THE ROLE OF INSECTS IN THE FOREST PP. 205-232

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INSECTS IN THE FOREST

BY

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The Role of Insects in the Forest.

By JOHN B. SMITH, Sc.D.

That a giant of the forest, one that has resisted the storms of a century, should succumb to the attacks of an insect, countless millions of which would be required to equal it in bulk, seems almost absurd; yet it is nevertheless true, though not, as a rule, quite so literally as it reads. Most of our forest trees support an immense insect population without showing any ill effects. Nearly 500 species are known to feed on the species of oak, and nearly 200 on the species of pine, in the United States. Given a perfectly healthy tree, it will bring to maturity a host of feeders upon its foliage, upon the smaller shoots, in the injured or broken twigs or branches, in its fruit, and even in its woody tissue. Comparatively few borers or other insects are able to maintain themselves in the growing wood of large healthy trees, and when these occur in moderate numbers they inflict only such wounds as are easily healed, corresponding to mere scratches in the human skin. Under some conditions these insects increase abnormally, and then thousands of acres of timber may be killed off. As the bleeding from many small scratches may drain the human body of blood when they are kept constantly open, so the boring of thousands of beetles, insignificant individually, may weaken even the forest giant; and when this occurs, when there is no longer a healthy, resistant tissue, then another host of other species steps in, adds to the injury, and paves the way for yet further armies that complete the work, leaving only a dead stick with bare branches, sooner or later prostrated by a storm, and then slowly reduced to dust by yet other agencies, insect, fungous, or microbic in character.

Of the feeders upon foliage in its broad sense, some, like caterpillars, feed openly and simply upon the leaf tissue, destroy and

convert a certain amount of it into caterpillar tissue, and their work is done. Little impress is left upon the tree under ordinary conditions, or unless the feeding numbers are excessive. Even if one of the large species defoliates a branch, this is not serious except on conifers, which, on the whole, suffer less from attacks of this kind.

The larvæ of saw-flies are also feeders upon forest-tree foliage, and these sometimes do local injury. Saw-flies are Hymenoptera, *i. e.*, they belong with the bees, wasps and ants in structure; but they differ by having the abdomen closely joined to the body, not connected with it by a slender waist. Saw-fly larvæ resemble caterpillars in shape and appearance; but have at least 18 legs, instead of 16, as in true caterpillars. They have a tendency to feed in colonies and often curl up the end of the body when feeding at the edge of a leaf. A black-spotted species occurs on pine, sometimes in such numbers as to attract attention and defoliate even large branches. Small or ornamental trees in parks are sometimes killed or severely injured; but on larger trees a dead twig or small branch is the extent of the mischief caused.

Some of these larvæ are covered with a white powdery bloom, and at least one species, occurring on willow, becomes of considerable size, reaching an inch and a half in length when extended at full length. It is pale yellowish in general color, with a whitish, small head and a black stripe down the back, making it easily recognizable and a fair sample of this kind of larva except in size.

On the hickory and butternut other species occur that are known as "woolly worms," because of the masses of fine waxen threads that cover the body and give it a fluffy appearance.

Yet other species are gall-makers, causing blister or marble-like excrescenses on leaves, stems or twigs, in the center of which the larvæ feed. Willows and poplars are especially subject to this kind of attack.

Among the caterpillars, besides those that eat of the leaf-tissue directly, many are leaf miners, eating between the upper and lower surfaces, sometimes irregular blotches, sometimes galleries of definite form, each species having a constant and characteristic type. A few others make little cases or sacks, in which they live and which they carry about with them. Many are leaf-

rollers, folding or rolling the entire or part of a leaf into a cylinder, in which they feed under shelter. Yet others live in colonies and spin up a number of leaves or even an entire branch. The well known web-worms and tent caterpillars will readily occur to all, and wide-spread injury is sometimes done by one or both. The forest tent caterpillar has defoliated acres of forest land in New York State during the season of 1899, and has opened the way for yet more serious injury in 1900. Less known is another species that attacks young trees, often enveloping one of 4 or 5 feet completely. When this occurs the death of the young tree often follows, the growth being smothered where not actually eaten.

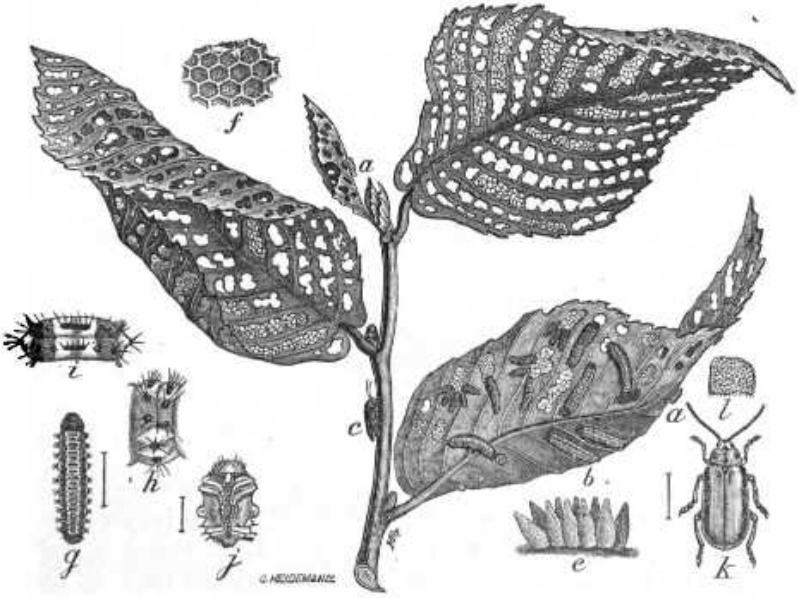

Figure 2.—Elm leaf beetle; typical of a destructive feeder on foliage: *a*, *a*, egg patches on leaves; *b*, larvæ feeding: *c*, adult; all natural size: *e*, egg-mass; *f*, surface of the egg; *g*, larva; *h*, *i*, details of the same; *j*, pupa; *k*, beetle; *l*, surface of elytra; all enlarged: from Div. Ent. U. S. Dept. Agt.

Numerous "grubs," or beetle larvæ, live on the leaves of forest trees, often in very large numbers, and these also may be open feeders, leaf miners or sac bearers; but they rarely become

as destructive as the Lepidopterous and Hymenopterous larvæ already mentioned.

Galls made by saw-fly larvæ have been already mentioned; but they are in the minority when compared with those made by others of the same order Hymenoptera, the *Cynipidæ* or true gall wasps. These galls may appear on almost any part of the tree when young; but, when older, trunks and larger branches are exempt: and they are as diverse as the places they attack. Oaks are favorite subjects, but other trees are by no means free from them.

On the leaves the galls are usually more or less spherical or marble-like, but they differ much in size and texture, being sometimes quite solid with thick walls, sometimes filled with

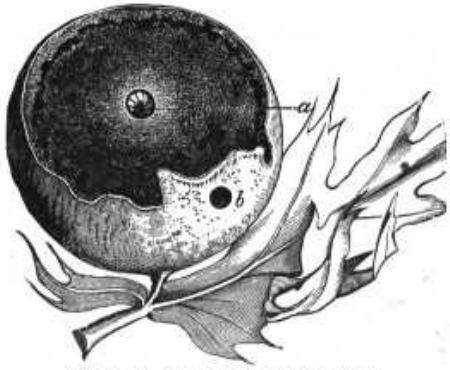

Figure 3.—A spongy oak gall: from Riley.

loose tissue and with a thin paper-like covering. Some are small and some are large, but that fact does not indicate the size of the larva that causes the gall. Two of the largest species occurring on oak exceed an inch in diameter and are filled, in the one case with a brown spongy mass, in the other with thread-like fibres radiating from the center in all directions to the outer wall.

On the twigs and branches the galls may be also marble-like in appearance or they may be mere swellings or other protuberances. One of the largest and most common forms occurs as a potato-like swelling on the trunks and branches of young and

twigs of older trees. It is fully 1¼ inches in diameter as a rule, and sometimes considerably more. Through the outer envelope comes, in due time, a series of pointed processes which are, each of them, larval cells: in other words, instead of the gall being produced by and containing only a single larva, some 50 to 100 have combined to form the larger swelling, in which each larva has a separate cell.

In some cases the very tips of the shoots become swollen and distorted, so that the gall is really a malformation of the shoot itself; or there may be a cluster of soft ovoid growths so close together as to press themselves out of shape and produce a series of irregular, more or less transversely flattened blisters.

More rarely galls occur on the roots, and these are usually irregular, lumpy swellings.

But not the Hymenoptera alone produce galls: quite a number of Diptera, or flies, belonging to the family *Cecidomyidæ* produce abnormal growths on leaves or twigs. One species attacks the base of the leaves of pines and causes an abnormal onion-like swelling at that point; quite a number are found making galls on the hackberry, while the willow is especially favored by them: all sorts of abnormal growths being produced, from little swellings to small cabbage-heads.

A few of the beetles are gall-makers—some on pine, like *Podapion gallicola*, others on deciduous trees—and these galls are usually mere swellings on the twigs or branches, in which the larvæ feed.

Phylloxera galls are common on hickories, and it is not an uncommon thing to see a young tree with the leaves covered with the large blister-like galls which are open inferiorly. If one of these galls be cut open, the inner surface will be found so crowded with the insects that they can scarcely find room to insert their beaks to obtain food.

Plant-lice, belonging to the same order as the *Phylloxera*, also produce more or less obvious gall-like growths, and the elm is a favorite tree for their attack. Sometimes there is a mere curling and distortion of the leaf, like that caused by *Schizoneura americana*, but often a real swelling, like the cocks-comb gall made by *Colopha ulmicola*, is produced.

It seems, thus, that most of the orders of insects outside of the Neuropterous series contain gall-makers, and all of them are, of