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THE GLOOMY SCALE

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RALEIGH

CONTENTS AND SUMMARY

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Z. P. METCALF, *Entomologist*

INTRODUCTION

When the author first came to North Carolina, in 1908, he was impressed with the number of shade maples in a dead and dying condition along the streets, in lawns, in cemeteries—in fact, everywhere that maples had been planted for shade purposes. Even a cursory examination showed that this injury was confined to the soft maples, whereas the hard maples were practically free from the trouble.

Since 1908 the author has studied various phases of this problem in all sections of the State. The present bulletin is a summary of the more important phases of these problems and is published at this time to make the results of these studies available for other entomologists, and for landscape gardeners, keepers of parks, home owners—in fact, for every one who is interested in better shade trees, or in the preservation of shade trees already planted. The life history of the pest is dealt with at some length because this is the foundation for all methods of control. The remedies that can be used are discussed in detail, as well as the enemies of this scale, because it is believed that much benefit will be derived from both these sources.

IMPORTANCE OF THE GLOOMY SCALE

The gloomy scale (Fig. 1) is without exception the most important insect pest of shade trees in North Carolina. This is due not only to its destructiveness, but also to the fact that its chief host plants are so largely used for shade purposes in this State. The importance of this insect is, however, not always appreciated, chiefly because its attacks are so insidious, and because the effects of the attacks of this insect are slow to develop. It is usually several years after a tree has been attacked before the attention of the owner is aroused. By this time the attack has usually progressed to such a point that it is beyond control.

The importance of this pest can only be appreciated by one who gives close attention to the shade trees of the State, and then by watching the progress of the insect over a series of years. The writer of this bulletin has been watching the gloomy scale for the past thirteen years, and has been noting carefully the attacks of this scale on numerous trees throughout that period, and all these observations have convinced him that it is useless to try to grow soft maples in the gloomy scale territory, unless the trees are sprayed consistently at least every second or third year. A visit to almost any of our cities or towns will show that fully three-fourths of the shade trees are soft maples. Perhaps the reason for this is the fact that these maples grow rapidly and stand much abuse in

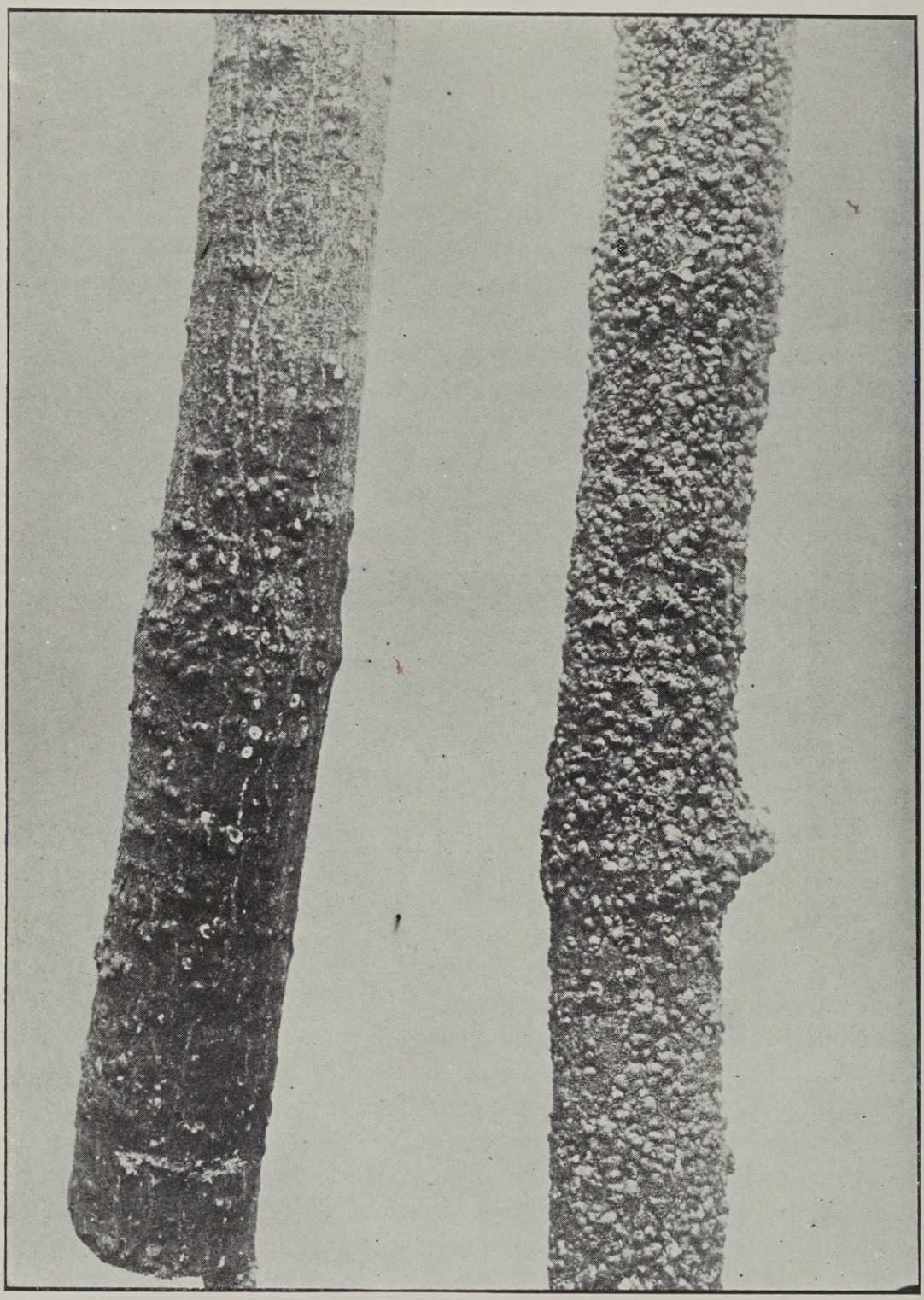

Fig. 1. Maple twigs infested with gloomy scale; slightly infested on the left, badly infested on the right. About twice natural size.

the way of mechanical injuries to trunk, limbs and roots. In spite of these advantages the soft maples have certain disadvantages in addition to the fact that they are attacked by the gloomy scale. The chief one is that the wood is especially brittle and apt to be broken during storms.

COMMON NAMES

So far as the writer is aware, only two common names have ever been used for this species. Comstock (1881), in his original description, proposed the name *Gloomy Scale,* and this name has been rather generally used ever since. The name *Maple Scale* has been used to a certain extent, but since that name does not distinguish this scale from other scales on maple, it is hardly advisable to use it. The name gloomy scale has also been used for another species, *Chrysomphalus obscurus* Comst., which occurs more commonly on oaks. This latter species was named obscure scale by Comstock, and this name should be retained, or the two species should be called the gloomy maple scale and the gloomy oak scale. The latter alternative is hardly advisable, for *Chrysomphalus tenebricosus* frequently occurs on oaks as well as maples, while *Chrysomphalus obscurus* often occurs on maples as well as oaks. The name gloomy scale is appropriate because the scale covering of the insect is very dark in color. With these things in mind, and the further fact that the name gloomy scale was originally proposed for *Chrysomphalus tenebricosus,* the name gloomy scale is retained for this species in this bulletin.

HISTORY AND SYNONOMY

This species was originally described by Comstock (1881) in the report of the United States Commissioner of Agriculture for 1880, as *Aspidiotus tenebricosus,* in 1897 Cockerell (1897) suggested that this species would fall in *Ashmead's* genus *Chrysomphalus* treated by Cockerell as a sub-genus of *Aspidiotus.* American writers have generally referred it to this genus, but Leonardi (1889) placed this species in his genus *Aonidiella.* Herrick (1911) has recently suggested that this species should be placed in the genus *Aonidiella* until the matter has been definitely settled by entomologists. The writer follows the usual custom among American entomologists and places this species in *Chrysomphalus Ashmead.*

The synonomy of the species would, therefore, be as follows:

Aspidiotus tenebricosus, Comstock 1881.
Aspidiotus (Chrysomphalus) tenebricosus, Cockerell 1897.
Aonidiella tenebricosus, Leonardi 1899.
Chrysomphalus tenebricosus, Fernald 1903.
Chrysomphalus (Aonidiella) tenebricosus, Herrick 1911.

The original description by Professor Comstock (1881) is exceedingly careful in detail as far as the structure of the insect goes, but at that time nothing was known of the life history or the habits of the insect. Professor Comstock's description and notes were repeated by Packard in 1890. Craw, in 1891, reported the insect as occurring in California, and Lintner, in 1896, mentions the insect very briefly. In 1911 the writer discussed the insect briefly and gave a detailed account of test sprayings that had been carried on against it. Herrick, in 1911, also gave the technical description of the insect, with the statement that it is "abundant nearly everywhere on the silver and red maples, which were often dying as a result of the severe infestation." Further than this the insect has been little noted in entomological writings, although entomological workers in the southern states generally appreciate its destructiveness.

DISTRIBUTION

The gloomy scale is generally distributed throughout the southeastern United States, from Maryland to Texas. From records and observations of entomologists from other states it is apparent that this insect does not occur normally north of Delaware, Maryland, Virginia, Tennessee, and Missouri. Its western distribution is not clear. It has been recorded by Craw from California, but has apparently not been found in that state in any recent collections. There are a few scattered records of this insect in states farther north than the boundaries indicated, but apparently these records are based on accidental or unusual occurrences. Scale insects have been collected extensively in Ohio, Indiana, Kentucky, and Kansas without revealing the presence of this

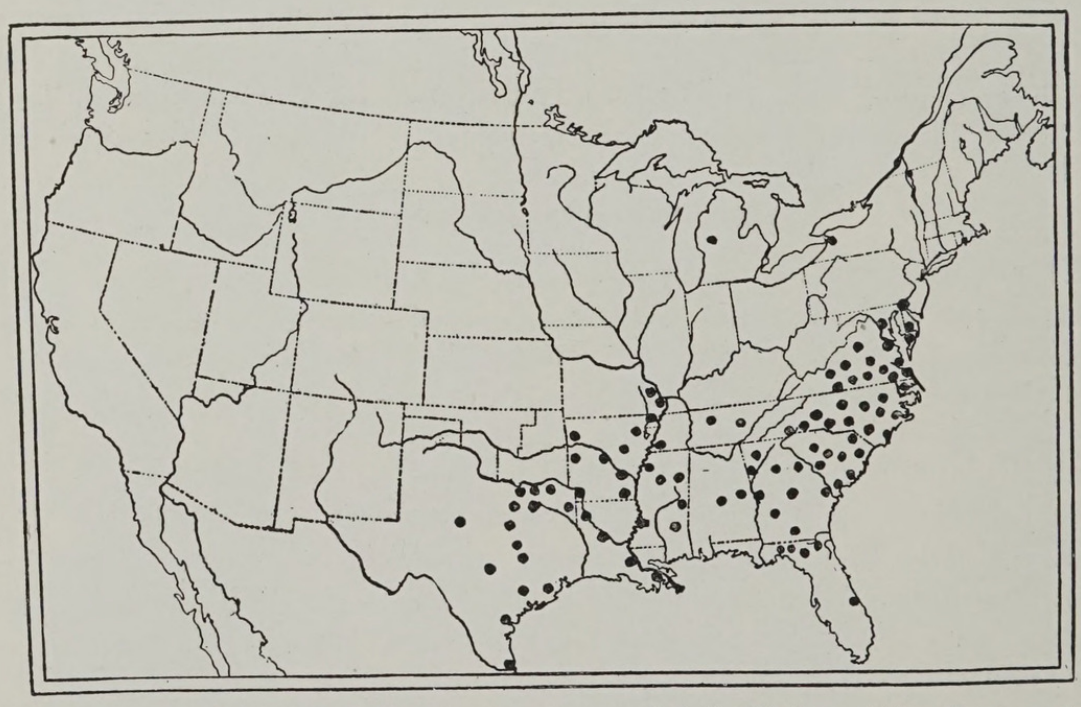

Fig. 2. Map of the United States showing the recorded distribution of the gloomy scale.

insect. In the states south of this line, however, the insects seem to be generally distributed in cities and towns wherever maples have been used extensively for shade purposes. The map given in Fig. 2 shows very clearly the distribution of this insect.

For the records outside of North Carolina my thanks are due to Mr. E. R. Sasscer, who has kindly sent me the records from the United States Bureau of Entomology, and to the entomologists of various states in the gloomy scale region who have very kindly summarized the conditions in their states.

DISTRIBUTION IN NORTH CAROLINA

In North Carolina the gloomy scale does not occur beyond what is generally accepted as the western boundary of the Upper Piedmont. The map in Fig. 3 indicates very well the distribution of this insect in the State. The records are based upon correspondence and careful inspec-

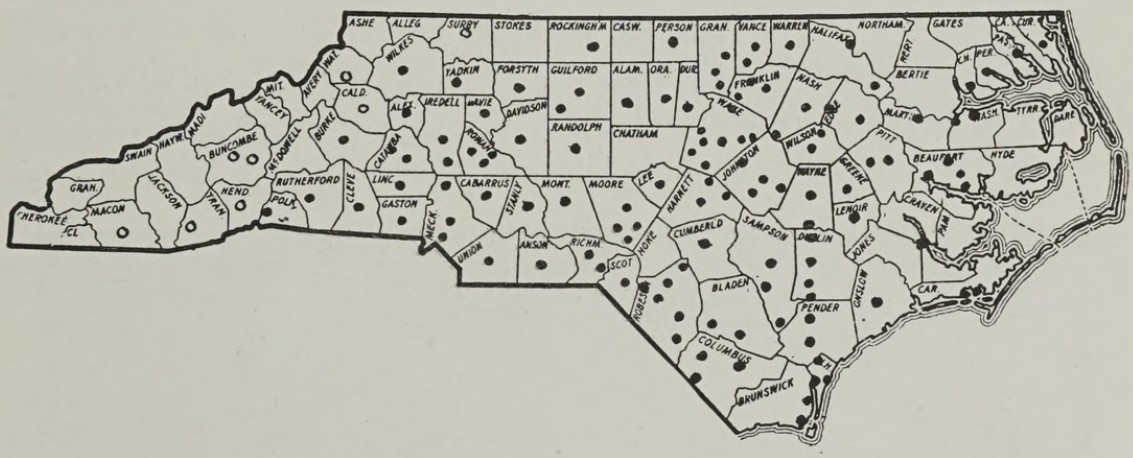

FIG. 3. Map of North Carolina. The solid dots indicate places where the gloomy scale has been found. The small rings indicate places inspected, but no scale found.

tion of all of the large cities and towns of the State. Its prevalence in the eastern part of the State is apparently dependent upon the extent to which soft maples have been used for shade purposes. In all of the larger cities and towns in the eastern part of the State it is practically impossible to find soft maples of any size which are not seriously infected with the gloomy scale.

An effort has been made to determine the western extent of this scale, and certain towns along the border have been visited with this in view. The localities in which it has not been found are also indicated in the accompanying map. We may look, therefore, for this scale everywhere in the Piedmont and Coastal Plain sections of the State where soft maples have been planted extensively.

NATIVE HABITAT

In the present day of world-wide commerce the native habitat of any species of insect becomes of interest. Due to the introduction from for-

eign countries of several very destructive pests, the opinion has become rather prevalent that all destructive pests are introduced from abroad. The writer, however, believes that the gloomy scale is a native species. His reasons for believing this are based on the following facts: (1) The gloomy scale is found frequently in woods far removed from towns or cities where infestation is general; (2) the gloomy scale has never been reported from any other country than the United States, so far as the writer is aware. While neither one of these facts is conclusive, they both point the same way. The finding of this pest on native maples growing wild, both in the foothills of the mountains and in the swamps in the eastern part of the State, frequently several miles from human habitation, would be hard to explain on any other basis. The further fact that scale insects have been rather generally studied in all parts of the world and the gloomy scale has not, so far as a careful search of the record shows, been reported from other countries, can lead to but the one conclusion—that this is a native pest.

HOST PLANTS

The gloomy scale attacks a long list of trees, as is shown by the following list, but it is chiefly an enemy of the soft maples, red maples (*Acer rubrum*), and silver maple (*Acer saccharinum*). The other trees

Fig. 4. Showing the resistance of the hard maples to the attacks of gloomy scale. The trees on either side are hard maples; the trees in the center are soft maples.

in the list are usually attacked only when they are placed close to soft maples so that they could hardly escape. Hard maples, such as the sugar maple (*Acer saccharum*), and the Norway maple (*Acer platanoides*), are very resistant (Fig. 4), even when placed in direct contact with dead or dying soft maples.

List of Host Plants

Apple (*Pyrus malus* L.). Occasionally infested.
Ash, white (*Fraxinus americana* L.). Bureau of Entomology.
Box-elder (*Acer negundo* L.). Occasionally slightly infested.
Buckeye (*Æsculus glabra* Willd.). Slightly infested.
Chestnut (*Castanea* spp.). Several badly infested trees.
Cottonwood (*Populus deltoidea* M.)
Currant (*Ribes* sp.). Bureau of Entomology.
Dogwood (*Cornus* spp.). Occasionally infested in the woods.
Elm (*Ulmus* spp.). A few slightly infested trees.
Gall-berry (*Ilex* sp.). J. R. Watson.
Hackberry (*Celtis* spp.). Slightly infested.
Hibiscus. Bureau of Entomology.
Iron-wood (*Carpinus caroliniana* Walt.). A single badly infested tree.
Linden (*Tilia americana* L.). Bureau of Entomology.
Maple, Norway (*Acer platanoides*). A few slightly infested trees.
Maple, red (*Acer rubrum* L.). Generally and badly infested.
Maple, silver (*Acer saccharinum* L.). Generally and badly infested.
Maple, sugar (*Acer saccharum* Marsh.). A few scattering individuals found infested very slightly.
Mulberry (*Morus* spp.) Sometimes very badly infested.
Oak, live (*Quercus virginiana* L.). Bureau of Entomology.
Oak, water (*Quercus aquatica* Catesb.). Sometimes slightly infested.
Oak, willow (*Quercus phellos* L.). Sometimes slightly infested.
Oak, white (*Quercus alba* L.). Sometimes slightly infested.
Osage Orange (*Maclura pomifera* Raffin.). Sometimes badly infested.
Sarsa sp. Bureau of Entomology.
Sycamore (*Platanus occidentalis* L.). Sometimes slightly infested.
Tulip (*Leriodendron tuliplifera* L.). Sometimes slightly infested.
Walnut (*Juglans* spp.). Some trees badly infested.
Willow (*Salix* sp.). Sometimes slightly infested.

APPEARANCE OF THE INSECT

Armored scales differ from other insects with which most of us are familiar because they live between two scales or coverings like a turtle in its shell. They differ from a turtle in that the insect is not attached to the scales, whereas in the turtle the animal is attached to its shell. They differ from other insects also in that they do not have legs or wings in their feeding stages; hence they cannot move from place to place, but are anchored on the bark of their host plant by means of their thread-like beaks.

If we examine closely a twig of a maple tree which is lightly infested with gloomy scales we will find small circular elevations scattered about, which have almost the same color as the bark (Fig. 1). If we

examine a badly infested twig we will find these little elevations closely crowded together so that they completely cover the surface of the bark (Fig. 1).

Now, if we take a pin or the small blade of a knife, we will find that these small elevations can be lifted up and under some of them we will find a small yellow sack-like structure, the insect itself. If we touch the insect carefully we see that it is anchored to the bark by its beak. Under the insect we will find a circular whitish area of wax, the ventral scale.

LIFE-HISTORY SUMMARY

The gloomy scale, in common with all the other armored scales, has two entirely distinct life histories, one for the female and the other for the male. Individuals of both sexes start their development as minute six-legged insects, with a pair of eyes and a pair of antennæ. These are called active young, and do not differ in the two sexes; but from this point the development in the two sexes is widely different.

In the female the active young soon settles, inserts her beak into the bark and commences to suck the sap of the host tree. Slender thread-like waxy filament exude from the wax pores located over the body, and as these mat together, two plates of wax are formed, one covering the back of the tiny insect and the other between it and the bark of the tree on which it is feeding. The insect is soon covered in this way, and in a short time it molts, loosing its eyes, legs, and antennæ. Thus the female becomes a sack-like animal with its beak inserted into the bark for sucking out the sap. It is not capable of locomotion, and from this stage onward the female is forced to remain in the same place. This development is taking place during the summer months. In the late summer the females are fertilized by males. They molt again and pass the winter as half-grown individuals. In the spring they grow rapidly for a short period and early in May they commence to give birth to living young, which start another cycle. This process is kept up during the whole summer. The mature females diminish gradually during the summer, the last ones dying in late August.

The males start from active young like the females and form their scale coverings and molt in the same way, but after the first molt they are more elongate than the females and the scale covering is oval in outline, not circular as in the female. The male at this stage is an elongate sack-like insect, feeding on the sap through the long, slender beak. About the middle of August the males change remarkably. They loose their mouth parts and cease feeding. Three pairs of legs, a pair of antennæ, and a pair of wings develop as sack-like outgrowths of the body. At first these appendages are poorly formed, and this stage is

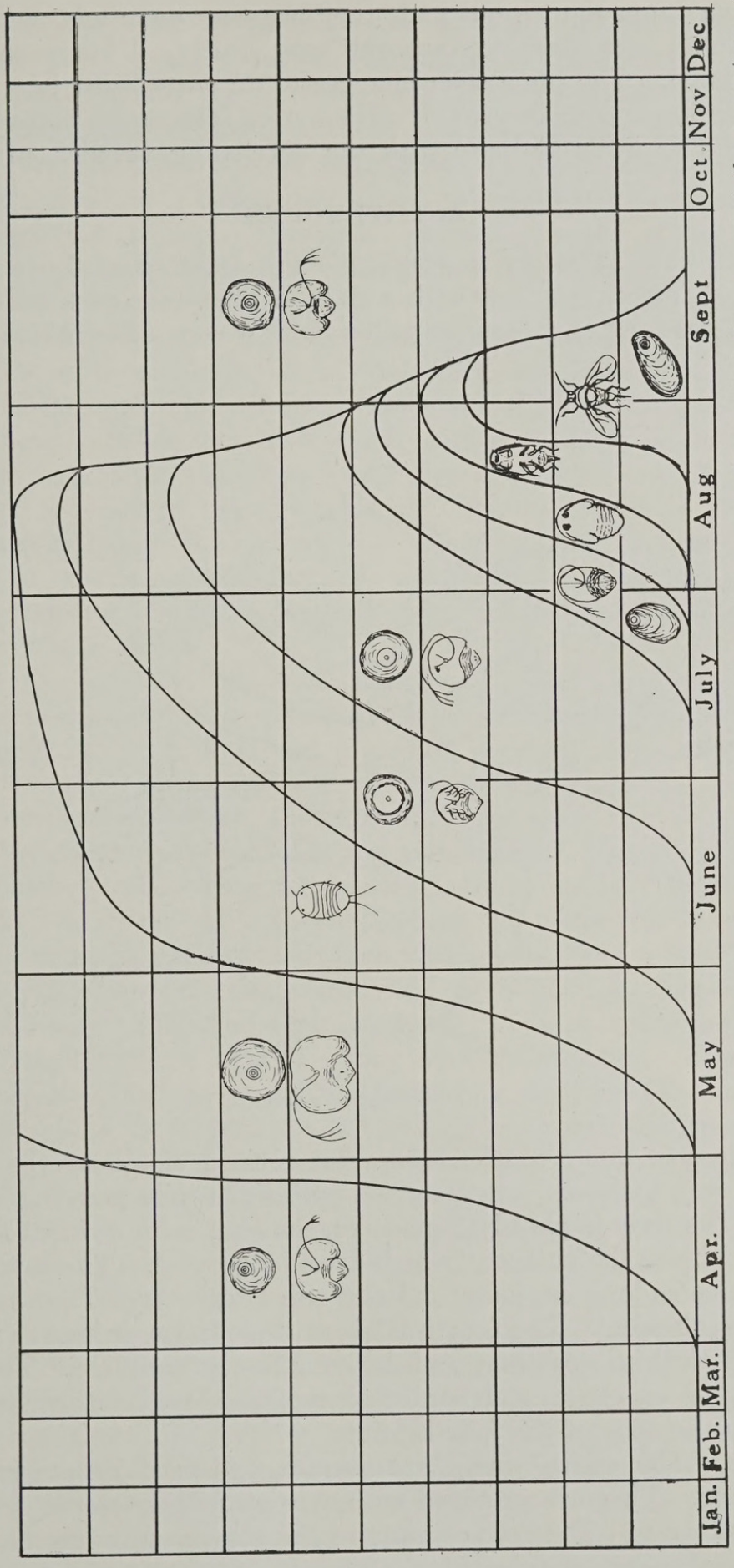

FIG. 5. Life-history summary based on counts of the living insects at various seasons of the year. The vertical lines represent the percentage of any stage found at any given season.

known as the pro-pupa, but later they are very definitely outlined, and the minute insect resembles the adult very closely. This stage is known as the pupa. The pupa soon changes to an adult with legs, antennæ, wings, and eyes fully developed. It emerges from under the scale covering and flies away to mate with the developing females, after which it dies.

ACTIVE YOUNG

Description. The active young gloomy scale (Fig. 6) is a minute six-legged insect, provided with a pair of antennæ and a pair of eyes. The general color is pale straw-yellow, with the eyes dark brown.

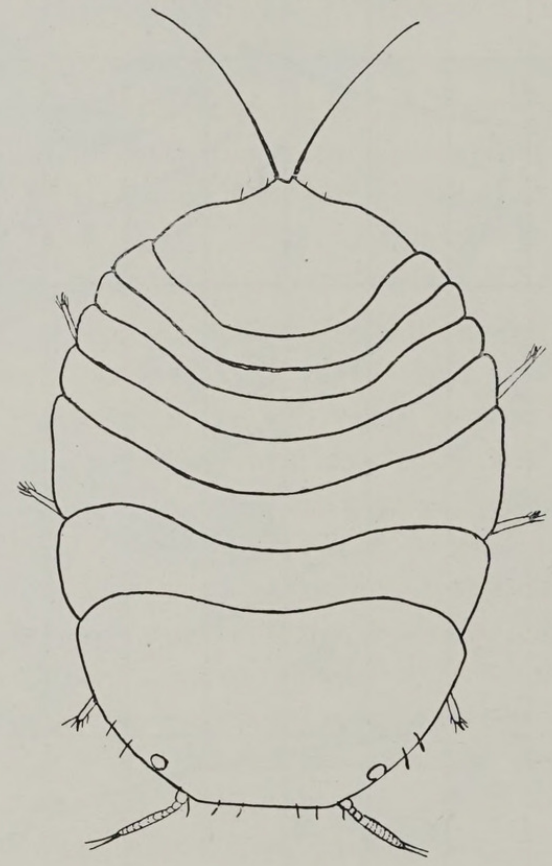

Fig. 6. Active young.

Length .244 mm., width .166. The general shape of the body is broadly oval, with legs, antennæ, and posterior spines showing conspicuously. The body is plainly segmented, showing seven evident segments. The head bears the antennæ, which are four-jointed. The first joint is about twice as long as the second and third together. The second and third are sub-equal. The fourth is about three times as long as the first, second, and third together, and is indistinctly annulate. There is a strong spine on the mesial border of the basal segment and two long spines on the apex of the fourth joint.

Habits. The active young are minute six-legged insects of a pale straw color. They are provided with a pair of dark-colored eyes and a pair of antennæ. The active young of the gloomy scale are born alive, but in a rather inactive condition. They usually remain under the scale

of the female for from 24 to 48 hours, although some remain much longer than this. Usually during the height of the breeding season, anywhere from one to ten active young may be found under each female. These usually fare forth after a time, crawling about on the limbs and branches of the trees until a convenient location is found. When such a location is found they attach themselves by inserting their beaks and sucking the sap. This active period is usually of short duration, averaging about one hour in the specimens studied. As a general proposition these active young do not travel far, although if conditions are unfavorable they may travel a considerable distance. Usually the young scales settle within a foot of their mother. This leads to great crowding of the scale, and results in the death of many, due to the red-headed fungus. Those that leave their mother for any distance travel towards the tips of the branches, where they settle for the most part in the axils of the leaf in the new growth. This insect would be much more destructive than it is if all the young adopted this method of attacking the young growth, for they would not be so crowded, hence fewer would die; and what is perhaps of greater importance, the young tip twigs would be killed.

The greatest measured distance that young scales have traveled for us is 56 inches, measured as a straight line. This young scale was removed from under its mother and placed on a young maple tree out of doors. The scale was liberated near the base of the tree and crawled upward and outward on a limb, near the top of the tree. No account was taken of the innumerable turnings and twistings of this young, but the distance measured as a straight line was about 56 inches. It is safe to say that the real distance traveled was about 100 inches (2500 mm.) in three hours, or an average of more than 8,000 times its own length in an hour. Usually, however, the young find a satisfactory location and settle within a few inches of their mothers. It is not unusual to find an adult female, with a ring of young scale around her. Frequently the active scales crawl under old male scales or dead female scales and settle there. It is not unusual to find as high as three generations overlapping each other in this way. It is of interest to note that these scales underneath other scales are grayish white in color, showing that light is required to develop the characteristic color of the adult scale. It is not unusual for young scale to settle on the dorsal scales of other individuals. And while their mouth parts cannot reach the bark in this position, they frequently secrete a dorsal and ventral scale covering and molt the first time, after which they die. This shows that the young carry enough food and energy to develop to a remarkable extent, although deprived of food. In the laboratory we have not been able to keep the young active for more than forty-eight hours without food. Apparently their energies are all used up in aimless endeavors to escape from their cages.

Soon after settling and inserting the beak, the active young contracts its antennæ and legs and the body contracts until it is almost circular in

outline (Fig. 5). Filaments of wax are secreted from all parts of the body, the waxy filaments soon run together and gradually melt, so that the downy appearance that is so characteristic at first is soon lost. The color of the wax is white at first, but later it turns a very dark grayish black.

DESCRIPTION OF FEMALE STAGES

After the *first molt* (Fig. 5) the female scale insect is nearly circular in outline and measures about .375 mm. in diameter, and except for its small size it resembles the adult female very closely. After the second molt the female scale insect is about .510 mm. in diameter.

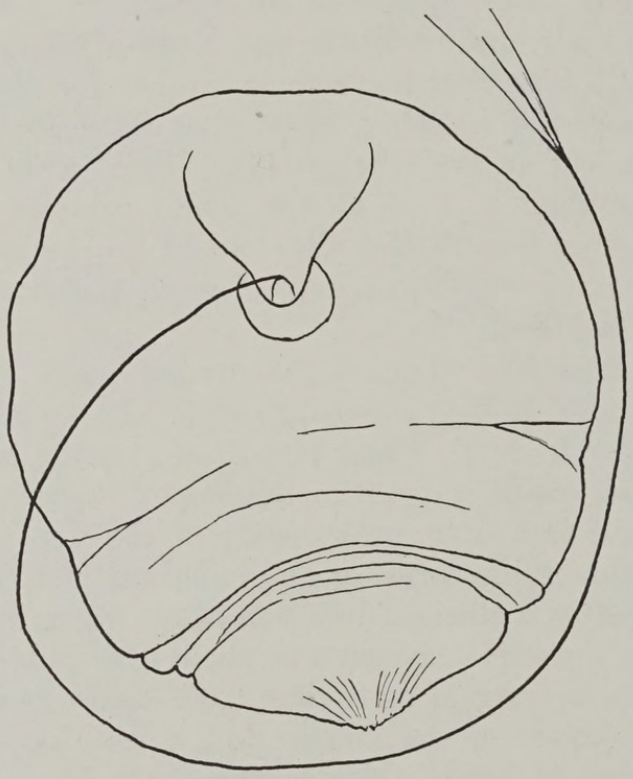

Fig. 7. Adult female insect.

The *adult female* (Fig. 7) measures about .950 mm. in diameter, but very slightly longer than broad. The mouth parts are nearly central in position. The segments of the abdomen are not very distinct. The general color as chitin yellow. The pygidium (Fig. 8) shows the following characters:

"There are three pairs of well-developed lobes. The median lobes are rounded posteriorly, or often with a slight notch on the lateral margin, and taper to a point anteriorly; the second lobe of each side is somewhat triangular in outline, with the lateral edge serrate; the third lobe is larger than either the first or second lobes, triangular in outline, and serrate on lateral margin.

"The posterior third of the lateral margin of the segment appears to be of the same structure as the lobes, and has five triangular serrate lobes; the posterior one of these is the largest, and is larger than either of the true lobes.

"There are seven club-shaped thickenings of the body wall upon each side of the meson, which are arranged as follows: One terminating near the lateral margin of the first lobe; this extends anteriorly but a short distance beyond the lobe. One appearing to be a prolongation of

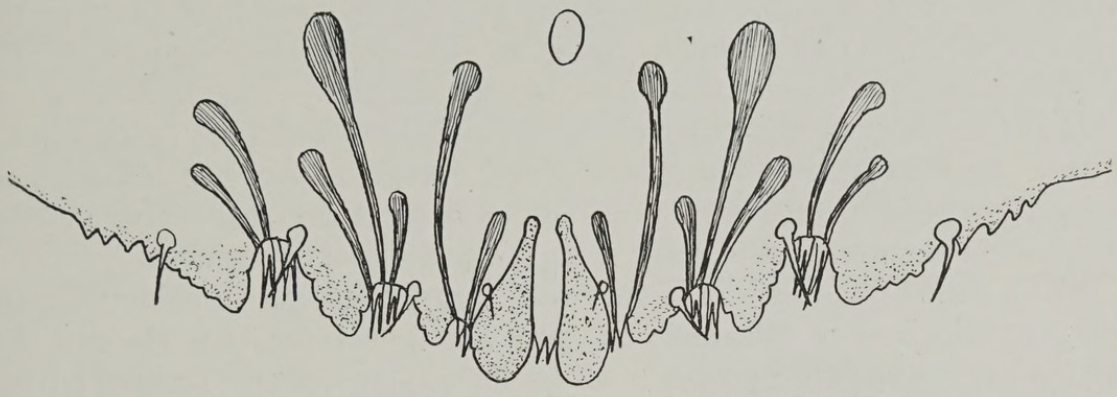

Fig. 8. Pygideal fringe of gloomy scale (*after Herrick*).

the mesal margin of the second lobe; this extends anteriorly to a point laterad with the anus. One terminating between the second and third lobes; this is linear, inconspicuous, and sometimes obsolete. One terminating at the base of the plates between the second and third lobes, and also one terminating at the base of the plates between the third lobe and the thickened lateral margin; these two are the largest, and extend anteriorly the farthest of all the thickenings. One terminating at the mesal margin of the third lobe, and one at the mesal end of the thickened lateral margin of the segment.

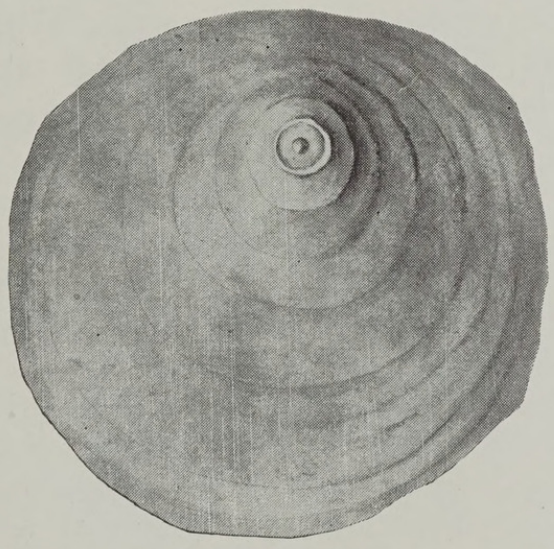

Fig. 9. Dorsal scale of female.

"The plates between the median lobes and between the first and second lobes of each side are very small and often obsolete; there are two small irregularly branched plates between the second spine and the third lobe, and also two similar plates between the third spine and the mesal end of the thickened lateral margin.

"There are five pairs of spines on the ventral surface of the segment, and six on the dorsal. Those at the base of the median lobes are very small; the others are conspicuous. The second and third spines of each surface are situated just laterad of the second and third lobes respectively; in each case the dorsal spine is slightly mesad of that on the ventral surface. The fourth spine of the ventral surface is on the penultimate lobe of the thickened lateral margin. The fifth spine of this surface is near the anterior end of the thickened part of that margin. The fourth and fifth spines of the dorsal surface are in each case mesad of the corresponding spines of the ventral surface. There is also a spine on the dorsal side, very near the penultimate segment.

"The scale of the female is very dark gray, agreeing in color with the bark to which it is attached; the protuberance indicating the position of the exuviæ is marked with a white dot and concentric ring (Fig. 9); in rubbed specimens this protuberance is smooth and black, in all cases the remainder of the surface of the scale is rough. The scale is very convex; the exuviæ are usually between the center and one side. The ventral scale is well developed, especially at the margin, where it is much thickened and is dark colored; the central part is white and adheres to the bark, while the thickened margin is easily removed as a ring. Diameter of scale, 1.5 mm. (.06 inch)." (Comstock.)

DESCRIPTION OF MALE STAGES

First stage. The scale covering is similar to the adult male scale covering and measures 1.0 mm. ($\frac{1}{25}$ in.) in length by .750 mm. ($\frac{1}{32}$ in.) in width. The insect is more elongate than that of the female (Fig. 5) and measures about .325 mm. in width and .451 mm. in length; otherwisewise it is similar to the female second stage.

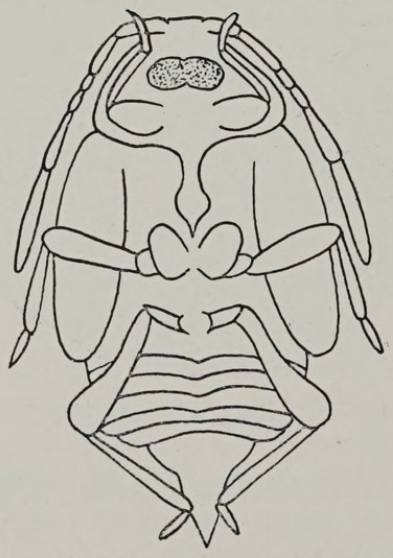

Fig. 10. Pupa of gloomy scale.

The *pro-pupa* (Fig. 5) measures about .577 mm. in length and about .420 mm. in width. The color is strong chitin yellow. The general

shape of the body is broadly triangular, with the head narrow. The antennæ, legs, and wings are developed as sack-like outgrowths of the body.

The *pupa* is pale chitin yellow in color, with the legs, wing pads, antennæ, and style well developed (Fig. 10). The antennæ reach to almost the base of the abdomen. The forelegs are folded forward, with the tips of the tarsi reaching the base of the antennæ. The femora of the middle legs project laterad and the tarsi are bent toward the end of the abdomen. The hind femora project backwards, with the tarsi bent at almost right angles. The style is short, measuring about .10 mm. in length.

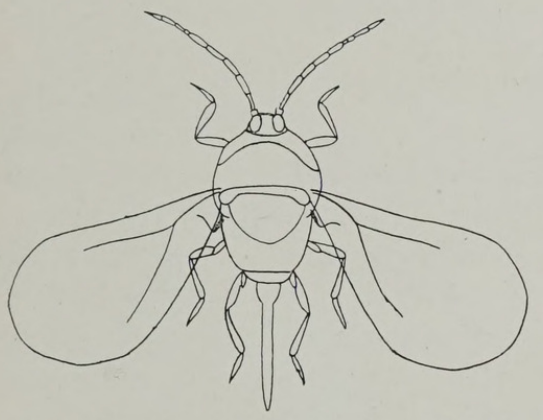

FIG. 11. Adult male gloomy scale.

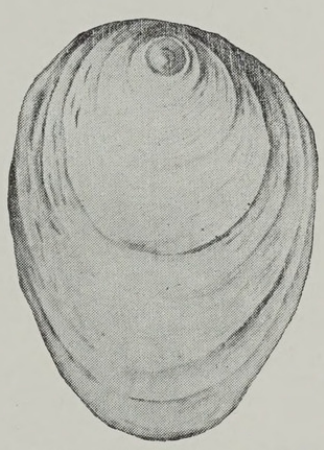

FIG. 12. Dorsal scale of male gloomy scale.

The *adult male* is a strong chitin yellow in color, with head and eyes darker (Fig. 11); the wing expanse is about 1.60 mm.; length of body, including the style, .75 mm.; style long and slender, about .24 mm. long; the antennæ are as long as the body, ten-jointed; basal joint short, scarcely half as long as second; second, third, and fourth sub-equal, which are one-half longer than fifth and sixth; seventh and eighth half as long as fifth; ninth as long as seventh and eighth together, broader; tenth about three-fourths as long as ninth, gradually tapering to a fine point. The antennæ are covered with short, sparse hairs. The head is small, with the lateral eyes situated just laterad to the antennæ; the diameter of the ventral eyes is about twice that of the lateral eyes. The prothorax is crescent shaped, about one-third as long on the middle as the mesothorax. The thoracic band is brownish in color and rather broad. The metathorax is about one and a half times as long as mesothorax and considerably inflated. The abdomen is flat and expanded.

The scale of the male (Fig. 12) is broadly oval in outline, of the same color as the female scale, and measures about .910 mm. in length and about .0680 mm. in breadth at the broadest part. The larval skin is near the anterior end. The ventral scale is white, with the margins darker and somewhat thicker.

HABITS OF THE MALE

After the male scale has reached the adult condition it remains under the scale covering for several days in the perfect state before it emerges. After the insect emerges from the scale it stretches its legs and expands its wings and generally deports itself like a person aroused from a sound sleep. Afterwards it walks about over the twigs, searching for suitable females. It taps the female scale covering with its antennæ and seems to be able to locate desirable mates in this manner. The males do not fly away from the place where they emerged and mate with distant females, as described by Quayle for the Red Scale, but they seem to mate with the first suitable female. In our cages the males have always died after mating only once. This can hardly be the rule in nature, however, for the proportions of females to males seem to be about two to one.

NATURE OF THE DAMAGE

The gloomy scale injures the tree by sucking the sap from the trunk, limbs, and branches. This sap carries the mineral foods and water from the soil through the roots, trunk, limbs and branches to the leaves, where it is manufactured into complex substances which are used by the tree in forming new growth, new leaves, seeds, etc. Now we can kill a tree by girdling it, that is, by cutting out a ring of bark all the way round the trunk. Thus we cut the flow of sap from roots to leaves. The gloomy scale has the same effect as girdling, by sucking the sap. A few insects will not hurt the tree appreciably, but if they become numerous enough they will kill small twigs or branches. If still more numerous, they may kill the tree outright.

The first signs of the injury of a tree by the gloomy scale is that small twigs die. These are perhaps most noticeable early in the spring when the leaves are putting out. As the attack progresses, larger limbs die, and the tree has the appearance shown in Fig. 13. That is, instead of the head being thick and dense, it is very thin. About this same time the tree commences to throw out suckers around the base. Trees apparently linger in this condition for years if other conditions are favorable, but in this stage they readily succumb to slight mechanical injuries to roots, trunk, or larger branches. In other words, the tree may have vitality enough to exist, but not enough to stand any additional shock.

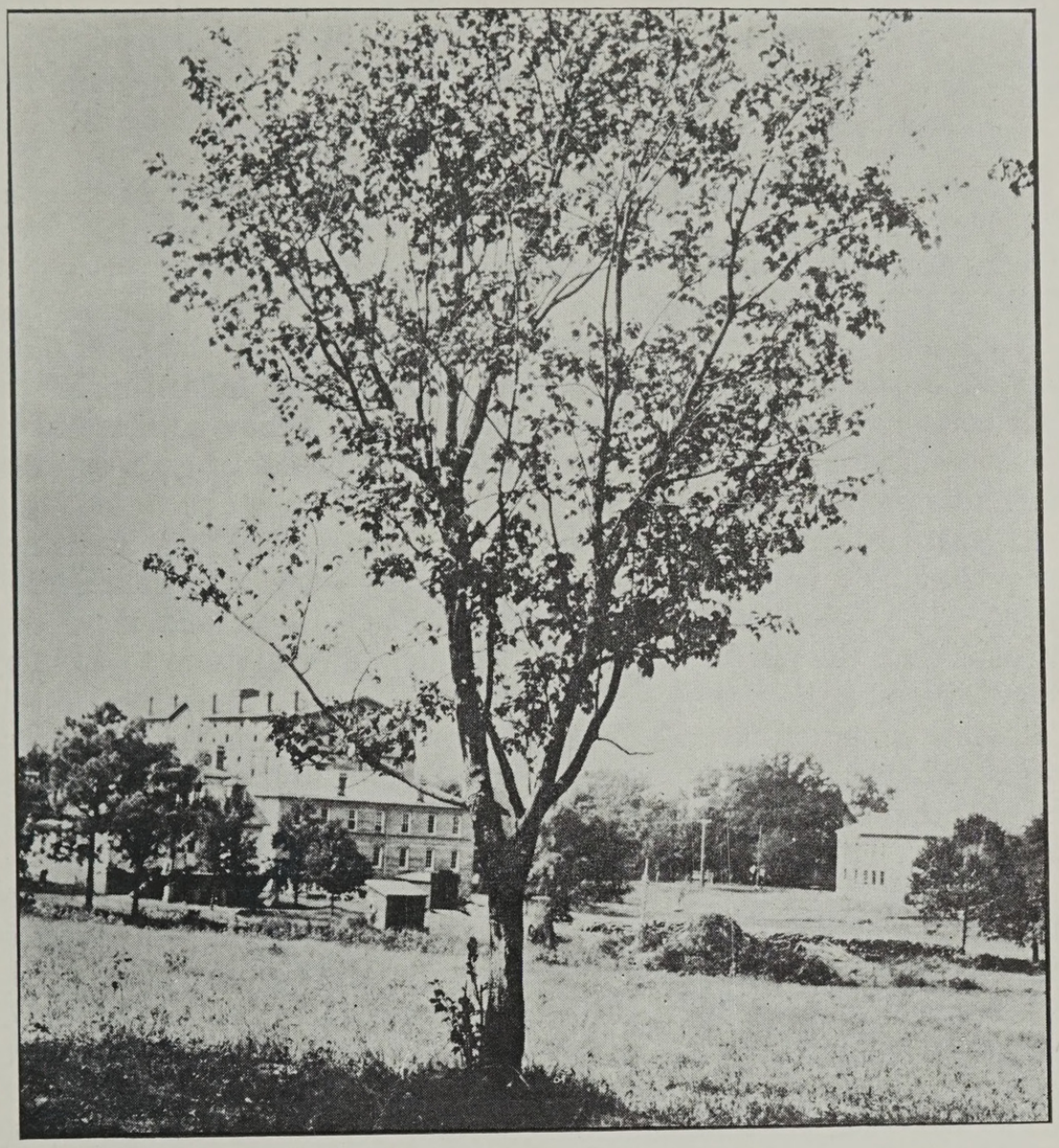

FIG. 13. Soft maple badly infested with gloomy scale.

HOW THE INSECT IS SPREAD

There are two factors in the spread of this insect: the spread from place to place, and the spread from tree to tree. The gloomy scale is so generally distributed in eastern North Carolina that the spread from place to place is not of so very much importance. However, it seems to take place chiefly through the nurseries. Nurserymen try to keep this pest in control, but it is of course a rather difficult matter to control them absolutely. And a single live insect would soon increase to such an extent that the pest would seriously injure the tree.

The spread from tree to tree may take place in a number of different ways. The active young may crawl from the limb of one tree to the limb of another if the limbs interlace. They may be blown from one tree to another, as they are very small and light. The young scale may

also be carried from one tree to another on the legs and feet of birds, although this method must be rather rare. On the whole, the insect must rely principally upon favorable winds to spread it from tree to tree.

ENEMIES

The gloomy scale is subjected to the attacks of a number of enemies, the chief one being a small parasitic wasp which attacks the young females during midsummer especially. This insect is perhaps the chief check on this pest, although there are a number of other parasites that prey upon it. It is very difficult to appreciate the good that these parasites do, because they are so small and their work is hidden under the scale covering. The work of these minute insects may be detected by the neat circular holes which they cut through the dorsal scale covering in making their escape.

At least two species of lady beetles, the twice-stabbed laby beetle and the pitiful lady beetle, prey upon the gloomy scale to a considerable extent. The twice-stabbed lady beetle is much larger and more conspicuous than the pitiful lady beetle, but the latter appears to do more towards keeping the gloomy scale in control.

Another group of enemies of the gloomy scale are certain predaceous mites. These mites seem to be more scavengers than predaceous enemies, but on occasions they have been observed attacking the living scale insects.

Still another enemy of the gloomy scale is the so-called red-headed fungus. This disease is always apparent on trees that are badly infested with the gloomy scale, and not infrequently it is accused of being the real source of the trees' troubles. This disease does not appear to be of much value in checking the ravages of the gloomy scale, for it seems to attack the old exhausted females principally. It is usually more prevalent on the trunk and larger branches of the tree, where the scale insect cannot do as much damage as they do on the smaller branches.

CONTROL

Preventatives. Obviously the preventative to be used against the gloomy scale is to plant trees that are not usually attacked by this insect. The hard maples and the oaks are good shade trees and highly resistant to this pest and to most others. Objections are usually raised to these trees, however, because they grow so much slower than the soft maples; but when we take into consideration the effects of these insects, little seems to be gained, for the persistent attacks of the gloomy scale usually stunt soft maples so much that in the long run they do not make as satisfactory growth as the hard maples (Fig. 4). When we take into consideration, also, that the soft maples are more subject to other diseases, and that they are also more subject to damage during storms, and that limbs are more apt to be split off by heavy snows, we can readily see that there is very little use to plant soft maples. Since nurserymen are not always careful to send hard maples when they are ordered, the

bud characters of the common hard and soft maples are shown in Fig. 14. By comparing the end buds of maple trees before they are set with these figures, any one can determine whether a maple is a hard maple or a soft maple, and all soft maples can be discarded.

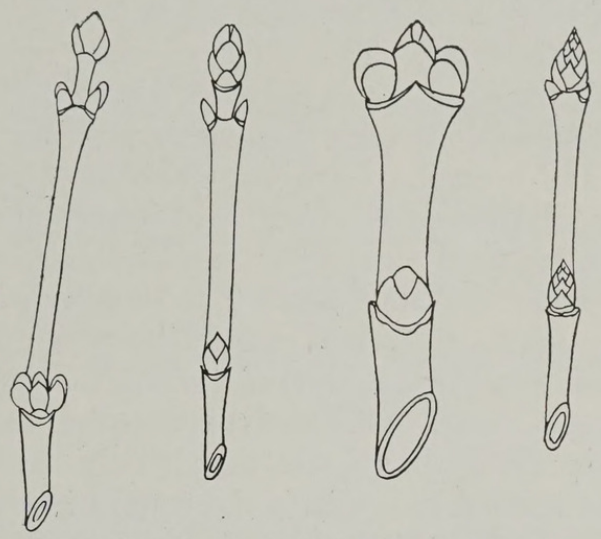

FIG. 14. Terminal buds of hard and soft maples.
A, Red maple; *B*, Silver maple; *C*, Norway maple; *D*, Sugar maple.

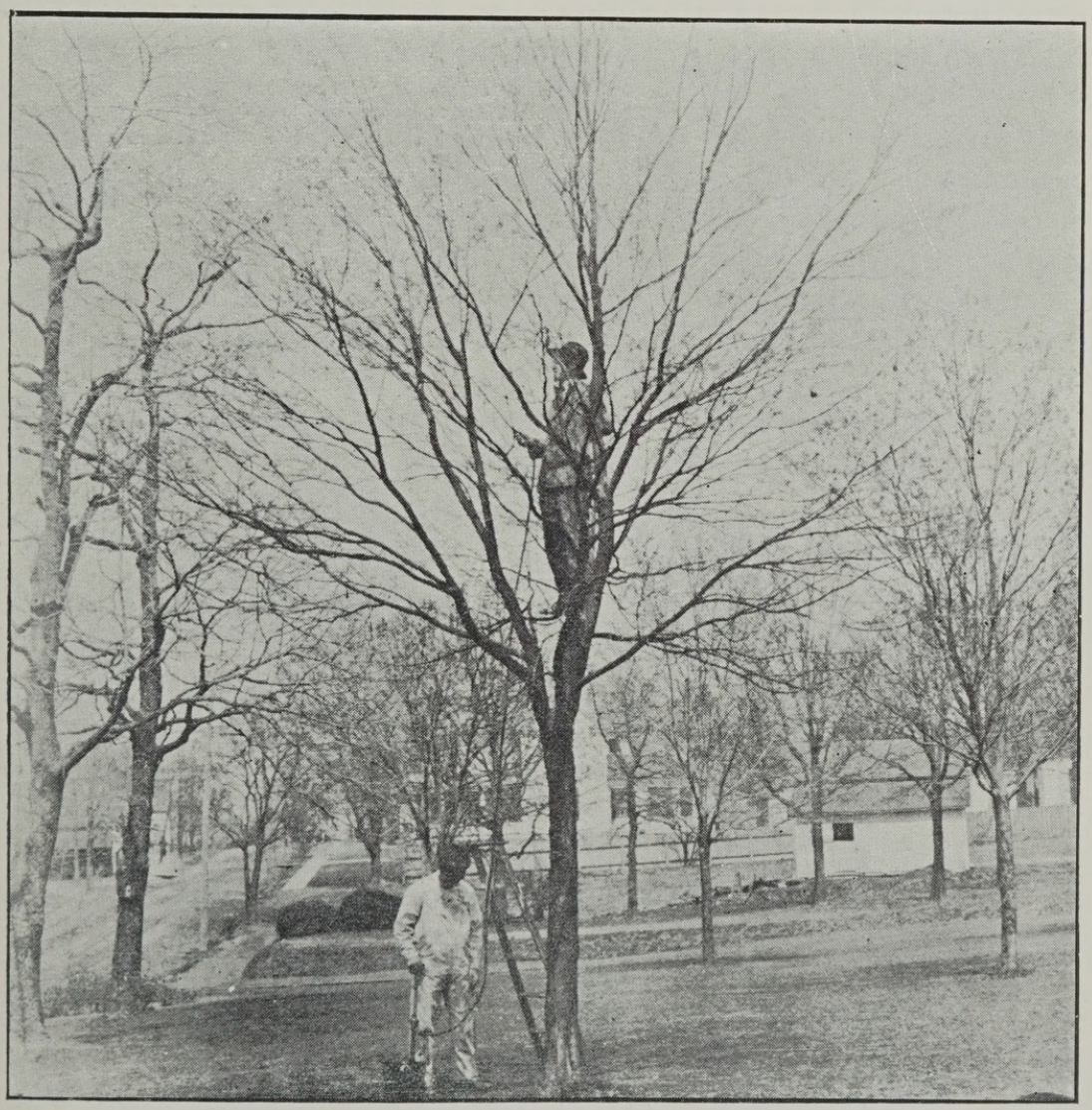

FIG. 15. A method of spraying small trees with a small sprayer.

Remedies. The standard remedy for the gloomy scale is to spray the trees thoroughly (Fig. 15) once each year, either late in the winter or early in the spring, with a mixture composed of one gallon soluble oil to eight to ten gallons of water. The soluble oils, which are sold under a variety of trade names, are heavy oils that make a milky emulsion when mixed with water. This mixture when sprayed on the trees kills only the scale insects that it touches, hence it is necessary that spraying of this kind be done very thoroughly and that care be taken to cover every limb and branch. Care must also be taken not to get any more of the spray mixture on the trees than is absolutely necessary, for oil injury has been reported on sprayed maples in other states, although it has never been noted in this State. The number of times it will be necessary to spray maple trees will depend upon a number of factors, chief among which are the amount of infestation and the care with which the spraying is done. Obviously a tree that is heavily infested will require more spraying than a tree that is only lightly infested. On the other hand, one careful spraying is the equal of two or more careless sprayings. Hence we set a standard of one spraying each year, and departures can be made from this standard as the case seems to demand.

Sprayings with strong oil solutions can be made only during the dormant life of the tree, that is, from the time the leaves are shed in the fall until the buds commence to swell in the spring. Apparently, scale insects are more susceptible early in the spring just at the time the buds are commencing to swell, and this is the most effective time for spraying. Summer sprayings are not successful against this pest because mixtures strong enough to kill the adults cannot be used without injuring the trees and the young are produced over such a long period that no remedy can be used against them successfully. Scraping, painting or whitewashing or scrubbing the trunks and larger limbs of infested trees is of very doubtful value, for the insects occur on the smaller limbs and branches in such numbers as to seriously damage the trees.

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