

## THE AIRPLANE IN CATALPA SPHINX CONTROL

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The catalpa tree, growing under Ohio conditions, is subject to the depredations of two destructive insect foes, which are a very decisive factor in limiting the value of this species for forestry purposes. The first of these pests is a small gnat-like fly, the catalpa midge<sup>1</sup>, whose larvae cause the withering of the growing tips of the branches and a spotting of the foliage. The second is the catalpa sphinx<sup>2</sup>, whose larvae, by reason of their size and voracious feeding habit, cause wholesale destruction of the foliage and sometimes, when present in sufficiently large numbers, the death of entire groves.



Fig. 5.—The pupa of the catalpa sphinx in its earthen cell in the soil



Fig. 6.—The adult or parent moth of the catalpa sphinx resting on the trunk of a catalpa. About 1½ natural size

The outbreaks of the catalpa sphinx are intermittent and vary in intensity. Quite frequently a period of years will elapse and little will be seen of the insect, then suddenly the pest will appear in large numbers and an entire grove will be stripped as if by magic. What probably happens in the case of these apparently sudden outbreaks is that the scourge, gradually develops

<sup>1</sup>*Itonida catalpae* Comstock.

<sup>2</sup>*Ceratonia catalpae* Bois.



for two or three years without the presence of the caterpillars being noticed, then, by reason of the fact that each mother moth is capable of laying 300 eggs or more, a comparatively insignificant number of the insects may serve as a basis for a brood of destructive proportions.

This seems to have been the case in the grove of H. B. Carver at Troy, Ohio, during the summer of 1921 when the insects appeared in June in sufficient numbers to defoliate the entire planting.

#### DESCRIPTION AND LIFE HISTORY OF THE CATALPA SPHINX

The successive stages of the life history of the catalpa sphinx are shown in the accompanying photographs. Fig. 6 shows the gray moth resting on the trunk of a catalpa tree and demonstrates the excellent protective resemblance which aids the insect in avoiding its enemies. When the wings are expanded it measures about three inches across from tip to tip.

The eggs, Fig. 7, are deposited in masses on the underside of catalpa leaves and are of a beautiful iridescent yellowish-green.

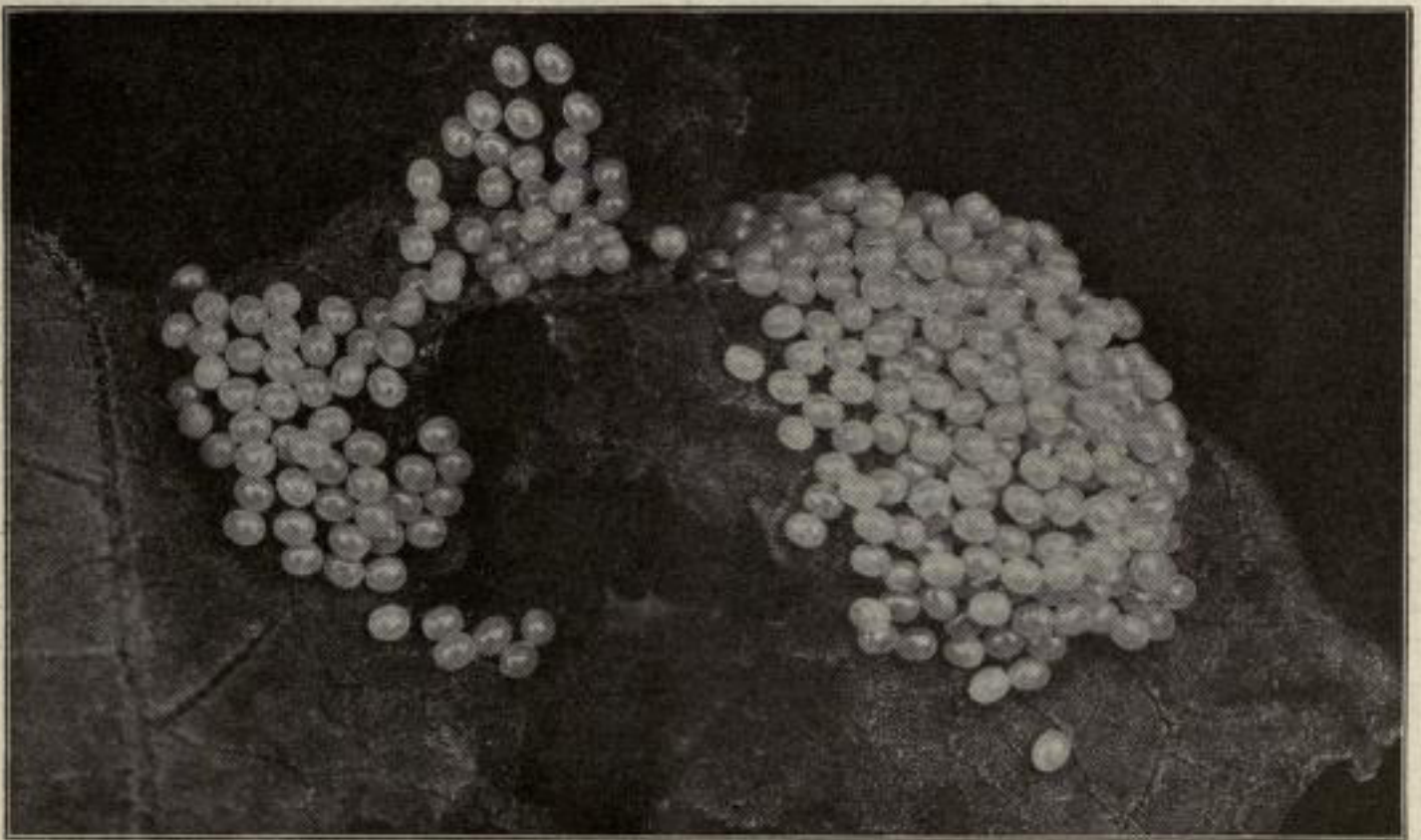


Fig. 7.—The eggs of the catalpa sphinx much enlarged

The larva, Fig. 8, is of the usual horn-worm type, striped with yellowish-green and black, and when mature measures about three inches in length.

The pupa, Fig. 5, is chocolate-brown in color and is found in an earthen cell two or three inches beneath the surface of the soil.



After passing the winter in the soil in the pupal stage, the moths appear well after the foliage is formed and deposit their eggs. Within a short time the eggs hatch and the caterpillars begin feeding. After reaching maturity they pass to the soil and change to the pupal stage, which in turn gives rise to another generation of moths.

About a month is required for the insect to pass through the four stages and during normal seasons, it is believed there are but two generations of the insect each year in Ohio, but during the season of 1921, three full broods appeared.

#### THE USE OF THE AIRPLANE IN DISTRIBUTING POISON ON TALL TREES

Early in the spring of 1921, Mr. C. R. Neillie, now acting City Forester of Cleveland, suggested to the writer that the airplane might be used advantageously as a means of distributing poison on tall trees and asked that if the opportunity presented itself that the method be given a trial.

Overtures were made to the Air Service of the Federal War Department for co-operation in the project and the arrangements were well under way when the outbreak of catalpa sphinx appeared at Troy and offered an immediate and convenient opportunity for making the experiment.

Through the hearty co-operation of the officials of McCook Field, Dayton, Ohio, specific plans were made for conducting the test. And in this connection the writer wishes to place on record the appreciation of the Experiment Station to those officials most concerned in the project, Major T. H. Bane, Director of McCook Field; Maj. H. S. Martin, Chief of the Engineering Division, and his assistant, Mr. M. Dormoy, who designed the hopper and operated it during the trials; Lieut. J. A. Macready, chief of the flying section, who piloted the plane; and Capt. A. W. Stevens, who photographed the dusting plane in action.

The value of the photographic record obtained by Captain Stevens scarcely can be overestimated, since it depicts in a manner beyond the power of the printed or spoken word to describe just what happened when the poison powder was released from the plane.

#### DESCRIPTION OF THE CATALPA GROVE UNDER TREATMENT

The grove under treatment belonged to H. B. Carver and was located about 4 miles west of Troy, Ohio. It was a level, rectangular plot 800 x 325 feet and contained about six acres. The trees,



4,815 in number, were planted twelve years ago for the growing of post and pole timber. During that time growth had been satisfactory, the trees having reached a height of from 25 to 30 feet and averaging better than a post and a half per tree.

#### CONDITION OF THE INSECT UNDER TREATMENT

On June 30, 1921, when the writer first viewed the outbreak of the catalpa sphinx in the Carver grove, the first brood of caterpillars was just reaching maturity and the trees were practically devoid of foliage. During the month of July the trees developed a second crop of foliage by the time the second brood of caterpillars appeared.

The Engineering Division of McCook Field made all possible haste to devise and manufacture a poison distributor and equip a plane with it, but these arrangements were not completed until August 2. By that time the brood of worms was about mature. Indeed, by the following day when the work was done, some had passed to the soil and were in the process of transforming to the pupal stage. Thus these were secure from the effects of the poison treatment of the foliage above. There remained on the leaves, however, countless thousands of the larvae. Had it been possible to do the work just a few days sooner, it doubtless would have made a vast difference in the later behavior of the trees. This point will be considered more fully later on in the discussion.

So plentiful were the numbers of this second brood of caterpillars that about 75 percent of the foliage had been destroyed by

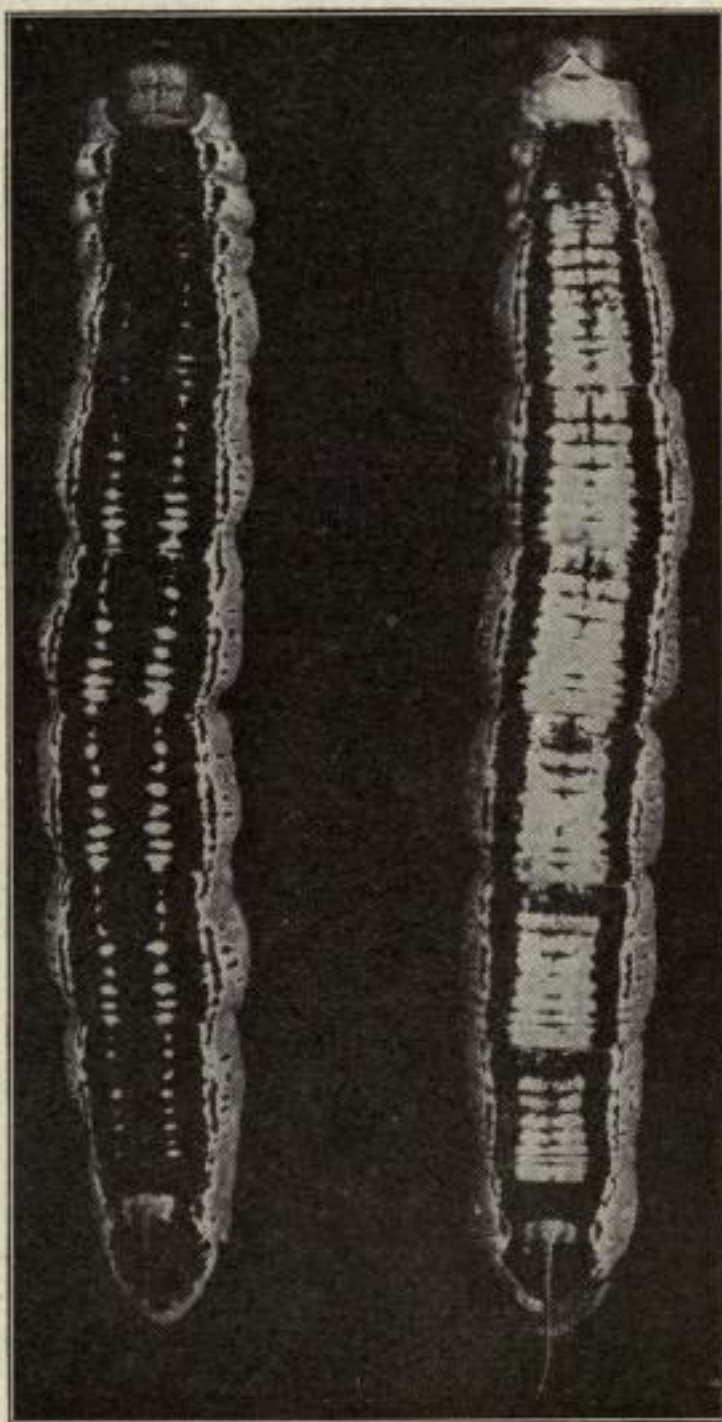


Fig. 8.—The dark and light forms of the catalpa sphinx larva. Slightly enlarged



the time the grove was dusted and, beyond any reasonable doubt, every vestige of foliage would have been consumed had the worms been permitted to continue unchecked.

#### ARSENATE OF LEAD POWDER USED

Because of the distinct limitations in both bulk and weight which accompany the aerial distribution of poisons, the undiluted arsenate of lead powder was used. It is customary in applying the poison in dust form to mix it with lime or some other carrier in proportions varying from 10 to 25 percent of the poison to the dilutant, the reason for this being lodged in the belief that by using a carrier, a two-fold benefit is derived—economy of material and evenness of distribution.

#### DESCRIPTION OF APPARATUS

The plane used was a Curtiss JN-6. The hopper for carrying and distributing the powder was attached to the right side of the passenger cockpit, and consisted of an irregularly shaped flat metal box of about 32 gallons capacity—sufficient to hold a little more than 100 pounds of arsenate of lead powder. See Fig. 10. At the top was a hinged cover for filling and near the bottom was an aperture, 7 x 9 inches, which could be opened and closed by means of a push and pull rod. Located at the bottom of the hopper was a revolving vane connected by a sprocket wheel and chain to a crank at the top, which could be operated by hand by a person in the observer's cockpit. When the gate was opened and the liberating mechanism revolved, the powder was released from the bottom of the hopper in an even stream much after the manner that grain is released by a grain drill.

It will be observed that no blower or fan such as is commonly used in dusting apparatus was used in this machine. The sole requirement of the mechanism was that the powder be released in a steady flow. A glance at the installation, however, will reveal the fact that upon its release from the hopper, the powder was introduced into the "slip stream", the violent air current set up by the moving propeller, and by this tremendous force was thrown out behind the moving plane in a violently swirling mass, which floated out in a beautiful trail to mark the path of the moving plane. As shown by the flying pictures the impetus of this force persisted for several seconds.





Fig. 9.—Lieut. J. A. Macready (right) who piloted the plane and Mr. E. Dormoy (left) who designed the hopper and operated it during the flight

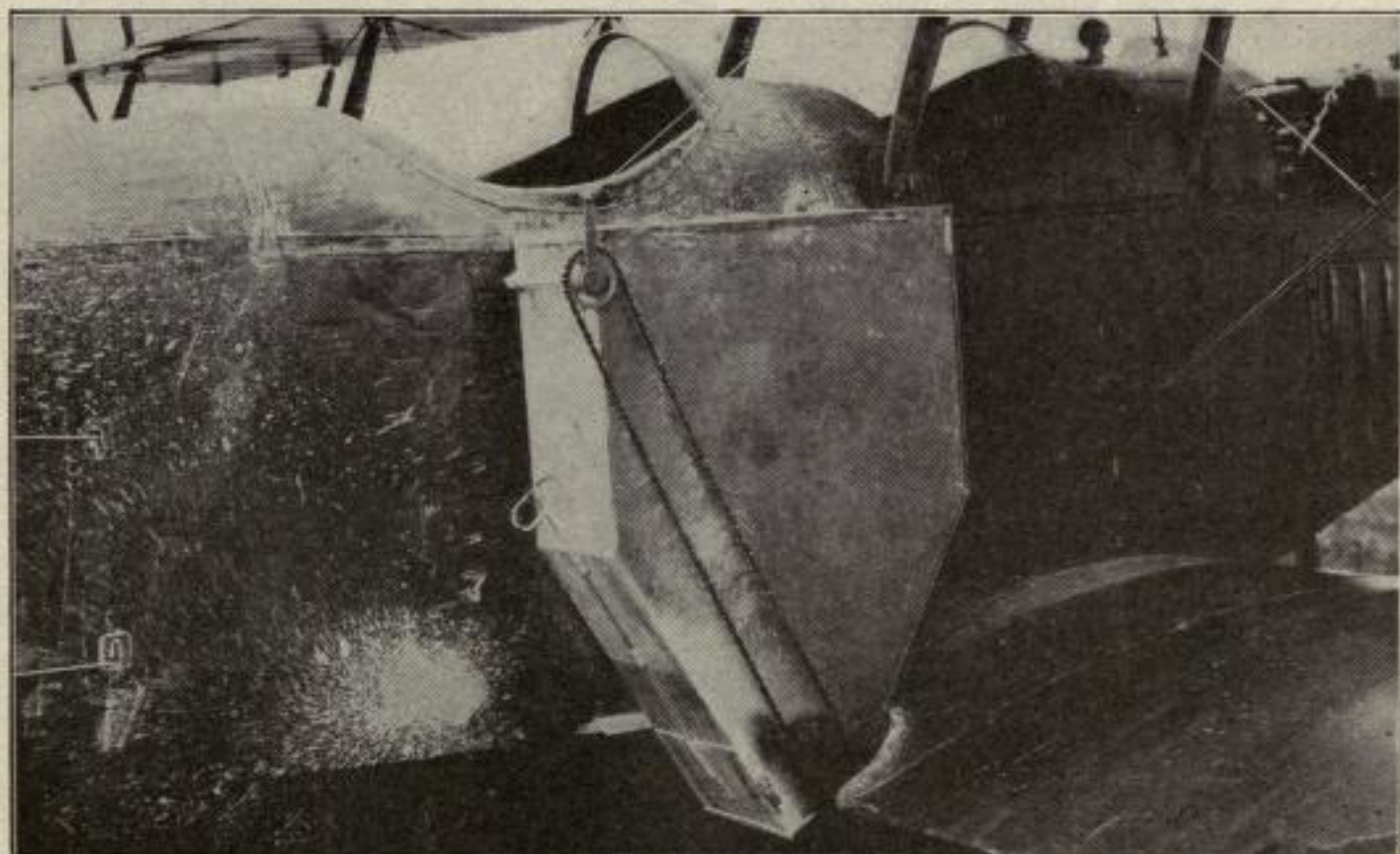


Fig. 10.—The hopper for carrying and distributing the poison, secured to the side of the fusilage and opposite the passenger cockpit



## DETAILS OF APPLYING THE DUST

The dusting plane left McCook Field shortly after noon on August 3, 1921, and flew to a previously selected landing field about a mile and a quarter distant from the grove to be treated. There the hopper was filled and the work of applying the dust began.

The meteorological conditions were ideal. The sunlight was excellent for photographing, and a steady wind, estimated at about 11 miles an hour, was blowing in the direction indicated by the arrows in the photographic record of flight. The dusting plane traveled at the rate of 80 miles an hour, and as shown by the photographs, flew along the windward side and parallel to the grove rather than over the trees. Six flights were made past the grove, the plane taking the same path for each passage, which was about 53 yards to the windward. The altitude varied from 20 to 35 feet.

The poison trail was controlled for a few seconds after leaving the plane by the impetus of the "slip stream", but this was soon lost, and the steadily moving wind grasped the poison cloud and carried it, as a wartime barrage, toward the caterpillar-infested grove. When the dust reached the grove, a new influence or force was observed to be at work, for it was noted that air currents were rising from among the trees and the influence of these rising currents, combined with the steady push of the wind was sufficient to carry the poison cloud to all parts of the grove, and even beyond, since some dust settled in a corn field as much as 500 feet to the leeward of the last row of trees.

Each flight past the grove required 9 seconds and, since six flights in all were made, the total time consumed in the act of liberating the dust was 54 seconds. To have done the same amount of work with a liquid sprayer would have required many hours.

The total amount of lead used was 175 pounds. In all probability this was more than was actually necessary.

After the final passage of the plane, a critical examination of the foliage in all parts of the grove was made. Not a catalpa leaf could be found anywhere which did not bear particles of arsenate of lead in sufficient quantity to constitute a killing dose.

The most gratifying phase of the act of applying the dust was the excellent distribution obtained and the remarkable manner in which it could be controlled and thus deposited where intended. By correlating altitude, wind currents, etc., the behavior of the



dust can be fairly estimated. After this is done a "trial puff" of the powder can be made and the "range" secured. Using the trial puff as a basis for correction the actual work of dusting can be begun with a fair degree of confidence that the cloud will settle where desired.

#### THE EFFECT ON THE CATERPILLARS

The morning following the application of the dust some dead caterpillars were to be found in the grove and many were ailing. Forty-six hours after the poison was applied evidence of the wholesale slaughter of the insects was apparent on every hand. Every part of the grove was literally polluted by the dead and dying larvae. Their bodies were hanging in every conceivable position on the trunks, branches, and foliage of the trees, fence posts, and weeds; and they were lying in the greatest profusion on the refuse of the forest floor; while still others had sought seclusion beneath fallen leaves, twigs, etc. Not a single step could be taken without crushing numbers of them.

The large as well as the small caterpillars were killed. Previous to the test it was feared that the full grown horn-worms might be able to withstand the treatment, since it is well known that the large horn-worms are rather difficult to kill.

The most careful and painstaking observations indicated that the poison had destroyed at least 99 percent of the caterpillars present at the time of its application. Unfortunately, however, as indicated previously, some individuals of the caterpillar brood had already passed into the soil and pupated when the work of dusting was done. These formed the basis for a third brood of worms which appeared in September and again defoliated the grove.

The effect on the trees of the two complete defoliations in June and September and the 75 percent defoliation of July coupled with the rigors of an abnormally dry summer proved fatal to many trees and the grove is being cut for market at this time. Had it been possible to have made the application of dusting a week earlier, much of the second crop of foliage would have been preserved and it seems reasonable to believe that the numbers of the third brood of caterpillars would have been greatly lessened. The writer confidently believes that if it had been possible to give the trees this bit of assistance they would have emerged from their experience with the caterpillars with sufficient vitality to leaf out this spring and continue growing.



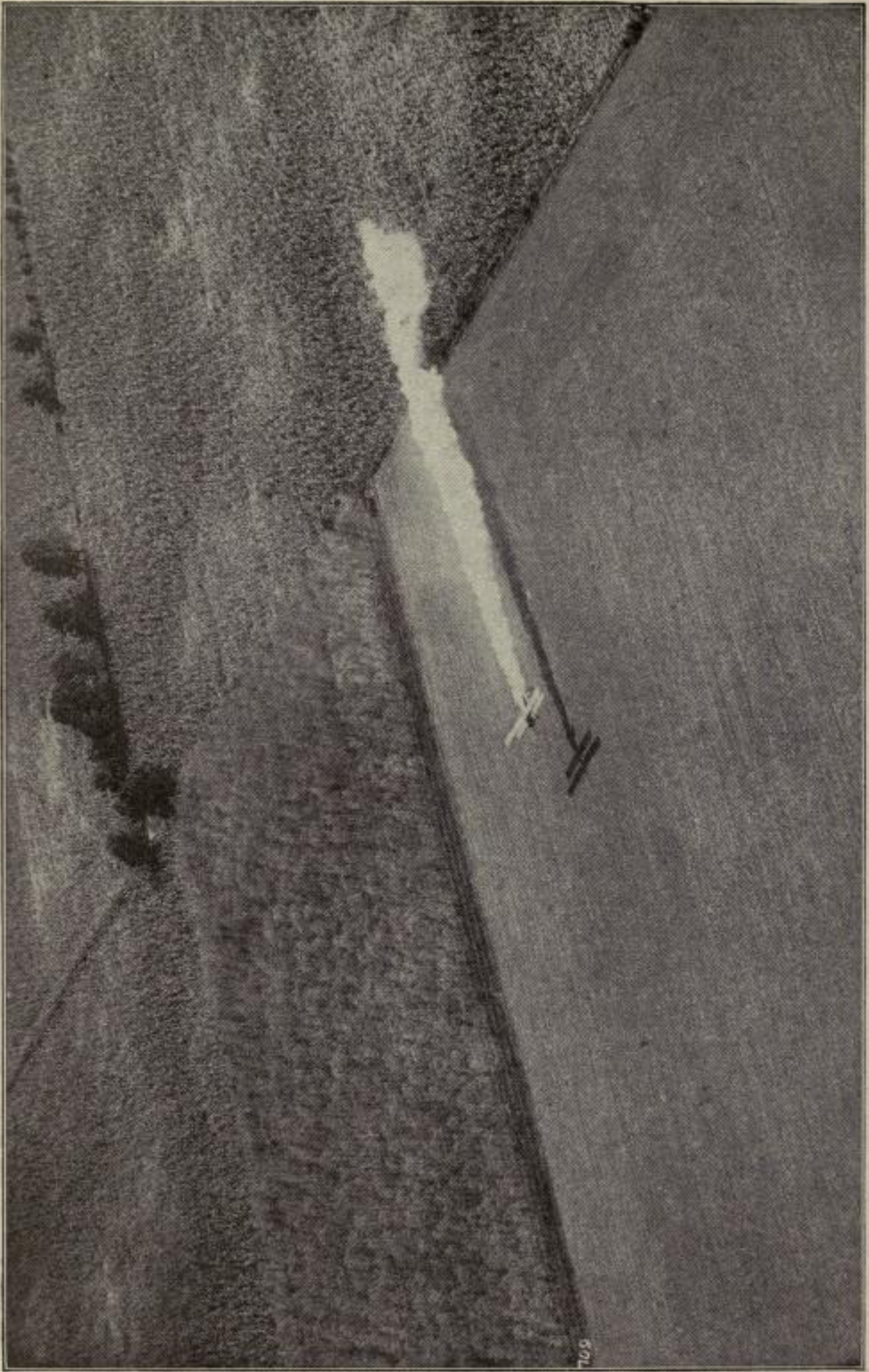


Fig. 11.—In the operation of applying the dust the plane flew at an altitude of from 20 to 35 feet in a path parallel to and 53 yards to the windward of the grove





Fig. 12.—After the dust was liberated it was floated through the grove by a wind varying from 8 to 11 miles per hour. Every leaf was covered with the poison





**Fig. 13.—The condition of the Carver grove,  
June 30, 1921, after the first brood  
of caterpillars had defoliated it**