

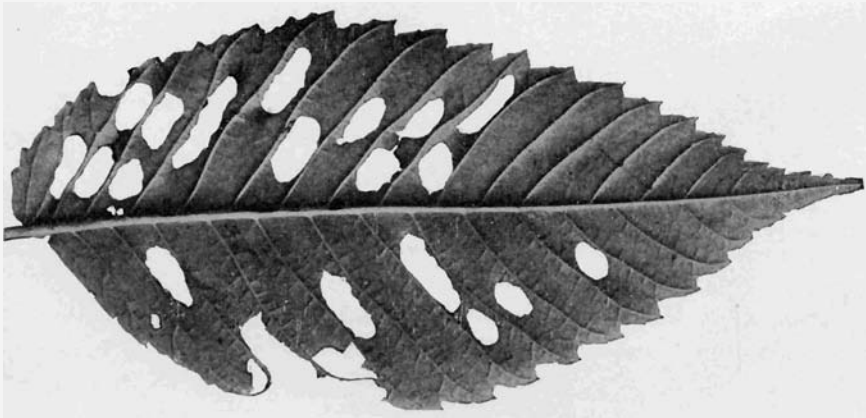
CONNECTICUT
AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

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ENTOMOLOGICAL SERIES, No. 14.

The Elm Leaf Beetle



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The Elm Leaf Beetle.

BY

W. E. BRITTON,

State Entomologist.

Twelve years ago an account of this insect was published by this Station in Bulletin No. 121, which has for some time been out of print. Since then only a few scattered notes have appeared in the bulletins and reports. The object of the present paper is to place in the hands of the people of Connecticut a fairly complete and comprehensive account of the elm leaf beetle with up-to-date remedies and methods of treatment. There is a constant demand for such information from public school teachers, members of village improvement societies, and men employed in the street and park departments of our cities and towns, as well as from private individuals who desire to give the best care to trees on their home grounds.

HISTORY AND DISTRIBUTION IN AMERICA.

The elm leaf beetle was introduced into this country probably more than seventy years ago. In its native country, Europe, where it had long been known, it had from time to time caused serious injury in Italy, Austria, and the southern portions of France and Germany. In Northern Europe the insect occurs sparingly, but can hardly be called a pest. Harris states* that the elm leaf beetle attacked and seriously injured the elm trees of Baltimore, Md., in 1838 and 1839. The beetle seemed to spread chiefly northward, though slowly, until Southern New England was reached in the early nineties, and much damage done. In the coast towns of Connecticut many fine old elms, including some historic trees, were killed by its depredations.

* Insects Injurious to Vegetation page 124.

Stamford, Norwalk, Bridgeport, Stratford, Milford and New Haven especially lost many noble trees. Later the inland cities were invaded, and the elm trees ravaged. In New Haven the pest was perhaps at its worst in 1895 and 1896. In 1896 many of the trees on the older streets about the center of the city were sprayed with poison by the street department. The following season the pest was less serious, and continued to subside until 1901, when it was again comparatively destructive. From

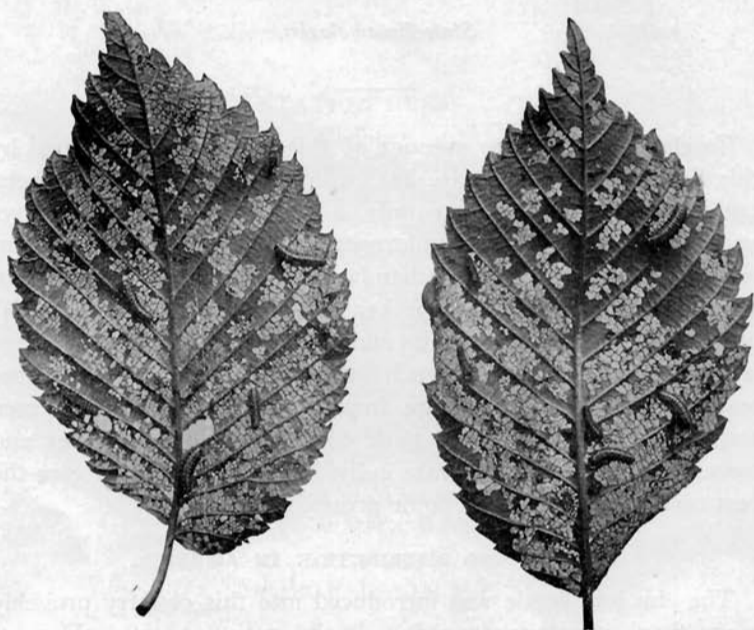


FIG. 1.—Elm leaves showing larvae and the damage which they do by feeding on the under surface, natural size.

1902 it diminished in abundance until 1906, when considerable damage was done to the trees.

So far as is known the distribution of this insect in America is confined chiefly to the lower altitudes of Southern New England and the Alleghanian region. From Charlotte, N. C., its southern limit, the elm leaf beetle now extends as far north as North Conway, New Hampshire. Up to this time, however, the beetle has done no particular damage in New Hampshire. Regions generally infested include the whole of Massachusetts.

Rhode Island, Connecticut, southeastern New York, New Jersey, eastern Pennsylvania, Delaware, Maryland and a portion of Kentucky, though isolated outbreaks have occurred in western New York, Pennsylvania, West Virginia, Ohio and North Carolina. It is of course found in Virginia, Vermont, New Hampshire, and probably in Maine. Kentucky, therefore, contains the western limit of the distribution of this insect, though we may expect that soon adjoining states may become infested. The insect exhibits a marked tendency to spread farther along river valleys than over mountains, and is distinctly a pest of city and village trees rather than of trees in the open fields and roadsides of the country.

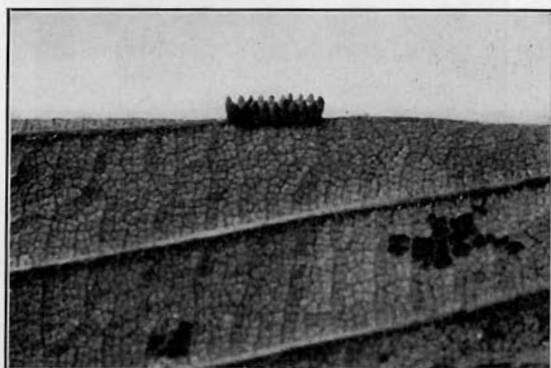


FIG. 2.—Cluster of eggs, greatly enlarged.

LIFE HISTORY AND HABITS.

The overwintering beetles come out of their winter quarters during the warm days of early spring, mate, and as soon as the leaves unfold they begin to eat small round or oval-shaped holes through them. Many leaves are thus riddled as though shot had been sent through them, and appear like the illustration on the front page of this bulletin.

During the latter part of May and early in June the females deposit small clusters of yellow eggs on the under sides of the leaves. The period of ovipositing extends over about four weeks, and each female may lay five or six hundred eggs. In about

a week the eggs hatch and the young larvae or grubs feed upon the under surface of the leaves, eating off the green tissue between the veins and leaving the veins and the upper epidermis, as is shown in Fig. 1.

In about three weeks the larvae or grubs are fully grown, and crawl down the trunks of the trees or drop from the ends of the branches to the ground and transform to the naked pupa stage. The great proportion of the pupae are found close around the base of the tree or lodged in the crevices of the rough bark of the trunk and larger branches. Except for being in crevices,

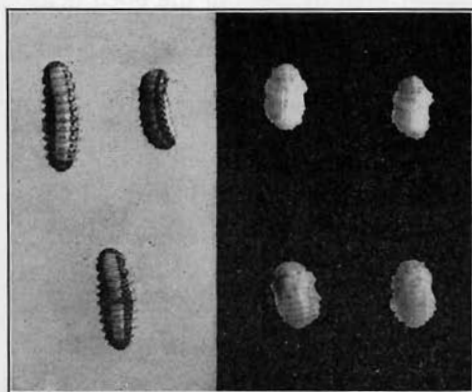


FIG. 3.—Larvae and pupae, twice natural size.

they are unprotected. The writer has seen trees in New Haven where it would be possible to gather several quarts of these pupae at the base of a single tree.

The pupa stage lasts about ten days, then the adult beetles appear, and lay eggs for the second generation, which seldom does much harm in Connecticut. Those emerging late probably do not lay eggs for a second brood, but may be seen crawling and flying about for a time, feeding more or less, but early going into winter quarters, usually in church belfries, attics of houses, barns, sheds or other outbuildings. They also pass the winter in cracks of fences, telephone poles, or under the edges of the loose bark of the trees. In some of the cities worst infested the adults sometimes gather in church belfries in such numbers that they can be swept up by the half bushel. The elm leaf beetle often occurs

with the two-spotted lady beetle in dwellings, simply because they both seek the same kind of a place for hibernation. Correspondents frequently send both species to the writer and desire to know if they are not in some way responsible for the injuries to their carpets. There is, of course, no relationship or similarity in food habits of the three species. The lady beetle is predatory, and in the larval stage destroys numbers of plant lice, and therefore should never be destroyed. The elm leaf beetles should, of course, be killed wherever they are found.

DESCRIPTION.

The *eggs* are bright yellow in color, bottle-shaped, and resemble the eggs of the Colorado potato beetle, but are smaller. They are fastened vertically to the under side of the leaf in clusters of from five to twenty-five arranged in two or three irregular rows.

When first hatched, the *larva* is dark or nearly black, covered with tubercles bearing black hairs. As the larva increases in size it molts several times and on becoming full-grown is about one-half inch long, dull yellow in color, with a pair of longitudinal black stripes along the back. Head, legs, lateral tubercles and two rows of small tubercles between the dorsal stripes are black. The tubercles also bear black hairs.

The *pupa* is about one-fourth inch in length and bright orange yellow in color, with black hairs or spines. It is not enclosed in an earthen shell to protect it, but is found at the base of the tree perfectly naked and wholly unprotected.

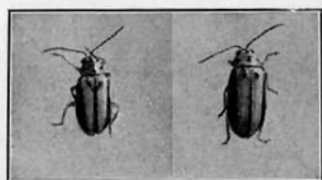


FIG. 4.—Adult beetles, twice natural size.

or markings on the pronotum of the thorax vary greatly in size and shape. Legs and antennae are yellow.

The *adult beetle* is light yellow in color when it first emerges, but soon takes on a duller hue, and finally becomes a dull olive green. An indistinct black stripe extends from the base to the extremity of each wing cover just inside of the margin. Small black spots

EFFECT UPON THE TREES.

It has previously been mentioned that the adult beetles do more or less feeding, always eating holes entirely through the leaves, as is shown on cover of this bulletin. This of course injures the tree, but is much less serious than the damage caused by the larvae, which eat away the under surface of the leaves. The larvae are always more abundant than the adult beetles, and are more voracious in their feeding habits. The worst infested trees usually drop their leaves in Connecticut about the middle of July. If this happens, and is followed by a rainy season, new leaves will be put out, but in a season of a protracted drought the trees may fail to put forth new leaves. In either case the tree is undoubtedly weakened, and often seriously so. Sometimes the second crop of leaves is devoured by the second generation of beetles, but in Connecticut the white fungus mentioned in another part of this bulletin is apt to serve as an important check to the beetle in a wet season. Two complete defoliations, one succeeding the other, usually kill a tree. Usually, however, the defoliation is not quite complete, and the trees continue to exist in a greatly weakened and devitalized condition. In the cities and larger towns, on account of further injuries* by horses, by leaky gas pipes in the ground, and pavements which cut off the supply of moisture, many trees have died. In 1901 the writer was called to Norwich, where nearly every elm had died for a distance of about one and one-half miles on a prominent residential street. These trees had been weakened by the constant attacks of the beetle year after year, and a leaky gas main finally destroyed what little vitality remained. Most of the maple trees along the street survived.

In many cases young or newly planted trees seem to be especially subject to attack, and therefore should receive extra attention.

FOOD PLANTS.

Elms constitute the only food plants known for this insect, and the European species suffer more than the American ones. The English elm (*Ulmus campestris*) and its weeping variety

* For a discussion of these injuries the reader should consult Bulletin 131 of this Station.

known as the Camperdown elm are favorites of the beetle. The writer has seen these trees entirely defoliated in New Haven when the common white, or American elms, were uninjured. The American elm is, however, the next choice, followed by the Scotch elm (*U. montana*), and though no variety is wholly exempt from attack, the winged elm (*U. alata*), the slippery elm (*U. fulva*), the cork elm (*U. suberosa*) and the rock elm (*U. racemosa*) are much less frequently attacked.

NUMBER OF GENERATIONS.

According to Burgess,* "in New Jersey, Professor J. B. Smith has recorded only a single brood and sometimes a partial second brood, while in the latitude of Washington, D. C., according to the observations of Messrs. Riley, Howard and Marlatt, of the Division of Entomology, two annual broods and sometimes a partial third brood have been found."

Dr. E. P. Felt, State entomologist, of Albany, N. Y., finds† two well marked broods and a partial third brood at Albany and Troy, N. Y.

The writer has not followed out this matter carefully in Connecticut, but all stages are found on the trees during the first half of September, so presumably there are at least two broods, but the egg-laying period of the adults is so prolonged that the lines of demarcation are nearly obliterated. In Connecticut the leaves of the trees severely attacked by the first brood generally turn brown and drop about the middle of July, when the larvae are descending the trees to pupate.

NATURAL ENEMIES.

One of the most important natural enemies of the elm leaf beetle in Connecticut is a fungus known to botanists as *Sporotrichum globuliferum* Speg. (*S. entomophilum* Peck), which attacks the pupae and adults in late summer, especially in a moist season. In 1902 this fungus was prevalent, and the following season the elm leaf beetle did little damage to the trees. In 1906 the beetles were abundant, but as the month of July was wet, the

* Bulletin No. 4, page 17, Ohio Dept. of Agriculture, Div. of Nursery and Orchard Inspection. 1905.

† Bulletin No. 57, N. Y. State Museum, p. 14, 1902.

fungus developed and killed a great many beetles. Beetles attacked by this fungus are covered with white mold, as shown in Fig. 5.

Predatory bugs of at least three species of the genus *Podisus* feed upon the larvae and pupae, and Riley* records three species of beetles that also devour full-grown larvae and pupae. The praying mantis (*Stagmomantis carolina* Linn.) is also an enemy of the elm leaf beetle in the southern portion of its range.

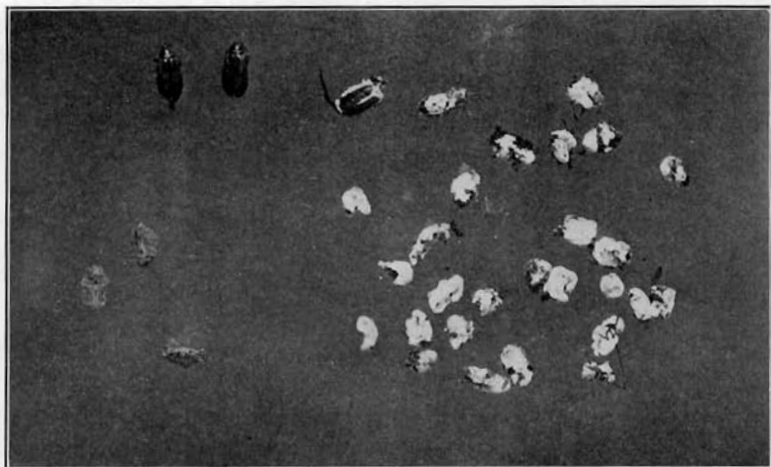


FIG. 5.—Pupae and adults killed by fungus. Healthy specimens at the left, natural size.

REMEDIES.

Spraying with poison. Covering the foliage with some arsenical poison is the only sure means of preventing injury to the trees, and for this purpose arsenate of lead is unquestionably the most satisfactory of these poisons. It remains better in suspension and adheres to the foliage longer than Paris green or London purple, and is less liable to injure it. As there are now several brands of good arsenate of lead on the market, it

* Div. of Entomology, U. S. Dept. of Agriculture, Bulletins No. 6, p. 10 and No. 10, p. 13.

will no longer pay to make it up each time from lead acetate and arsenate of soda. The arsenate of lead made by the Merrimac Chemical Co., Boston, Mass.; Schoonmaker & Son, Cedar Hill-on-Hudson, N. Y., and the Bowker Insecticide Co., Boston, Mass., (Disparene) have all been used in our tests and have given satisfaction. Arsenate of lead should be used in the following proportions:—

Formula	{	Arsenate of lead.....	3-5 lbs.
		Water	50 gals.

There are two methods of spraying elms: (1) To spray as soon as the leaves unfold, the treatment being aimed especially at the parent beetles, and to forestall all injury. As growth takes place, new leaves are constantly appearing, and these will not carry poison unless the application is from time to time repeated. This should be done often enough to keep the foliage well coated with poison until July 1st, when growth usually ceases, and both sides of the leaves should be coated.

(2) The other method is to spray the under sides of the leaves very thoroughly about June 1st, or soon after the eggs begin to hatch. This treatment is aimed at the larvae, and sometimes a single spraying is sufficient, as the poison will remain throughout the season. By it the great bulk of damage will be prevented, but the leaves will show the small holes made by the parent beetles before the poison was applied.

If arsenate of lead cannot be procured and it seems desirable to use other poisons, Paris green can be substituted.

This should be used at the following rate:

Formula	{	Paris Green	1 lb.
		Fresh lime	3 lbs.
		Water	50 gals.

Paris green is quicker in its action upon the insects than arsenate of lead, but will not remain as long upon the trees. Unless the lime is added, there is danger of "burning" the leaves. Lime is not needed with arsenate of lead.

The cost of spraying elm trees will vary from ten cents each in case of small trees to five dollars or more for the largest trees, according to the price of labor and the efficiency of the outfit.

Destroying the pupae. If the trees have not been protected by spraying, and have been attacked and injured by a horde of beetles and their larvae, it is always advisable to destroy the insects in the pupa stage at the base of the trees, in order to reduce the crop for next year as much as possible. These can often be swept up in large quantities; they can be killed by sprinkling them with hot water; but best of all is to spray the ground not only close to the tree but as far away as the branches reach, and also spray the bark of the trunk and large branches, with kerosene emulsion or some other contact insecticide. The pupae are easy to kill, but as they remain in the pupa stage only about ten days, it is essential that this work be done at the right time, and it is only when we observe that most of the larvae descending the trunk have transformed to bright yellow pupae that we can know when is the proper time to act.

Destroying the adult beetles. The beetles should of course be destroyed in attics, belfries and other places where they hibernate. This can be done by sweeping them up before they become very active in spring and dropping them into the fire, hot water or kerosene to kill them.

OUTFIT FOR SPRAYING ELM TREES.

The barrel hand-power pump can be used for spraying small trees or for a limited number of large trees, but if one expects to make a business of spraying street trees, it will pay to procure a power sprayer; this may be a steam or gasoline engine with pump, or what is perhaps better, the "Niagara Gas Sprayer," which utilizes cylinders of carbonic acid gas to furnish pressure, thus doing away with a pump. Each large village and city should have at least one power sprayer that can be put to immediate use for spraying street or park trees. Strong one-half inch hose should be provided in long lines of from fifty to two hundred feet, and from four to six of these can be attached to each power sprayer. Even a larger number might be attached, but while in operation some workmen would be in the way of others, so that nothing would be gained. Mr. H. L. Frost of Boston, who is in the spraying business, informed the writer that four lines of hose is about the most economical number for each outfit. Each hose is furnished with an extension rod with closing valve at the

lower end and a cluster of nozzles at the upper end. These rods should be of different lengths, from four to twelve or fourteen feet for the different kinds of work. Any of the standard nozzles such as "Vermorel," "Mistry," or "Spraymotor" will be found satisfactory, and if several are used together in a cluster one is able to cover more leaf surface in a given time.

For getting about in tall trees it will be necessary for the men to be provided with climbing irons and extension ladders.

SUMMARY.

The elm leaf beetle was introduced into this country from Europe about seventy years ago, and caused serious injury to trees at Baltimore, Md., in 1838 and 1839. From this point it spread slowly, chiefly to the northward, reaching Connecticut in the early nineties, and injuring and killing many fine old trees in the coast towns. Later, inland towns were attacked, and the trees ravaged. The insect is now found from Charlotte, N. C., as far north as North Conway, N. H., and as far west as central Kentucky, but has not proven destructive to elm trees north of Massachusetts. It is preëminently a pest of shade trees in cities and towns, and seldom injures trees in the open fields. Since 1896 the attacks have diminished, but the pest was again serious in 1906.

The winter is passed by the adult beetles in attics, belfries and cracks in fences, and they come forth in April, and later feed and lay their yellow eggs upon the unfolding leaves. Beetles eat holes through the leaves, eggs hatch in a week, and the larvae eat off the green tissue from the under surface, causing the leaves to turn brown and fall about the middle of July, at which time the larvae are about full grown. Then they descend to the base of the tree and transform to naked pupae; ten days later the adult beetles emerge and lay eggs for the second brood or go early into winter quarters.

Two complete defoliations in succession will kill a tree.

How to Fight the Elm Leaf Beetle.

(1) Search all attics, church belfries and cupolas for the dormant beetles in winter and early spring. Sweep them up and burn them.

(2) Spray the leaves with poison as soon as they have opened, if their shot-hole appearance shows that the beetles are there in abundance, and the under sides of the leaves should be coated about June 1st to destroy the larvae or grubs.

(3) When, later in the season, the yellow pupae appear on the trunks of trees and the ground beneath, kill them with a spray of kerosene emulsion or by sweeping them up and burning or soaking with kerosene.

The first and third measures should be taken by each householder, church or social organization, at individual expense. The spraying, which is difficult and expensive if the trees are large, can only be done by concerted action of the town or borough authorities. For extensive spraying work power sprayers are desirable, but small elms or a few large trees can be treated successfully by means of a hand pump of barrel size. The "Niagara gas sprayer" in operation is shown in Fig. 6.

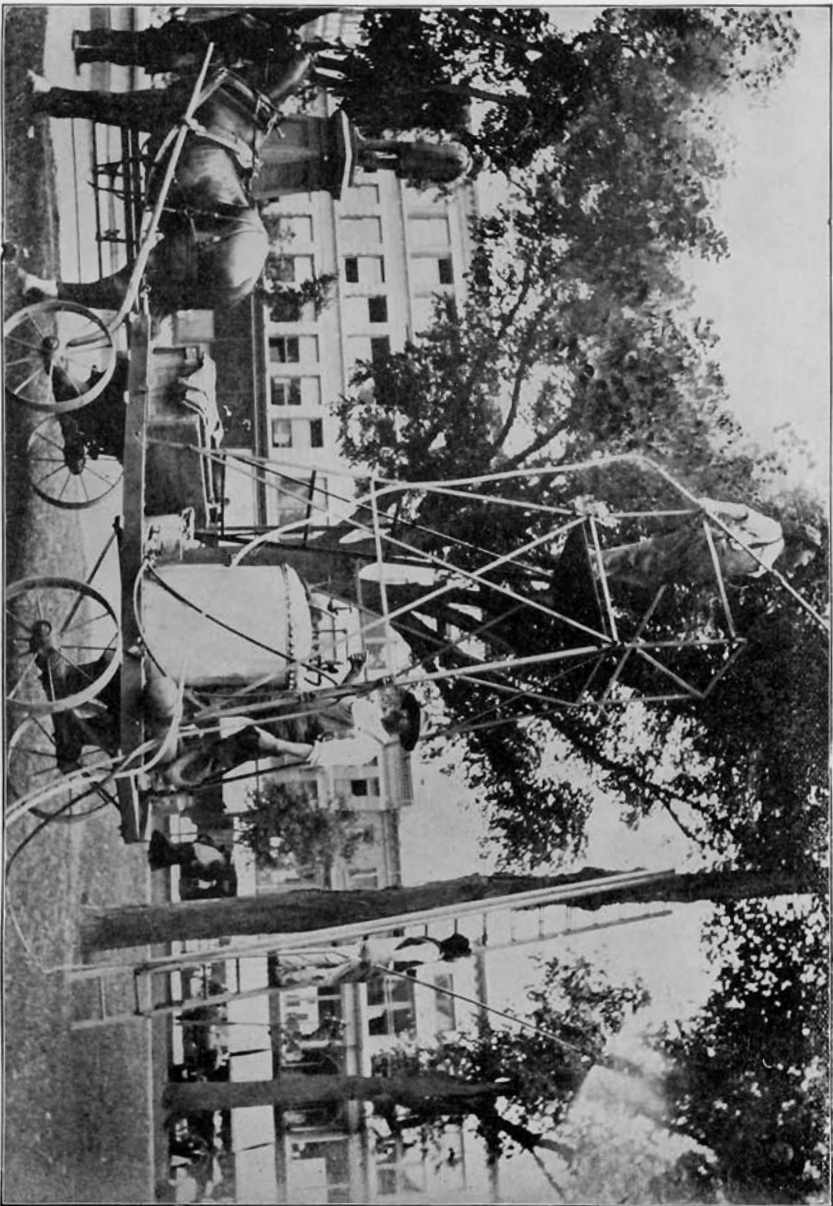


FIG. 6.—“Niagara gas sprayer” and outfit for spraying street trees. (After Smith, Report New Jersey Expt. Station for 1905.)