS INJURIOUS TO THE LARCH OR TAMARACK (*Larix americana*).

1. The pine bark-beetle (*Tomicus pini*) is reported to mine the bark and outer surface of the sap wood of the tamarack the same that it does the pine.

2. In July and August troops of white caterpillars with black dots and along their backs eight black tufts of hairs, the larvæ of the hickory tussock moth (*Loptocampa caryæ*), are sometimes found on this tree, nearly stripping the leaves from the limbs which they occupy. (Fitch.)

3. In Labrador I have found the larva of *Arctia quenselii* feeding upon the larch in July.

4. The larch cheater.

Tolype laricis Fitch.

Order Lepidoptera; family Bombycidæ.

On the limbs in June and July, feeding on the leaves; a large flattened ash gray worm resting appressed to and closely resembling the bark; forming an oblong flattened gray cocoon molded to the limb and resembling the bark in its color; the latter part of July producing a thick-bodied moth with thin delicate wings, which are almost transparent in the males and 1.00 broad, in the females 1.50, and of a white color with faint wavy dusky bands. (Trans. 1855, p. 494. Fitch.)

5. The imperial spiny caterpillar.

Eacles imperialis Hübner.

Noticed on the tamarack by G. D. Hulst (Bulletin Brooklyn Entomological Society, p. 77).

6. The fir lophyrus?

A Lophyrus-like false caterpillar which may have been the larva of *Lophyrus abietis*, in 1877 attacked a plantation of Scotch larches. The following letter from Mr. B. M. Watson, proprietor of the Old Colony Nurseries, Plymouth, Mass., written under date of July 5, 1877, will give the facts in the case:

I have a large plantation of Scotch larches, twenty-five years old, forty to fifty feet high, many hundred trees, which is attacked by a caterpillar (enclosed) which I do not find in Harris, or any forestry book which I have at hand. Do you know it or its remedy? The trees are much riddled by them, and the foliage more than two-thirds destroyed. The trees look bare and unsightly. We have had them several years. They began at one end and have advanced to one-fifth of the plantation; the other four-fifths are not infested.

The use of a fluid preparation of Paris green or London purple thrown over the trees by a garden pump or modern machine for such purpose, figured in the Reports and Bulletins of this Commission, would so reduce the numbers of these caterpillars that a second year the trees would leave out again and not show much marks of injury. The Lophyrus sawflies are sporadic and periodical in their attacks; though occasionally doing great and widespread injury.

7. The larch aphis.

Lachnus laricifex Fitch.

Order Hemiptera; family Aphidæ.

Solitary upon the small twigs, stationed in the axils of the tufts of leaves, with its beak sucking the juices that should go to the leaves, a wingless brown plant-louse slightly tinged with coppery, 0.12 long, with a dull white line along the middle of its back and a similar whitish band at the sutures of each of the abdominal segments, in which bands on each side of the middle are three black punctures, the short tubercles on each side of the tip deep black, the under side dull white and dusted with white powder, the legs pale with the feet and knees black and also the apical half of the hind thighs and shanks, and the antennæ pale with black tips. (Fitch.)

Many of these lice were noticed on a particular tree the latter part of May, but no winged ones were to be found. Ants, as usual, were guarding them and drinking the honey dew which they ejected. Many of them were accompanied with four or more young, huddled close around the base of the sheath from which the leaves arise. These were scarcely half the length of the parent, of a light dull yellow color with two brown spots above on the base of the abdomen, the legs and antennæ similarly colored to those of the parent but more pale. (Fitch.)

8. The larch chermes.

Chermes laricifoliæ Fitch.

Order Hemiptera; family Aphidæ.

Solitary and stationary upon the leaves, extracting their juices, small black shining flies 0.10 long, having the abdomen dark green, the legs obscure whitish, the wings nearly hyaline with pale brown veins, and the large stigma-spot upon their outer margin beyond the middle more opaque and pale green.

This is closely like the pine Chermes, but has the wings more clear, and differs also in some of the details of its colors. (Fitch.)

INSECTS INJURIOUS TO THE CEDAR OR ARBOR VITÆ—(*Thuja occidentalis*).

1. The cedar tineid.

Bucculatrix thuiella Packard.

Order Lepidoptera; family Tineidæ.

Feeding on the leaves and spinning slender, small, conspicuous white cocoons attached to the leaves, and transforming to a narrow-winged beautiful pearly-white moth, dotted and marked with brown.

The following account is taken from my first report to the Massachusetts board of agriculture:

This is a little moth, of which the caterpillar is unknown, though I found the moths and cocoons in abundance on a cedar tree in Brunswick, Me., July 10. It is undoubtedly similar in its habits to a little moth which lives not uncommonly on the apple tree, and has been described by Dr. Clemens under the name of *Bucculatrix pomifoliella*. Its long, slender, white cocoons may be found, at any time after the leaves have fallen, on the branches of apple trees.

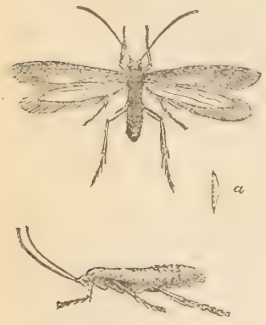

Fig. 100.—The cedar Tineid, enlarged; *a*, cocoon, nat. size.—From Packard.

Dr. Clemens says that "the larva feeds externally on the leaf of the apple, at least at the time it was taken, in the latter part of September. It is cylindrical and submoniliform; tapers anteriorly and posteriorly; with punctiform points and isolated hairs; first segment with rather abundant dorsal hairs; three pairs of thoracic feet and five abdominal pairs. Head small, ellipsoidal, brown; body dark yellowish green, tinged with reddish anteriorly; hairs blackish and short. Early in October the larva enters the pupa state, wearing an elongated, dirty white, ribbed cocoon, and appears as an imago during the latter part of the following April, or early in May." The present species seems to be undescribed, and may be called *Bucculatrix thuiella*. It belongs to the extensive Tineid family, and its general appearance is sufficiently indicated by the drawing.

Moth.—The body and wings are pearly white, and the antennæ are white, with brown wings, while there is a low broad tuft of white scales between the antennæ, the crest being much flatter than in the species living on the apple. The fore wings are white, and crossed in the middle by a broad brown band, and beyond this band by alternating white and brown stripes, crossing from the front edge (costa) of the wing. On the end of the wing, and in the middle of the outer edge, is a conspicuous black spot, like the eye in a peacock's feather. To describe the wing and its markings more fully—the basal half of the wing is white, unspotted, except a short, transverse brown band, extending from the inner edge, not quite to the middle of the wing. On each side of this band is a row of two or three minute dots. The middle band is

broadest on the hind edge. Beyond and arising from the costa, where they are broadest, and extending to the opposite side of the wing, are six brown lines, alternating with white interspaces. These lines run together in the middle of the wing, brown dots being added, but which end as distinct lines on the inner edge of the wing. The three outermost lines are much curved, and, with the curve of the fringe, form a circular area, in the middle of which, on the base of the fringe, is the curvilinear, rather thick, dark brown spot. The long fringe on the end of the wing is white at base and brown at the end. The hind wings are pale brown, acutely pointed, with a long silvery fringe. The tibiæ and tarsi of the fore legs are brownish, while the hind legs are white, with a long fringe on the hindermost tibiæ. The length of one fore wing is .18, and the length of the body is .13 inch.

The cocoon is white, tough, dense, slender cylindrical, and .20 inch in length. It is fastened by one side to the leaf, and differs from that of the apple Bucculatrix in not being ribbed longitudinally. A minute, beautifully brilliant green ichneumon (Chalcis) fly seems to attack in considerable numbers the chrysalids of this insect, as nearly half of those reared by me turned out one of these parasites. It is a species of a genus allied to Eulophus, having the antennæ pectinated, the terminal joints throwing off five long branches. It differs, however, from Eulophus among other characters by having a short, thick body, a small, conical abdomen, and short, thick antennæ. The fore wings are broad, triangular.

We noticed these beautiful moths again in 1881, at Brunswick, flying about a cedar hedge in considerable numbers from the middle of July until early in August.

2. The fir saw-fly.

Lophyrus abietis Harris.

False caterpillars closely resembling those found on the fir, and identical with that found on the low-bush juniper, occurred on two cedar hedges in Brunswick, from July 18 to the last of August. But a few scattered individuals occurred. We will give a description of the variety found on the cedar. Body cylindrical, broadest on the thoracic segments; all the segments finely transversely wrinkled. Head small round, deep, amber-colored; eyes black. Body pale green with a broad diffuse dark green medio-dorsal and a lateral stripe. Body paler beneath. Thoracic feet black. Eight pairs of abdominal feet green. Length 13^{mm}. One was found without the three dark stripes. This species differs from the others in the caterpillar having no dark spots on the body as seen in most Lophyrus larvæ.

3. The promethea moth.

Callosamia promethea (Drury).

Said by Mr. Riley to feed on the arbor vitæ. (Fourth Rep., 123.)

INSECTS INJURIOUS TO THE SEQUOIA GIGANTEA.

1. *Gonops fissunguis* Leconte.

"Three specimens from Big Trees, California." (Leconte's Rhynchophora.)

2. *A longicorn borer.*

While at the Big Trees of the Mariposa Grove, we observed that one of them had been mined under the bark by what must have been a longicorn borer, as the mine was broad and shallow, being about 4mm broad and about four inches long.

3. THE SEQUOIA ÆGERIAN.

Bembecia sequoiæ Edwards.

Order LEPIDOPTERA; family ÆGERIADÆ.

Very destructive to *Sequoia sempervirens*, as well as to some species of Pinus. H. Edwards. (Papilio, vol. I, p. 181.)

INSECTS INJURIOUS TO THE CYPRESS (*Taxodium distichum*).

Cecidomyia cupressi-ananassa Riley.

Tennessee. (Riley, American Entomologist, ii, 244 and 273. Fig. 153, gall.)

APPENDIX.

AFFECTING THE PERSIMMON:

Psylla diospyri Ashmead, Can. Ent. 222, Nov. 1881.

AFFECTING THE CATALPA:

Diplosis catalpæ, Comstock's 1880 Rep. Dept. Ag. 266.

AFFECTING THE BAY MAGNOLIA:

Psylla magnoliæ Ashmead, Can. Ent. 224, Nov. 1881.

AFFECTING THE OAK:

Selandria quercus-alba Norton, Trans. Amer. Ent. Soc. i, 258.

Aphis quercifoliæ Walsh, Proc. Ent. Soc. Phil. i, 298, 1863.

Lachnus quercicolens Ashmead, on *Q. virens*, Can. Ent. 154, 1881.

Phyllaphis niger Ashmead, on *Q. phellos* var. *laurifoliæ*, Par. Ent. 155, 1881.

Xyleborus celsus, Leconte's Rhynchophora, 360.

fuscatus, Leconte's Rhynchophera, 360.

Heterocampa subalbicans Grote, Comstock's Rept. for 1880, 259.

Limacodes minuta Reakirt, Proc. Ent. Soc. Phil. iii, 251, 1864.

Cecidomyia quercusmajulis O. Sack. Trans. Amer. Ent. Soc. iii, 53.

Bostrichus bicornis Web. C. E. Worthington, Can. Ent. xii, 107.

AFFECTING THE BUTTERNUT:

Gaurotes cyanipennis, ovipositing on butternut, F. B. Caulfield, Can. Ent. 60, 1881.

Grapholitha caryæ Shimer, Trans. Amer. Ent. Soc. ii, 394.

AFFECTING THE HICKORY:

Catocala flebilis, Kellicott in Papilio, 141, 1881.

Chramesus icoriæ, Leconte's Rhyncophora, 375.

Cecidomyia cossæ Shimer, Trans. Amer. Ent. Soc. ii, 395.

caryæ O. Sacken, Monographs, etc. i, 191.

caryæcolor O. Sacken, Monographs, etc. i, 192.

cynipsea O. Sacken, Monographs, etc. i, 193.

glutinosa O. Sacken, Monographs, etc. i, 193.

nototricha O. Sacken, Monographs, etc. i, 193.

persicoides O. Sacken, Monographs, etc. i, 193.

sanguinolenta O. Sacken, Monographs, etc. i, 192.

AFFECTING THE ELM:

Plocetes ulmi, Leconte's Rhyncophora, 213.

FEEDING ON WILD CHERRY:

Cerura borealis, G. H. French in Can. Ent. 145, 1881.

FEEDING ON THE CHESTNUT:

Limacodes viridis Reakirt, Proc. Ent. Soc. Phil. iii, 251, 1864.

Eugonia subsignaria, Comstock's 1880 Rep. Dept. Ag. 271; also on hickory.

FEEDING ON WILLOW:

Cerura occidentalis, G. H. French in Can. Ent. 144, 1881.

Grapholitha gallæ-saliciana Riley, Trans. St. Louis Acad. Sci. 320, 1881.

AFFECTING THE BASS-WOOD:

Pogonocherus nubilus, according to Leconte.

AFFECTING THE BIRCH:

Apatela spinigera Guen, R. Thaxter, Psyche, ii, 121.

AFFECTING THE MAPLE:

Eunomis alniaria; larva abundant on maple. C. E. Worthington in Can. Ent. x, 16

AFFECTING THE LOCUST:

Ecdytolopha insiticiana Zeller, Comstock's 1880 Rep. Dept. Ag. 260.

Pempelia contatella Grote, Comstock's Rep. Dept. Ag. 261.

AFFECTING THE HONEY LOCUST:

Pempelia gleditschiella Fernald, Comstock's 1880 Rep. Dept. Ag. 262.

AFFECTING THE SCOTCH PINE:

Chermes pinicorticis H. Osborn, Iowa Ag. Report, 96, 1881.

AFFECTING THE PITCH PINE:

Tomicus exesus, Harris' Treatise, 87.

Tortrix politana, Haworth ?, Comstock's 1880 Rep. Dept. Ag. 264. This is the caterpillar whose case is figured and described on page 207.

AFFECTING PINUS TÆDA:

Tetralopha diluculella Grote, Comstock's 1880 Rep. Dept. Ag. 263.

AFFECTING ABIES BRACTEATA:

Grapholitha bracteatana Fernald, Comstock's 1880 Rep. Dept. Ag. 265.

AFFECTING THE LARCH:

Tomicus pini, Harris' Treatise, 88.

Samia columbia (Caulfield).

CORRESPONDENCE.

[The following correspondence relates to certain insects mentioned in the foregoing pages.]

PHILADELPHIA, *October* 13, 1881.

MY DEAR DOCTOR: I am afraid that some confusion has been produced by the crowded condition of my box of Pityophthori. The specimens have now been properly spaced and arranged, and I have gone over them carefully.

The result is that Blanchard's oak bark species is *P. minutissimus* Zimm., and I consider it as Dr. Harris' *Tom. pusillus*. It agrees very nearly in habits and characters with *P. pubipennis* Lec., from California. The ♂ has the front heavily fringed with long yellow hairs.

The species found by Blanchard (to me No. 36) under white pine bark is *P. sparsus*, and is easily known by the prothorax having a smooth spot each side behind the middle, and by the very shining lustre. The elytra are feebly and sparsely punctured, the declivity is deeply sulcate near the sature, and on the outer limit of the groove are two or three acute cusps. This species is depredated on by *Hypophlœus tenuis*.

Then there is *P. puberulus*, well described by me from the specimen given me by Ulke. Specimens since received from Schwarz (Port Huron) and Blanchard (Mass., No. 139) have the elytra more strongly punctured.

I am disposed to believe this species from white pine is the one referred to by Dr. Fitch as *Tom. pusillus* Harris. It is about the size of *ramulorum* of Europe, but the elytra are more coarsely punctured, and the punctures are not arranged distinctly in striæ, but are confused. This is probably your 35.

Your No. 34, as I see by reference to Fitch's report, is quoted textually from that author, and if my opinion be well founded, is not different from your 35, unless it be *annectens*. If there are any types to be seen, please have them sought for, and send me one. I have forgotten what became of Fitch's collection.

I am sorry your correspondents have not been more diligent in collecting these destructive insects, so that their characters may be defined, and their habits after-

wards carefully observed. I have made frequent appeals, but have met with no response either inside or outside of the Commission on Forests.

P. annectens Lec., found in Florida in *yellow pine*, resembles in sculpture *ramulorum*, and agrees with Fitch's description of 34 in having the elytral punctures arranged in rows, and the sutural angle acute. It may really be the same as your 34, but as the localities are so widely apart, and the food tree different, I am unwilling to express a positive opinion until I can compare the specimens. I returned as you requested all that you sent, and I have from you in my collection no other Scolytide than the *Crypturgus* recently received. Perhaps you could get a type of Fitch's *pusillus*. If so it would solve all the difficulties.

Please let your collectors know that in Scolytidæ there is no benefit derived from the study of single specimens. They must be collected in numbers that both sexes may be obtained. As they are always abundant when found there is no difficulty in getting specimens enough.

Very sincerely,

J. L. LECONTE.

NEW YORK, *December* 12, 1881.

MY DEAR DR. PACKARD: * * *

Sciapteron robiniæ Hy. Edw. is extremely destructive in California and Nevada to the white poplar (*Populus alba*) and to the downy poplar (*Populus canescens*), both of these species being introduced into the Pacific States as ornamental trees. A small avenue of the latter at San Leandro, near San Francisco, was utterly destroyed by the *Sciapteron*, the pupa cases being found sticking out of the holes in hundreds. The perfect insect was rather scarce, as they emerge very early in the morning, and take flight with the first gleam of sunshine. *Sciap. robiniæ* also destroys the locust trees (*Robinia pseudoacacia*), a grove of this species in Napa County being observed by me in a state bordering upon destruction from the attacks of this insect.

Sciapteron syringæ (*Trochilium syringæ* Harris) has been found to be a pest to ash trees in Brooklyn, N. Y. Some observations upon this and other species of *Ægeridæ* will shortly be published by Rev. G. D. Hulst.

Bembecia sequoiæ Hy. Edw. is devastating the pine forests of Mendocino County, California, and is particularly destructive to *Sequoia sempervirens*, *Pinus ponderosa*, and *Pinus Lambertiana*. The eggs appear to be laid in the axils of the branches, the young caterpillar boring in a tortuous manner about its retreat, thus diverting the flow of the sap, and causing large resinous nodules to form at the place of its workings. These gradually harden, the branch beyond them dies, and the tree at last succumbs to its insignificant enemies. Hundreds of fine trees in the forests of the region indicated are to be seen in various stages of decay. A similar habit seems to prevail in the life history of *Sciapteron pini* Kellicott, a species described by its author in the Can. Entom., 1881.

Bembecia marginata (*Troch. marginatum* Harris) attacks the bushes of various species of *Rubus*. Mr. Hulst has made admirable observations upon this species, and will, I hope, soon give them to the world.

Yours, truly,

HENRY EDWARDS.

CAMBRIDGE, *November* 14, 1881.

DEAR PROFESSOR PACKARD: Your letter of the 9th instant was duly received. Before replying I have waited to get from Dr. Hagen a list of species of insects taken by me last September on the highest peak of Ktaadn. They were put in spirits and handed to Dr. H. without examination on my part. As he has just given me the list of all that can interest you in your present inquiries, I will send it with a few words of my own.

In my trips to Ktaadn in 1879, 1880, and 1881, I did not see about the mountain, nor on the way to and from it, any increase of dead spruces above what I observed in my visits of 1869 and 1871. There are now, as in the earlier years, the usual proportion and no more of dead and bleached spruce trunks standing among the living, but none recently dead and retaining their bark.

I camped in the Basin seven days in 1879, thirteen days in 1880, sixteen days in 1881. The only borers I ever saw there—to know them—are *Prionus unicolor* and *Monohammus scutellatus*. In 1879 I saw more of the former, but this year none of that, while the latter swarmed everywhere—but ten days later in the month. These two species I have known for years. Thinking that you might possibly find in a list of my unexamined species the new destroyer, I asked Dr. Hagen to prepare one. But though I have forgotten the name of this recent pest, you will not find it among the species collected by me. This fact and the other, that no unusual killing of spruces appears to have taken place lately in the Ktaadn region, indicate of course that the destroyer has not penetrated thither.

I took insects only on the highest peak, hoping to get by chance something not found lower down, though aware that the season for characteristic Alpine species had long passed. But you will probably find in the list only species common at lower elevations. Their presence on the summits I suppose you will attribute, in part at least, to their being blown there by winds. My collection of wild black spiders may, on examination, prove different from low-ground species. Please note that this abundance of *M. scutellatus* occurs high above the growth of *Pines*, which are not found at all in the Basin.

Yours, truly,

C. E. HAMLIN.

Insects taken on highest peak of Mt. Ktaadn, September, 1881.

6 *Monohammus scutellatus* Say.
1 *Leptura canadensis.*
1 *Buprestris maculiventris.*
1 *Melanotus communis.*
1 *Clerus dubius.*
Upis sp. ?
2 *Scymnus* sp. ? (*very* small).
Atta pennsylvanica.

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