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# The University of the State of New York

## New York State Museum

JOHN M. CLARKE, Director
EPHRAIM PORTER FELT, State Entomologist



# 31st REPORT OF THE STATE ENTOMOLOGIST

ON

# INJURIOUS AND OTHER INSECTS

OF THE

# STATE OF NEW YORK

1915



ALBANY
THE UNIVERSITY OF THE STATE OF NEW YORK
1916

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*The University of the State of New York*
*Science Department, December 18, 1915*

*Dr John H. Finley*
*President of the University*

SIR: I have the honor to transmit herewith and to recommend for publication as a bulletin of the State Museum, the annual report of the State Entomologist for the year ending September 30, 1915.

Very respectfully
JOHN M. CLARKE
*Director*

THE UNIVERSITY OF THE STATE OF NEW YORK
OFFICE OF THE PRESIDENT

*Approved for publication this 3d day of January 1916*

*President of the University*

# New York State Museum Bulletin

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## The University of the State of New York

### New York State Museum

John M. Clarke, Director

Ephraim Porter Felt, State Entomologist

## 31st REPORT OF THE STATE ENTOMOLOGIST 1915

*Dr John M. Clarke, Director of the State Museum*

I have the honor to present herewith my report on the injurious and other insects of the State of New York for the year ending September 30, 1915.

The depredations of the apple tent caterpillar and the forest tent caterpillar, so evident the last two years, were continued the past season, though severely infested localities were more restricted than in earlier years. Popular warning notices were sent early to the press. On Long Island in particular, a power spraying outfit was used most successfully, though the large areas of oak infested made it impossible to cover all satisfactorily with the equipment available.

There was an unusual and entirely unexpected outbreak of the cherry leaf beetle, Galerucella cavicollis Lec., a small, reddish brown insect which appeared in immense numbers in widely scattered localities and caused considerable apprehension because of its feeding upon cherry and peach tree foliage, though in most instances the damage was comparatively insignificant.

**Oil injuries.** The unfortunate developments following the application of oils or oily compounds to the bark of deciduous trees has again come to our attention, and in one locality was followed by serious injury to forest trees. Experimental tests with this compound upon small forest trees, under normal conditions, resulted in the death, within six months, of six out of ten, while the remaining four showed evidence of injury which may be followed by death another season. Details of this work are given in the body of the report.

**Fruit tree insects.** Practical work with the codling moth was conducted the past season in cooperation with the bureaus of farmers' institutes and of horticulture of the State Department of Agriculture and the Monroe County Farm Bureau. These studies, conducted in three commercial orchards in western New York, showed first of all a marked discrepancy between the habits of the insect in portions of the western part of the State, as compared with the Hudson valley. The cool evening temperatures prevailing near Lake Ontario at about the time the moths appear result, in some seasons at least, in a delayed deposition of eggs and a very high percentage of side injury caused by the young codling moth larva entering the smooth surface of the fruit and then, in many instances, migrating to the blossom end. This characteristic blemish affected 20 per cent or more of the yield in some cases. The data obtained emphasize the great importance of the spraying given just after the blossoms fall, and also the advisability in sections where this injury is prevalent, of making annual applications whether the trees be fruiting or not. Furthermore, the second spraying ordinarily advised for the codling moth, namely about two weeks after the first, would probably be more effective in reducing this side injury if it were made the latter part of June. The general prevalence of apple scab in this section amply justifies three sprayings after the blossoms drop, even though the latter two are not necessary for the control of insect pests. A detailed account of the work is given in the body of the report.

**Leaf roller.** Investigations made in connection with the above-named codling moth work showed this insect to be generally distributed and frequently very abundant in apple orchards of western New York. Furthermore, the data obtained when classifying the fruit for codling moth work indicated very little reduction in leaf roller injury as a result of any of the poisoned applications made after the blossoms fell. The injury by this insect in the Hudson valley is much less and, generally speaking, is almost negligible. An exhaustive study of this species is being made by our colleague, Prof. G. W. Herrick, and there is therefore no necessity for giving more attention to this species at the present time.

**Green fruit worm.** These characteristic leaf and small fruit eaters were somewhat abundant in western New York and less so in Hudson valley orchards, the damage apparently not equaling that caused by the leaf rollers.

**San José scale** has been less abundant in some Hudson valley orchards than in earlier years, though this does not appear to be

equally true of the western part of the State. Examinations in several infested and unsprayed orchards in the town of Schodack show a decrease in the infestation compared with that of two years ago. The reduction is probably attributable in large measure to the activities of various small parasites. The condition of most of these infested trees, however, is not entirely satisfactory, and although the damage resulting from scale infestation is much less, we do not consider that this justifies the abandonment of dormant applications for the control of this pest.

**Apple maggot,** generally known in New England as the railroad worm on account of the irregular, brown, sometimes rotting channels caused by the maggots in the flesh or pulp of the fruit, is becoming locally abundant in some fruit-growing sections in the Hudson valley. The attention of the Entomologist was called to some very badly infested trees this season and it is evident, should this condition continue, that active, repressive measures must be adopted for the control of the pest.

**Red bugs.** The two red bugs, as shown by more extended observations the past season, are both widely distributed in the Hudson valley, and where unchecked have frequently seriously damaged the apple crop. The lined red bug appears to be more numerous though the other species is sometimes abundant. Practical work during the past summer has demonstrated the efficacy of a tobacco application just before the blossoms open.

**Pear thrips.** The erratic and sometimes complete destruction of the pear crop by this new pest has continued here and there in the Hudson valley. It was especially serious the past season because an early and extremely warm period caught many growers unaware and gave the thrips an opportunity to enter the blossoms. This was followed by comparatively cool weather accompanied by a slow development of the leaves and flowers, a condition favorable for severe damage by insects which might have gained entrance to the buds during the warm weather. Observations show that this attack may be very sudden and trees apparently free from thrips one day may be infested by large numbers the next, this even occurring in orchards where the pest was practically unknown the preceding season.

**Pear psylla.** Serious injury by this insect has prevailed in some Hudson valley orchards, though the outbreaks were usually very limited and were, as shown by observations of the preceding year, frequently closely related to unusually favorable winter shelters, such as nearby brush heaps, fences or stone walls and their accompanying weedy growths.

The sinuate pear borer, another European insect which became established in New Jersey some years ago, is extending its range slowly in New York State and is already known in several localities. It is an extremely dangerous pest owing to its insidious method of work, because the larvae make numerous serpentine, interlacing galleries in the inner bark and outer sapwood, thus speedily destroying limbs or entire trees before there are marked, outward signs of the borer's presence.

**Gipsy moth.** An examination of conditions obtaining at Mount Kisco where an infestation of several years' standing was discovered in 1914, shows that very satisfactory work has been done in the control of the pest. The infested areas have been well cleaned, banded with tanglefoot and sprayed, and the outlying, unsprayed area banded with burlap for the purpose of catching any possible stray caterpillars. The great reduction in the infestation, as compared with conditions obtaining last year, is very gratifying, and if the work is continued along present lines the probabilities are excellent of eliminating this local infestation by an insect known to be a serious enemy of both orchard and forest trees.

**Grass and grain pests.** The extended grasshopper devastations of last year on the borders of the Adirondacks, especially in portions of Fulton, Saratoga and Warren counties, were continued, though the insects were present in much smaller numbers, especially in Fulton county where poisoned bait was used very effectively the preceding season. The Entomologist, cooperating with the State Department of Agriculture and the Saratoga County Farm Bureau, conducted a series of experiments for the destruction of young grasshoppers. It was found that while the poisoned, fruit-flavored bait, frequently known as the Kansas bait, would kill many of the grasshoppers, especially in sections where vegetation was sparse, that a sweetened solution of sodium arsenite was most effective in destroying young grasshoppers in fields where there was considerable vegetation, particularly in clover seedings. The work of the past two seasons has demonstrated beyond all question the practicability of controlling outbreaks of this character, even on individual farms, though cooperation in badly infested areas is extremely desirable. The details of this work are given on following pages.

The white grub outbreak of last season, predicted by the Entomologist the preceding fall and spring, was very serious in southern Rensselaer and northern Columbia counties in particular, though the damage was mitigated to a considerable extent by an unusually copious and well-distributed rainfall during the summer months.

Last fall and early in the spring the Entomologist sent out popular notices regarding these insects, giving directions for the location of badly infested areas and advising certain preventive measures. In spite of these warnings numerous farmers suffered unnecessary losses, either by allowing badly infested land to remain unplowed, or by planting potatoes, corn and other susceptible crops upon recently turned and seriously infested sod. The three-year life cycle of these insects makes it comparatively easy for a farmer to judge the probabilities of damage a year or two in advance.

Depredations by grass webworms have continued in Dutchess county, in one case a five acre field of corn near Pine Plains being destroyed by the insects. The work of these pests, as in the case of white grubs, can be avoided to a large extent by refraining from planting badly infested sod to susceptible crops such as corn. An effort has been made to interest several persons in the practical control of these insects and it is possible that grasslands can be effectively freed from the pests at a very moderate cost.

**Shade tree insects.** Injuries by the elm leaf beetle have not been particularly severe the past season, due in part presumably to low temperatures prevailing in June and thus delaying egg deposition, and also probably to the abundant rainfall which has enabled the trees to withstand successfully a considerable amount of leaf injury. Many of the insects completed their transformations successfully, and with favorable climatic conditions another season severe damage may result in localities where the trees suffered but little the past summer.

Other rather common shade tree pests such as the white-marked tussock moth, the false maple scale and the cottony maple scale, have attracted comparatively little attention the past season.

**Forest tree pests.** There has been continued injury by the hickory bark beetle in the vicinity of New York City and in other sections of the State though the insects do not appear to be so abundant and destructive as in earlier years. The general interest in the protection of forest trees, especially in the vicinity of New York City, has resulted in the cutting out of many dead and dying trees which has undoubtedly had a material influence in reducing the numbers of the pest. In this connection we have been able to rear large series of secondary forms occurring in dying and dead hickory trees.

The two-lined chestnut borer is continuing its nefarious work and destroying groups of oaks, especially in regions about New York City. Here, likewise, the prompt removal and destruction of infested trees is of considerable value in checking the pest.

The recently established bayonet or post-horn pine borer, an introduction from Europe, has come to our attention from several localities and bids fair to develop, unless kept under rigid control, into a serious enemy of our native pines.

Another pine twig borer, Dioryctria abietella Zinck., has been found working in the buds of Austrian pine at Rochester. It tunnels the young shoots and in some instances produces a deformation very similar to the species named above.

**Periodical cicada.** A scattering infestation of this interesting species was reported the past season from here and there in the Hudson valley, indicating a somewhat general and sparse distribution in this region, of a brood almost unknown heretofore north of the immediate vicinity of New York City.

**Flies and mosquitoes.** Interest in the control of the house fly and its associates has continued. The Entomologist has complied with a number of requests for information in regard to these insects and their control, a matter which has also received some attention through the State Department of Health.

The control of mosquitoes has been undertaken in cooperation with several local improvement associations, the most important being that in conjunction with the Sodus Point Improvement Association. The conditions in this locality are somewhat unusual, in that there are large areas of practically lake level swamps in the immediate vicinity of a summer resort, consequently draining or filling were out of the question, the former being impossible and the latter impractical on account of the great expense involved. Another peculiar feature was the occurrence of considerable areas of floating or nearly floating cat-tails and, as subsequent investigations showed, adapted to the breeding requirements of the irritating mosquito, a species remarkable because the larvae depend for their air supply upon that contained in the roots of various aquatic plants. The Entomologist advised the employment of a reliable person to work under his direction for the purpose of ascertaining the most important breeding places and their treatment with oil before there was an opportunity for the wrigglers to mature. Incidentally it was planned to make observations upon the mosquito fauna of the region for the reason that such exact biological data should be made the basis of future work. The results were very satisfactory from both the practical and scientific standpoint and are discussed in some detail on the following pages.

**Gall midges.** The past season has been marked by the discovery of the Chrysanthemum midge, Diarthronomyia hypogaea

H.Lw., in widely separated localities in the country. These European midges deposit their eggs upon the young growth and when abundant may produce such marked deformations as to render the plants practically valueless. Studies have been made of this insect and its habits and an extended account is given in the body of the report.

Our studies of the gall midges have been continued and a number of new species, mostly reared, and several new genera described. One of the more important papers relating to this group and published during the past year, appeared in the Proceedings of the United States National Museum and describes a number of exotic species and contains a revised tabulation for the separation of the genera in the Asphondyliariae.

**Lectures.** The Entomologist has delivered a number of lectures on insects, mostly economic species, before various agricultural and horticultural gatherings, some of them being in cooperation with the bureau of farmers' institutes or county farm bureau agents. Several lectures have also been given under the auspices of local improvement associations.

**Publications.** A number of brief, popular accounts regarding such common pests as the apple and forest tent caterpillars, pear thrips, white grubs, etc., have been widely circulated through the press. A list of the more important publications of the year is given in this report.

**Faunal studies.** The investigations along these lines have been continued and the manuscript list of the insects of the Adirondack region, based mostly upon material in the State collection, is nearly ready for publication. This list is a growing one, additions being constantly made thereto in connection with other work carried on within the limits of this faunal area, such as the study of grasshoppers noted above.

**Collections.** The assembling and preparation of the enlarged exhibit of insects has required much time and necessarily prevented very desirable work in the arrangement and classification of the reference collections. Additions to these latter are constantly being made, especially of specimens representing the early stages and work of various injurious forms, since biological material of this character greatly facilitates identification of the different insects and is indispensable in a well-prepared exhibit illustrating the life histories of different species. The State collection now contains a large amount of material which is invaluable because of the associated data. Numerous microscopic preparations of smaller insects have been made and incorporated in the collections as in earlier years.

A very advantageous exchange (the species are listed elsewhere) has been made with Dr Nathan Banks of East Falls Church, Virginia, the State becoming the possessor of a number of species determined by this specialist in Diptera. A similar exchange has also been made with Mr R. R. Parker, now of Montana, who has made a special study of the very difficult flesh flies or Sarcophagidae. The species acquired from this student are listed with the other accessions.

The need of additional boxes or trays referred to in previous reports still exists. The wooden cases containing the insect collections should be replaced by steel cabinets and more provided to accommodate the extra boxes and trays required. No adequate provision has as yet been made for the constantly increasing biological material, which is also true of the large number of microscopic slides, many of them containing types of species and genera and therefore impossible of duplication. A metallic filing case for the collection of negatives and photographs illustrating insects or their work is also greatly needed.

**Nursery inspection.** The nursery inspection work of the State Department of Agriculture has resulted in numerous specimens representing any stage in insect development, some in very poor condition being submitted to the Entomologist for identification. As such material may originate in a foreign country, determinations of this character are laborious and require for their successful prosecution a large collection and an excellent library of both domestic and foreign works. The correct identification of such material is very important, since the disposal of entire shipments of nursery stock must depend in considerable measure upon the character of the infestation.

**General.** The work of the office has been materially aided as in past years, by the identification of a number of species through the courtesy of Dr L. O. Howard, chief of the bureau of entomology, United States Department of Agriculture, and his associates. There has been, as already stated, very effective cooperation with the State Department of Agriculture, a number of county farm bureaus and other public welfare agencies in the State. A number of correspondents have donated valuable specimens and many have rendered efficient service by transmitting local data respecting various insects. It is a pleasure to note that there has been, as in the past, a most helpful cooperation on the part of all interested in the work of the office.

Respectfully submitted

EPHRAIM PORTER FELT

*State Entomologist*

*October 15, 1915*

# INJURIOUS INSECTS

## CODLING MOTH

### *Carpocapsa pomonella* Linn.

Serious and repeated injury in the western part of the State by what was supposed to be the work of the second brood of the codling moth, resulted in the planning of a series of experiments in connection with field observations, to ascertain if there was not some way of lessening the damage. The work was undertaken in cooperation with the bureaus of farmers' institutes and of horticulture of the State Department of Agriculture, and also with the Monroe County Farm Bureau. The orchards selected for the experiments were located through the courtesy of Messrs A. B. Buchholz of Albion, and L. F. Strickland of Lockport, both agents of the State Department of Agriculture, and of Mr L. A. Toan of Rochester, manager of the Monroe County Farm Bureau. It was our aim to secure orchards in a good horticultural condition, which had been sprayed regularly and thoroughly for a series of years and which were also in sections where the codling moth was known to be injurious. Furthermore, in order to secure satisfactory data it was necessary to take orchards which promised a fairly good and uniform crop; otherwise comparisons are apt to be confusing.

Satisfactory orchards were located in Albion, Monroe and Niagara counties, and through the courtesy and cooperation of Messrs J. A. Talbot of Spencerport, H. E. Wellman of Kendall, and W. H. Cowper & Son of Newfane, every facility was placed at our disposal, these gentlemen agreeing to spray according to the plan described in detail below. In each case the men and the equipment on the place were used, the Entomologist supervising the operations. There were twenty experimental trees in each orchard, some bearing as high as eleven barrels, so that the manual labor involved in the actual sorting and classification of the yield was by no means small and acknowledgments are due Messrs Toan, Buchholz and Strickland, especially the last named, since he was personally responsible for the classification of the wormy fruit in all the orchards, for the material assistance they rendered in this laborious part of the undertaking.

**Life history and habits.** Before giving the details of the experimental work, it may be well to outline the life history of the pest, since a knowledge of its habits is essential to satisfactory control work. The codling moth or apple worm winters in a tough, silken

cocoon usually located in an oval cell under the rough bark of trees. The caterpillars transform to brown, apparently lifeless pupae in late April and early May and the moths commence to emerge and continue to appear throughout the greater part of June. Cool evenings, that is, a temperature below 60°, may delay egg laying considerably. The minute, whitish eggs are deposited largely on the leaves, though under certain conditions, as shown by our observations of last June and July, they may be more abundant on the young fruit. The eggs hatch in about a week and consequently the young apple worms of the first brood may be entering the fruit from early in June, approximately three weeks after the blossoms fall, to the end of the month or even later. Some of these young caterpillars, especially those hatching from late deposited eggs, have the habit of gnawing a small hole in the side of the fruit, excavating a circular gallery with a radius of approximately one-sixteenth of an inch and then deserting this cavity and entering at the blossom end. This appears particularly likely to occur in the western part of the State during late June and early July and is there generally known as "side injury" (see plate 1). The caterpillars require about four weeks to complete their growth, at which time they desert the fruit, wander to a sheltered place, spin a cocoon, transform to pupae and in about two weeks, namely the last of July or early in August, another brood of moths may appear. These in turn deposit eggs which hatch in due time and the young larvae enter the side of the fruit, especially where two apples touch or a leaf hangs against the apple, as well as at the blossom end. Two broods appear to be the rule in the northern fruit-growing section of the United States, though some investigators claim a third in the southwest.

## EXPERIMENTAL WORK

### Newfane orchard

Three plots were located in the orchard of W. H. Cowper & Son of Newfane, the farm being managed by E. G. Cowper. The orchard borders upon the Lockport-Olcott trolley line and is composed of Greenings about 35 years old, set approximately 27 by 30 feet apart and about 15 feet high. The orchard is cultivated and is mostly in a very good condition, though the trees are a little close for thoroughly satisfactory spraying. Mr Cowper states that this orchard has received three sprayings annually for the last seven years, the first being the dormant spray, the second just as the blossoms were falling, and the third during the fourth week in July or the first week in August, the two latter treatments, except last year, being

restricted to fruiting trees. Prior to the above-mentioned period there was no spraying so far as we have been able to learn. There was a fairly heavy and uniform bloom on the selected trees. The plots were laid out so far as practical on the basis of 42 trees, 6 one way and 7 the other, the 6 central trees being the ones from which the data were secured. Special care was exercised to obtain so far as possible a uniform bloom.

Plot 1 was located 2 trees north of the Lockport-Olcott trolley line and 2 trees east of a temporary roadway across the end of the orchard.

Plot 2 was 7 trees north of the trolley line and 2 trees east of the roadway.

Plot 3 was 12 trees north of the trolley line and 1 tree east of the roadway.

The check trees were 12 trees north of the trolley line and 9 trees east of the roadway.

This arrangement, a modification of the typical plan outlined above, was rendered necessary by vagaries in blooming and plots 1, 2 and 3 were therefore separated from each other by but 3 instead of 4 trees.

A period of unusually cool weather occurred at the time of blooming and as a consequence the dropping of the petals was greatly delayed. The first application of poison was made May 19th, the day being cool and clear. Only about one-third of the blossoms had fallen, though the stamens had mostly burst. The petals were dropping very freely at the time of spraying. Two pounds of Corona dry arsenate of lead and 2½ gallons of Grasselli's 33° lime-sulphur wash were used to each 100 gallons of spray. A 33° Brown angle disk nozzle was employed together with a rather coarse disk and 160 pounds pressure. The spraying was done entirely from the top of the tank, the platform being about 7 feet high, an 8-foot extension being employed. About 6 gallons (6.4 gallons was the average for 19 trees) of the spray were applied to each tree. The northeast corner of tree A was not thoroughly sprayed though the others were covered in a fairly satisfactory manner.

The average time of spraying 3 moderate sized trees was 2⅔ minutes. The black spray was easily seen on the outside of the base of the white stamens and a little on the inside and even on the pistil, though uniform penetration of the lower calyx cavity did not occur. There appears to be ample poison on the stamen bars to kill the young larvae.

Some old, partly rotten apples were to be seen under trees here and there in the orchard, but codling moth larvae were not excessively abundant under the bark of such trees. One pupa was found on a tree at the base of which was a pile of old apples.

The second spray was applied on the afternoon of June 8th to plots 2 and 3, the treatment in this instance being restricted to the 6 experimental trees of each plot, there being no attempt to include the barrier trees in this application. The work was started at 4.55 p.m., the afternoon being clear, mild and with a light breeze. The spraying was completed at 5.10 and approximately 7 gallons were used to each tree. Engine troubles delayed the work somewhat. Two codling moth larvae just ready to pupate were found in the orchard.

Leaf rollers were somewhat common, a few pupae and full-grown larvae being seen. Young tussock moth larvae were also hatching in small numbers, though the latter were not abundant enough to be important factors.

Numerous eggs and recently hatched larvae were found July 13th on certain Baldwin apple trees. Some of the eggs had just been laid and were white, others were in the red stage, a few in the black stage and a number of egg shells were also seen. There were 2 or 3 and, in a few cases, 4 eggs or egg shells upon individual apples, though this was by no means an average. Side injury was rather frequent on trees where eggs or egg shells were abundant, the point of entrance being usually half an inch or more from the egg. The affected tissues extended only to about one-twelfth of an inch in depth and were injured by the small larvae penetrating through the skin and then running a circular or nearly circular gallery in the outer layers of the fruit, the radius of this gallery being approximately one-sixteenth of an inch. The young larvae appear to remain in these holes rarely more than several days and then migrate to the blossom end of the fruit. This was evidenced by the fact that on the 8th, as observed by Mr Strickland, eggs were found in numbers on the apples and only a little side injury, while on the 13th there was considerable injury and most of the larvae had deserted the initial point of entrance and were frequently found in the blossom end. One larva was observed wandering on the surface of an apple, another on the tip of the calyx and a number were found in the calyx cavity, several of the latter being dead. Apples with the stamens partly eaten off or fully devoured were not uncommon. This feeding was speedily followed and sometimes preceded by the young larvae excavating a circular gallery in the succulent tissues at the base of the calyx

cup. These observations, in connection with those recorded above as to the occurrence of the poison upon the floral organs, shows where many of the pests were destroyed.

The week of July 5th, according to Mr Strickland's observations, was the earliest date this year when he found eggs on the leaves or apples, relatively few being seen upon the former. Furthermore, the fruit bore no evidence of previous side injury and it is probable that this does not occur until the apple is an inch or more in diameter and loses, in large measure, the pubescence of the very young fruit. Some half-grown larvae were observed in the apples, though one-third grown larvae were plainly more numerous. The presence of these indicate an earlier oviposition by moths from overwintering larvae.

The third application in this orchard was made to the 6 experimental trees of plot 3, July 26th, the day being bright, clear and hot. The apples were then in excellent condition and the trees bore a fair amount of fruit on all plots. The check trees showed a decidedly larger proportion of wormy apples.

## Newfane orchard, plot 1 (sprayed once), 1915

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | | END AND SIDE JULY | END AND SIDE AUGUST |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August | | |
| A | Drops | 23 | 0 | 19 | 4 | 23 | 6 | 14 | 11 | 0 | 0 |
| | Picked | 524 | 36 | 466 | 104 | 112 | 19 | 76 | 29 | 3 | 3 |
| | Total | 547 | 36 | 485 | 108 | 135 | 25 | 90 | 40 | 3 | 3 |
| | Per cent | ..... | 6.58 | 88.66 | 19.74 | 24.68 | 4.57 | 16.45 | 7.31 | .54 | .54 |
| B | Drops | 20 | 0 | 12 | 3 | 7 | 3 | 4 | 0 | 0 | 0 |
| | Picked | 1 799 | 193 | 1 578 | 120 | 174 | 19 | 150 | 64 | 39 | 0 |
| | Total | 1 819 | 193 | 1 590 | 123 | 181 | 22 | 154 | 64 | 39 | 0 |
| | Per cent | ..... | 10.61 | 87.41 | 6.76 | 9.94 | 1.21— | 8.46 | 3.51 | 2.14 | 0 |
| C | Drops | 28 | 0 | 19 | 4 | 24 | 6 | 8 | 10 | 0 | 0 |
| | Picked | 1 335 | 152 | 1 042 | 161 | 215 | 11 | 156 | 93 | 4 | 2 |
| | Total | 1 363 | 152 | 1 061 | 165 | 239 | 17 | 164 | 103 | 4 | 2 |
| | Per cent | ..... | 11.15 | 77.84 | 12.10 | 17.53 | 1.24 | 12.03 | 7.55 | .29 | .14 |
| D | Drops | 5 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Picked | 306 | 34 | 230 | 57 | 41 | 2 | 29 | 10 | 0 | 0 |
| | Total | 311 | 38 | 230 | 58 | 41 | 2 | 29 | 10 | 0 | 0 |
| | Per cent | ..... | 12.21 | 73.95 | 18.64 | 13.18 | .64 | 9.32 | 3.21 | 0 | 0 |
| E | Drops | 46 | 11 | 15 | 7 | 13 | 7 | 6 | 0 | 0 | 0 |
| | Picked | 832 | 131 | 645 | 137 | 78 | 11 | 55 | 30 | 4 | 5 |
| | Total | 878 | 142 | 660 | 144 | 91 | 18 | 61 | 30 | 4 | 5 |
| | Per cent | ..... | 16.17 | 75.17 | 16.40 | 10.36 | 2.05 | 6.94 | 3.41 | .45 | .56 |
| F | Drops | 12 | 7 | 2 | 2 | 5 | 3 | 3 | 3 | 3 | 0 |
| | Picked | 461 | 94 | 288 | 109 | 37 | 4 | 11 | 22 | 1 | 2 |
| | Total | 473 | 101 | 290 | 111 | 42 | 7 | 14 | 25 | 4 | 2 |
| | Per cent | ..... | 21.35 | 61.31 | 23.46 | 8.87 | 1.47 | 2.95+ | 5.28 | .84 | .42 |
| Grand total | ..... | 5 391 | 662 | 4 316 | 709 | 729 | 91 | 512 | 272 | 54 | 12 |
| | Per cent | ..... | 12.20 | 80.05 | 13.15 | 13.52 | 1.68 | 9.49 | 5.04 | 1.00 | .22 |

It will be seen from the tabulation on page 20 that the yield of individual trees in plot 1 ranged from 311 to 1819, an undesirable variation so far as making close comparisons are concerned. The number of wormy apples varies approximately with the yield excepting in the case of tree A which had 135 or over 24 per cent of the total yield wormy. A note made at the time of spraying shows that one corner of this tree was not covered so satisfactorily as some of the others. Excluding this tree, the percentage of wormy fruit varies from 8.87 to 17.53. It will be observed that in each instance a large percentage of the infestation is in the side of the fruit and due to late-hatching caterpillars of the first brood. The average percentage of wormy fruit for the plot is 13.52 per cent, while the side injury, due to eggs hatching in July, amounts to 9.49 per cent.

**Newfane orchard, plot 2 (sprayed twice), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| A | Drops..... | 46 | 8 | 24 | 9 | 19 | 2 | 17 | 0 |
| | Picked..... | 1 173 | 278 | 695 | 157 | 133 | 9 | 115 | 26 |
| | Total..... | 1 219 | 286 | 719 | 166 | 152 | 11 | 132 | 26 |
| | Per cent.... | ..... | 23.46 | 58.98 | 13.61 | 12.46 | ..... | 10.82 | ..... |
| B | Drops..... | 42 | 25 | 10 | 3 | 8 | 1 | 6 | 3 |
| | Picked..... | 548 | 244 | 247 | 28 | 67 | 1 | 47 | 28 |
| | Total..... | 590 | 269 | 257 | 31 | 75 | 2 | 53 | 31 |
| | Per cent.... | ..... | 45.59 | 43.55 | 5.25 | 12.71 | ..... | 8.98 | ..... |
| C | Drops..... | 22 | 5 | 11 | 3 | 11 | 3 | 8 | 6 |
| | Picked..... | 1 168 | 565 | 315 | 198 | 163 | 8 | 121 | 67 |
| | Total..... | 1 190 | 570 | 326 | 201 | 174 | 11 | 129 | 73 |
| | Per cent.... | ..... | 47.9— | 27.4— | 16.9— | 14.62 | ..... | 10.84 | ..... |
| D | Drops..... | 58 | 41 | 12 | 3 | 9 | 1 | 7 | 1 |
| | Picked..... | 1 337 | 672 | 439 | 164 | 135 | 6 | 108 | 51 |
| | Total..... | 1 395 | 713 | 451 | 167 | 144 | 7 | 115 | 52 |
| | Per cent.... | ..... | 51.11 | 32.32 | 11.97 | 10.32 | ..... | 8.24 | ..... |
| E | Drops..... | 12 | 2 | 6 | 2 | 4 | 1 | 4 | 1 |
| | Picked..... | 590 | 234 | 241 | 60 | 108 | 1 | 87 | 54 |
| | Total..... | 602 | 236 | 247 | 62 | 112 | 2 | 91 | 55 |
| | Per cent.... | ..... | 39.20 | 41.02 | 10.3— | 18.60 | ..... | 15.11 | ..... |
| F | Drops..... | 14 | 0 | 4 | 3 | 4 | 2 | 4 | 2 |
| | Picked..... | 628 | 278 | 254 | 102 | 62 | 3 | 50 | 27 |
| | Total..... | 642 | 278 | 258 | 105 | 66 | 5 | 54 | 29 |
| | Per cent.... | ..... | 43.30 | 40.18 | 16.35 | 10.28 | ..... | 8.41 | ..... |
| Grand total... | | 5 638 | 2 352 | 2 258 | 732 | 723 | 38 | 574 | 266 |
| Per cent..... | | ..... | 41.71 | 40.04 | 12.98 | 12.82 | .67 | 10.10 | 4.71 |

The trees on plot 2 bore a more uniform crop, the apples on individual trees ranging from 590 to 1395 and the infestation by the codling moth is likewise somewhat uniform, the percentage of

wormy fruit ranging for individual trees, from 10.28 to 14.62. Here, as in the preceding plot, by far the greater proportion of the apples were injured by late-hatching larvae, the percentage of such apples ranging for individual trees, from 8.24 to 15.11.

**Newfane orchard, plot 3 (sprayed three times), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| A | Drops..... | 14 | 7 | 3 | 1 | 4 | 1 | 3 | 0 |
| | Picked..... | 720 | 373 | 226 | 72 | 120 | 3 | 99 | 33 |
| | Total..... | 734 | 380 | 229 | 73 | 124 | 4 | 102 | 33 |
| | Per cent.... | ..... | 51.77 | 31.19 | 9.94 | 16.89 | ..... | 13.89 | ..... |
| B | Drops..... | 34 | 20 | 4 | 1 | 10 | 6 | 4 | 0 |
| | Picked..... | 1 511 | 709 | 423 | 151 | 320 | 11 | 178 | 84 |
| | Total..... | 1 545 | 729 | 427 | 152 | 330 | 17 | 182 | 84 |
| | Per cent.... | ..... | 47.18 | 27.63 | 9.83 | 21.35 | ..... | 11.77 | ..... |
| C | Drops..... | 17 | 7 | 3 | 2 | 8 | 1 | 7 | 0 |
| | Picked..... | 301 | 158 | 45 | 41 | 76 | 1 | 63 | 17 |
| | Total..... | 318 | 165 | 48 | 43 | 84 | 2 | 70 | 17 |
| | Per cent.... | ..... | 51.88 | 15.09 | 13.52 | 26.41 | ..... | 22.01 | ..... |
| D | Drops..... | 8 | 3 | 2 | 2 | 2 | 0 | 2 | 0 |
| | Picked..... | 525 | 323 | 90 | 66 | 75 | 1 | 53 | 33 |
| | Total..... | 533 | 326 | 92 | 68 | 77 | 1 | 55 | 33 |
| | Per cent.... | ..... | 61.16 | 17.26 | 12.75 | 14.44 | ..... | 10.31 | ..... |
| E | Drops..... | 37 | 15 | 9 | 5 | 13 | 3 | 10 | 0 |
| | Picked..... | 1 034 | 634 | 118 | 170 | 157 | 4 | 139 | 25 |
| | Total..... | 1 071 | 649 | 127 | 175 | 170 | 7 | 149 | 25 |
| | Per cent.... | ..... | 60.50 | 11.85 | 16.34 | 15.87 | ..... | 13.81 | ..... |
| F | Drops..... | 49 | 21 | 13 | 5 | 15 | 2 | 13 | 1 |
| | Picked..... | 1 858 | 1 097 | 504 | 163 | 215 | 3 | 179 | 68 |
| | Total..... | 1 907 | 1 118 | 517 | 168 | 230 | 5 | 192 | 69 |
| | Per cent.... | ..... | 58.62 | 27.11 | 8.81— | 12.06 | ..... | 10.06 | ..... |
| Grand total... | | 6 108 | 3 367 | 1 440 | 679 | 1 015 | 36 | 750 | 261 |
| Per cent..... | | ..... | 55.10 | 23.57 | 11.11 | 16.61 | .58 | 12.27 | 4.27 |

The trees in plot 3 present as great a variation in yield as in plot 1, the apples to each tree ranging from 318 to 1907. There is likewise a considerable variation in the percentage of wormy fruit, it ranging for individual trees from 12.06 to 26.41, by far the greater proportion, however, being due to injury from late-hatching eggs, this latter being responsible for from 10.06 to 22.01 per cent of the affected fruit.

**Check trees, Newfane orchard, 1915**

| TREES | PICKED | | DROPS | | TOTALS | | PER CENT | |
|---|---|---|---|---|---|---|---|---|
| | X | Y | X | Y | X | Y | X | Y |
| Perfect | 7 | 4 | 2 | 0 | 9 | 4 | 1.25 | 1.50 |
| Scab | 563 | 205 | 65 | 33 | 628 | 238 | 87.71 | 90.49 |
| Leaf roller or green fruit worm | 45 | 33 | 10 | 11 | 55 | 44 | 7.69 | 16.72 |
| End wormy | 36 | 37 | 24 | 45 | 60 | 82 | 8.48 | 31.17 |
| End and side wormy, July | 40 | 19 | 25 | 20 | 65 | 39 | 9.07 | 14.64 |
| End and side wormy, August | 1 | 7 | 1 | 4 | 2 | 11 | ..... | 4.18 |
| End and side wormy, July and August | 14 | 8 | 10 | 2 | 24 | 10 | 3.35 | 3.80 |
| Side wormy, July | 194 | 66 | 21 | 33 | 215 | 99 | 30.02 | 37.64 |
| Side wormy, August | 25 | 23 | 0 | 4 | 25 | 27 | 3.49 | 10.26 |
| Side wormy, July and August | 224 | 1 | 7 | 0 | 231 | 1 | 32.26 | ..... |
| Total wormy | 424 | 114 | 89 | 54 | 513 | 168 | 71.64+ | 63.87 |
| Total end wormy | ..... | ..... | ..... | ..... | 151 | 142 | 21.08 | 53.99 |
| Total side wormy | ..... | ..... | ..... | ..... | 471 | 138 | 65.76 | 52.47 |
| Total fruit | 625 | 209 | 91 | 54 | 716 | 263 | ..... | ..... |

The two check trees, it will be seen by referring to the tabulation above, were very badly infested, 71.64 per cent being wormy in the case of tree X and 63.87 per cent in the case of tree Y. A very large proportion of this injury was due to the work of larvae hatching from late-deposited eggs, and in the case of tree X this amounted to 30.2 per cent and in that of tree Y to 37.64 per cent. These percentages relate only to side injury due to the activities of the first brood. Tree X, in addition, had 32.2 per cent entered at the side by both larvae of the first and second broods, a total side wormy for this tree of 65.76 per cent, while the total side infestation for tree Y amounts to 52.47 per cent.

**Newfane orchard, summary of plots, 1915**

| PLOTS | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | End | Side July | Side August |
| 1 Total | 5 391 | 662 | 4 316 | 709 | 729 | 91 | 512 | 272 |
| Per cent | ..... | 12.20 | 80.05 | 13.15 | 13.52 | 1.68 | 9.49 | 5.04 |
| 2 Total | 5 638 | 2 352 | 2 258 | 732 | 723 | 38 | 574 | 266 |
| Per cent | ..... | 41.71 | 40.04 | 12.98 | 12.82 | .67 | 10.10 | 4.71 |
| 3 Total | 6 108 | 3 367 | 1 440 | 679 | 1 015 | 36 | 750 | 261 |
| Per cent | ..... | 55.10 | 23.57 | 11.11 | 16.61 | .58 | 12.27 | 4.27 |
| Total, sprayed Plots | 17 137 | 6 381 | 8 014 | 2 120 | 2 467 | 165 | 1 836 | 799 |
| Per cent | ..... | 37.23 | 46.76 | 12.37 | 14.39 | .96 | 10.71 | 4.66 |
| Checks, total | 979 | 13 | 866 | 99 | 681 | 293 | 684 | 331 |
| Per cent | ..... | 1.32 | 88.45 | 10.11 | 69.56 | 29.92 | 69.86 | 33.81 |

A study of the summary of the plots in this orchard gives a better idea of the results actually obtained. The total yield to each plot did not vary greatly and it will be noted that there was a progressive increase in the perfect fruit, resulting from the additional sprayings and due largely to the better control of scab, the percentage of apples infected by this fungus being reduced from 80.5 per cent in plot 1 to 40.4 per cent in plot 2, and 23.57 per cent in plot 3.

The three sprayings for the codling moth, it will be seen by reference to the tabulation, had very little influence in reducing leaf roller injury.

The percentages of wormy apples obtained from the three plots show no material benefit in worm-free fruit from the second and third applications. In fact, there is a larger percentage of wormy apples on plot 3 than plot 1, which is probably due to some factor which can not be readily explained at the present time. It will be noted that there is a progressive increase in the side injury, resulting from the work of late-hatching larvae of the first brood. This, likewise, we believe to be largely accidental.

The percentage of wormy fruit on the two check trees is so high that it is not surprising that better results should not have been obtained by spraying. The treatment on each of the three plots has reduced the percentage of wormy apples by over 55 per cent. This of itself is striking testimony to the value of poisoned applications for the destruction of the codling moth, though we would not give the impression that the results obtained in this orchard, striking though they be, are entirely satisfactory.

## Kendall orchard

This greening orchard, the property of Mr H. E. Wellman, is bounded on the west by a highway, a rather well-marked drive on the south and extends north to another highway. Eleven trees lie between the experimental plots and the western highway.

Plot 1 was located 3 trees north from the southern margin, plot 2, 9 trees north, and plot 3, 15 trees north, the check trees being 22 trees north. The bloom in this orchard, while heavy on the rows containing the actual experimental trees, was somewhat irregular, and it was therefore not feasible to have the plots separated by more than 3 trees. Two rows on each side were used as barriers. The orchard is about 40 years old, the trees being set 33 by 33 feet and large enough so that the branches are moderately close but not so near as to prevent satisfactory spraying. Mr Wellman states that it has been his practice to do a very thorough job when making the calyx application, treating the nonfruiting as well as the bearing

trees. The amount of spraying later, however, depended upon the crop prospects.

The first application was made May 22d, 18 pounds of Niagara arsenate of lead (15 per cent arsenic oxide), $6\frac{1}{2}$ gallons of Dow's lime-sulphur wash (33° Baumé) being used to 250 gallons of spray. The pressure was maintained at about 200 pounds. One man stood on an 11 foot tower and the other on the ground, the latter provided with 50 feet of hose and both equipped with 10 foot extensions. The average time to each tree was $2\frac{1}{10}$ minutes, the amount of spray being $5\frac{1}{5}$ gallons. The blossoms were two-thirds or more off and the remainder were falling fast. The weather was sunny with light clouds and a variable breeze in the orchard, which latter proved to be a stiff breeze on the highway.

The man on the tower covered the top of one tree and touched up the inner side of the windward row, while the man on the ground went around the tree and also touched up the inner side of the windward row. The distribution of the spray was very uniform, there being practically no unsprayed areas and almost no overloading of the foliage. In fact, a large percentage of the leaves were lightly specked with the poison while very few showed a running and gathering at the tip. Brown angle nozzles were used with a rather fine disk and the spray was driven only to a slight extent, say 3 or 4 feet in the light breeze prevailing.

One codling moth larva was observed transforming to the pupa and another had partly changed. Bud moth, case-bearers and green fruit worms were present in small numbers, while leaf roller larvae were somewhat abundant.

A second spraying of plots 2 and 3 was given June 8th. The day was clear with a variable and rather strong, whirling breeze. Approximately 10 gallons were used to each tree. The barrier rows on plots 2 and 3 were sprayed later though not under supervision.

There was great disparity in the development of the leaf rollers, some being in the pupa stage, others nearly full grown and a number partly grown. There was considerable leaf roller work upon the foliage and many young apples were partly eaten by this pest.

The first spraying of the season, originally intended for San José scale, was not given until after the buds had started perceptibly, the leaves being probably from one-fourth to three-fourths of an inch long. On this account Mr Wellman used 3 pounds of arsenate of lead to 50 gallons of water and the lime-sulphur wash at the rate of 1 to 15, together with three-fourths of a pint of black leaf 40 to 100 gallons in an attempt to control the scale, leaf roller and plant lice with one application. The probabilities are that the leaves had

started to such an extent that the leaf rollers were able to penetrate the buds and thus, in large measure, avoid the poison. There appeared to be at this time more leaf roller injury to both fruit and foliage of the check trees.

An examination of this orchard July 14th showed a few recently laid eggs and some side injury on the greenings and decidedly more on the adjacent Baldwins. Some larvae were found in the calyx cup. The setting of fruit on the experimental trees is scanty and the crop has been still more reduced by a heavy drop.

Plot 3 was sprayed for the third time July 28th, the day being cloudy and still and the conditions almost perfect for good work. The trees were well covered with the spray and dripped a little. The work began at 8.45 a.m., was completed about 10 a.m. and rain began falling about 10.30 and continued most of the afternoon. The same formula was employed as before and possibly a little more spray was applied, since the pressure tended to remain at about 210 pounds. Side injury was easily found and some eggs were observed in the red stage though no recently deposited ones were seen.

**Kendall orchard, plot 1 (sprayed once), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| A | Drops..... | 20 | 4 | 3 | 11 | 11 | 1 | 10 | 0 |
| | Picked..... | 760 | 330 | 502 | 233 | 170 | 0 | 159 | 11 |
| | Total..... | 780 | 334 | 505 | 244 | 181 | 1 | 169 | 11 |
| | Per cent.... | ..... | 42.82 | 64.74 | 31.28 | 23.20 | ..... | 21.66 | ..... |
| B | Drops..... | 41 | 1 | 9 | 20 | 35 | 2 | 32 | 1 |
| | Picked..... | 496 | 148 | 247 | 168 | 162 | 1 | 154 | 7 |
| | Total..... | 537 | 149 | 256 | 188 | 197 | 3 | 186 | 8 |
| | Per cent.... | ..... | 27.74 | 47.67 | 35.00 | 36.68 | ..... | 34.63 | ..... |
| C | Drops..... | 34 | 4 | 1 | 13 | 16 | 2 | 19 | 0 |
| | Picked..... | 571 | 223 | 168 | 181 | 151 | 1 | 136 | 14 |
| | Total..... | 605 | 227 | 169 | 194 | 167 | 3 | 155 | 14 |
| | Per cent.... | ..... | 37.52 | 27.93 | 32.06 | 27.60 | ..... | 25.62 | ..... |
| D | Drops..... | 52 | 10 | 13 | 13 | 33 | 0 | 33 | 0 |
| | Picked..... | 1 699 | 690 | 547 | 520 | 506 | 1 | 450 | 55 |
| | Total..... | 1 751 | 700 | 560 | 533 | 539 | 1 | 483 | 55 |
| | Per cent.... | ..... | 39.97 | 31.98 | 30.43 | 30.78 | ..... | 27.58 | ..... |
| E | Drops..... | 35 | 5 | 3 | 16 | 23 | 11 | 21 | 0 |
| | Picked..... | 1 430 | 530 | 422 | 339 | 236 | 1 | 225 | 10 |
| | Total..... | 1 465 | 535 | 425 | 355 | 259 | 12 | 246 | 10 |
| | Per cent.... | ..... | 36.51 | 29.01 | 24.23 | 17.67 | ..... | 16.79 | ..... |
| F | Drops..... | 36 | 2 | 8 | 17 | 30 | 5 | 35 | 0 |
| | Picked..... | 424 | 160 | 119 | 149 | 176 | 3 | 145 | 28 |
| | Total..... | 460 | 162 | 127 | 166 | 206 | 8 | 180 | 28 |
| | Per cent.... | ..... | 35.21 | 27.60 | 36.08 | 44.78 | ..... | 39.13 | ..... |
| Grand total... | | 5 598 | 2 107 | 2 042 | 1 680 | 1 549 | 28 | 1 419 | 126 |
| Per cent..... | | | 37.63 | 36.45 | 30.01 | 27.67 | .50 | 25.34 | 2.25 |

It will be seen from the tabulation on page 26 that the yield of trees in plot 1 ranged from 460 to 1751, a rather wide variation which is not accompanied by a corresponding difference in the number of wormy apples. The percentage of the latter on individual trees varies from 17.67 to 44.78, the lowest percentage being upon one of the most fruitful trees, while the highest was, as might be expected, on the tree producing the smallest crop. The average percentage of wormy apples for this plot was 27.67, the injuries by late-hatching larvae amounting to 25.34. Even in the case of the tree with the lowest percentage of wormy apples, by far the most injury resulted from the late egg deposition, this being 16.79 per cent out of a total of only 17.67. The damage resulting from end wormy infestations was almost negligible, it amounting to half of 1 per cent.

**Kendall orchard, plot 2 (sprayed twice), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| A | Drops..... | 12 | 0 | 0 | 6 | 13 | 1 | 12 | 0 |
| | Picked..... | 319 | 125 | 59 | 117 | 103 | 1 | 96 | 7 |
| | Total..... | 331 | 125 | 59 | 123 | 116 | 2 | 108 | 7 |
| | Per cent.... | ..... | 37.76 | 17.82 | 37.16 | 35.04 | ..... | 32.62 | ..... |
| B | Drops..... | 14 | 0 | 1 | 11 | 12 | 3 | 9 | 0 |
| | Picked..... | 378 | 115 | 27 | 204 | 140 | 0 | 127 | 13 |
| | Total..... | 392 | 115 | 28 | 215 | 152 | 3 | 136 | 13 |
| | Per cent.... | ..... | 29.33 | 7.11 | 54.84 | 38.77 | ..... | 34.69 | ..... |
| C | Drops..... | 12 | 1 | 1 | 9 | 10 | 0 | 10 | 0 |
| | Picked..... | 371 | 135 | 44 | 186 | 101 | 2 | 98 | 1 |
| | Total..... | 383 | 136 | 45 | 195 | 111 | 2 | 108 | 1 |
| | Per cent.... | ..... | 35.50 | 11.74 | 50.91 | 28.98 | ..... | 28.19 | ..... |
| D | Drops..... | 11 | 1 | 1 | 8 | 10 | 2 | 8 | 0 |
| | Picked..... | 243 | 114 | 23 | 78 | 59 | 0 | 56 | 3 |
| | Total..... | 254 | 115 | 24 | 86 | 69 | 2 | 64 | 3 |
| | Per cent.... | ..... | 45.11 | 9.44 | 33.85 | 27.16 | ..... | 25.19 | ..... |
| E | Drops..... | 15 | 5 | 1 | 5 | 8 | 0 | 8 | 0 |
| | Picked..... | 1 001 | 437 | 148 | 354 | 269 | 4 | 255 | 15 |
| | Total..... | 1 016 | 442 | 149 | 359 | 277 | 4 | 263 | 15 |
| | Per cent.... | ..... | 43.50 | 14.66 | 35.34 | 27.26 | ..... | 25.88 | ..... |
| F | Drops..... | 13 | 2 | 2 | 6 | 11 | 1 | 10 | 0 |
| | Picked..... | 458 | 157 | 36 | 210 | 165 | 1 | 148 | 16 |
| | Total..... | 471 | 159 | 38 | 216 | 176 | 2 | 158 | 16 |
| | Per cent.... | ..... | 33.75 | 8.07 | 45.85 | 37.36 | ..... | 33.54 | ..... |
| Grand total... | | 2 847 | 1 092 | 343 | 1 194 | 901 | 15 | 837 | 55 |
| Per cent..... | | ..... | 38.35 | 12.04 | 41.93 | 31.64 | .52 | 29.39 | 1.93 |

The yield on plot 2 was low and more uniform than in the case o plot 1, the number of apples to each tree ranging from 331 to 1016, while the percentage of wormy apples to each tree was fairly uniform

and varied from 27.16 to 38.77. Here, as in plot 1, a very large proportion of the apples were damaged by late-hatching larvae, the injury for individual trees in no case falling below 25.19 per cent and ranging from this to 34.69 per cent. The average infestation for the plot was 31.64 per cent, of which .52 per cent was due to end wormy infestation, 29.39 per cent to the characteristic side injury damage and 1.93 per cent to late infestation by the second brood.

**Kendall orchard, plot 3 (sprayed three times), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| A | Drops..... | 7 | 2 | 0 | 3 | 5 | 1 | 4 | 0 |
| | Picked..... | 85 | 25 | 6 | 53 | 15 | 0 | 14 | 1 |
| | Total..... | 92 | 27 | 6 | 56 | 20 | 1 | 18 | 1 |
| | Per cent.... | ..... | 29.34 | 6.52 | 60.86 | 21.73 | ..... | 19.56 | ..... |
| B | Drops..... | 5 | 1 | 0 | 3 | 13 | 0 | 3 | 0 |
| | Picked..... | 91 | 36 | 1 | 52 | 14 | 0 | 14 | 0 |
| | Total..... | 96 | 37 | 1 | 55 | 27 | 0 | 17 | 0 |
| | Per cent.... | ..... | 38.54 | 1.03 | 57.29 | 28.12 | ..... | 17.70 | ..... |
| C | Drops..... | 14 | 1 | 0 | 10 | 10 | 0 | 10 | 0 |
| | Picked..... | 150 | 36 | 15 | 79 | 54 | 0 | 53 | 1 |
| | Total..... | 164 | 37 | 15 | 89 | 64 | 0 | 63 | 1 |
| | Per cent.... | ..... | 22.56 | 9.14 | 54.26 | 39.02 | ..... | 38.41 | ..... |
| D | Drops..... | 44 | 3 | 2 | 21 | 32 | 2 | 30 | 0 |
| | Picked..... | 913 | 360 | 152 | 287 | 297 | 2 | 297 | 1 |
| | Total..... | 957 | 363 | 154 | 308 | 329 | 4 | 327 | 1 |
| | Per cent.... | ..... | 37.93 | 16.09 | 32.18 | 34.37 | ..... | 34.16 | ..... |
| E | Drops..... | 5 | 1 | 0 | 3 | 3 | 0 | 3 | 0 |
| | Picked..... | 314 | 105 | 14 | 154 | 121 | 0 | 118 | 3 |
| | Total..... | 319 | 106 | 14 | 157 | 124 | 0 | 121 | 3 |
| | Per cent.... | ..... | 33.22 | 4.38 | 49.21 | 38.87 | ..... | 37.93 | ..... |
| F | Drops..... | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 0 |
| | Picked..... | 53 | 19 | 5 | 30 | 16 | 0 | 16 | 0 |
| | Total..... | 55 | 19 | 5 | 32 | 18 | 0 | 18 | 0 |
| | Per cent.... | ..... | 34.72 | 9.09 | 51.00 | 21.27 | ..... | 21.27 | ..... |
| Grand total.... | | 1 683 | 589 | 195 | 697 | 582 | 5 | 564 | 6 |
| Per cent..... | | ..... | 34.99 | 11.52 | 41.41 | 34.52 | .29 | 33.51 | .35 |

The yield from plot 3 was decidedly lower than in the case of the two preceding, the product of individual trees ranging from 55 to 957 apples, while the percentage of wormy fruit varied from 21.27 to 39.02. This plot is characterized by an almost complete absence of end-wormy apples, the infestation amounting to only .29 per cent, while by far the most damage was caused by late-hatching larvae and amounted for the plot to 33.51 out of a total plot infestation of 34.52 per cent.

The yield on plot 3 was so light that two special trees just to the north and designated as trees AA and BB were also picked and the fruit classified to see if the conditions on these trees varied materially from those found to exist on the trees originally selected. The yield of these two trees, as will be seen by referring to the tabulation, was 634 and 410 apples, respectively, the percentage of wormy fruit being 32.33 and 39.26 per cent, with side injury amounting to 32.01 and 38.53 per cent, respectively. In other words, here as elsewhere in this orchard, a very large proportion of the wormy apples suffered from the late-hatching larvae.

Another tree designated CC was east of plot 2 and was supposed to have had three sprayings. It was selected because of the relatively large crop of apples, producing 3175. Here there was 20.44 per cent wormy, 18.96 per cent being classed as such because of the side injury. The relatively high percentage of scab infection, namely 47.14, indicates that this tree may not have been sprayed so thoroughly as some others. All three of these special trees, like those in plot 3, are remarkable because of the almost total absence of end-wormy apples.

**Kendall orchard, special trees (sprayed), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| AA | Drops..... | 17 | 2 | 3 | 7 | 9 | 1 | 8 | 0 |
| | Picked..... | 617 | 229 | 74 | 242 | 196 | 0 | 195 | 1 |
| | Total..... | 634 | 231 | 77 | 249 | 205 | 1 | 203 | 1 |
| | Per cent.... | ..... | 36.43 | 12.14 | 39.27 | 32.33 | ..... | 32.01 | ..... |
| BB | Drops..... | 30 | 3 | 2 | 17 | 16 | 1 | 15 | 0 |
| | Picked..... | 380 | 110 | 61 | 183 | 145 | 0 | 143 | 2 |
| | Total..... | 410 | 113 | 63 | 200 | 161 | 1 | 158 | 2 |
| | Per cent.... | ..... | 27.55 | 15.36 | 48.78 | 39.26 | ..... | 38.53 | ..... |
| CC | Drops..... | 128 | 16 | 55 | 46 | 65 | 0 | 61 | 4 |
| | Picked..... | 3 047 | 1 161 | 1 442 | 713 | 584 | 0 | 541 | 43 |
| | Total..... | 3 175 | 1 177 | 1 497 | 759 | 649 | 0 | 602 | 47 |
| | Per cent.... | ..... | 37.07 | 47.14 | 23.90 | 20.44 | ..... | 18.96 | ..... |
| Grand total... | | 4 219 | 1 521 | 1 637 | 1 208 | 1 015 | 2 | 963 | 50 |
| Per cent..... | | ..... | 36.05 | 38.80 | 28.63 | 24.05 | .04 | 22.82 | 1.18 |

**Kendall orchard, checks (unsprayed), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| X | Drops..... | 34 | 2 | 12 | 12 | 34 | 5 | 28 | 1 |
| | Picked..... | 169 | 17 | 115 | 56 | 89 | 0 | 81 | 8 |
| | Total..... | 203 | 19 | 127 | 68 | 123 | 5 | 109 | 9 |
| | Per cent.... | ..... | 9.35 | 62.56 | 33.49 | 60.59 | ..... | 53.69 | ..... |
| Y | Drops..... | 99 | 3 | 44 | 21 | 95 | 12 | 83 | 0 |
| | Picked..... | 349 | 41 | 248 | 89 | 212 | 1 | 181 | 24 |
| | Total..... | 448 | 44 | 292 | 110 | 307 | 13 | 264 | 24 |
| | Per cent.... | ..... | 9.82 | 65.17 | 24.55 | 68.52 | ..... | 58.92 | ..... |
| Grand total.... | | 651 | 63 | 419 | 178 | 430 | 18 | 373 | 33 |
| Per cent..... | | ..... | 9.52 | 62.82 | 27.34 | 67.58 | 2.76 | 57.29 | 5.06 |

The check trees bore 203 and 448 apples, the percentage of wormy fruit being 60.59 and 68.52, respectively. The end-wormy apples are relatively very few and by far the greater portion of the injury in this orchard, as on the unsprayed trees, was due to late-hatching larvae, practically all but 10 per cent of the affected fruit for the two trees being affected in this way.

**Kendall orchard, summary of plots, 1915**

| PLOTS | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | End | Side July | Side August |
| 1 Total..... | 5 598 | 2 107 | 2 042 | 1 680 | 1 549 | 28 | 1 419 | 126 |
| Per cent..... | ..... | 37.63 | 36.45 | 30.01 | 27.67 | .50 | 25.34 | 2.25 |
| 2 Total..... | 2 847 | 1 092 | 343 | 1 194 | 901 | 15 | 837 | 55 |
| Per cent..... | ..... | 38.35 | 12.04 | 41.93 | 31.64 | .52 | 29.39 | 1.93 |
| 3 Total..... | 1 683 | 589 | 195 | 697 | 582 | 5 | 564 | 6 |
| Per cent..... | ..... | 34.99 | 11.52 | 41.41 | 34.52 | .29 | 33.51 | .35 |
| Special, total..... | 4 219 | 1 521 | 1 637 | 1 208 | 1 015 | 2 | 963 | 50 |
| Per cent..... | ..... | 36.05 | 38.80 | 28.63 | 24.05 | .04 | 22.82 | 1.18 |
| Total, sprayed plots | 14 347 | 5 309 | 4 217 | 4 779 | 4 047 | 50 | 3 783 | 237 |
| Per cent..... | ..... | 37. | 29.39 | 33.31 | 28.20 | .34 | 26.29 | 1.65 |
| Checks, total..... | 651 | 63 | 419 | 178 | 430 | 18 | 373 | 33 |
| Per cent..... | ..... | 9.52 | 62.82 | 27.34 | 67.58 | 2.76 | 57.29 | 5.06 |

A study of the summary of the plots gives in brief compass an idea of the results obtained. It will be noted first of all that the yields of plots 1, 2 and 3 decreased, each being about one-half smaller than

the preceding, and that the percentage of perfect fruit remained about the same in plots 1 and 2, despite the decrease in yield, while in plot 3 it was smaller, the variation in each instance being due to the small yield of the plots receiving more than one application. A decrease in the percentage of scab infection is to be noted on these three plots, though there is little variation between plots 2 and 3, while there is a higher and nearly identical percentage of leaf roller injury on plots 2 and 3. There is a nearly regular increase in the percentage of wormy apples in these three plots, due almost entirely to the progressive reduction in the crop. This is practically paralleled by the increased percentage of blemishes caused by late-hatching larvae.

Compared with the checks or unsprayed trees, these three plots show a marked improvement, making due allowance for the reduced yield of plots receiving more than one spray in the percentage of perfect apples and the reduction in percentage of scabby fruit. There is also a very marked reduction in wormy apples. It will be noted that a summary of the data from the special trees given above, is not materially different from that obtained on the regular experimental trees.

### Webster orchard

This was an exceptionally fine Baldwin orchard managed by Mr J. A. Talbot of Spencerport, to whom we are indebted for most hearty cooperation. The orchard is well cultivated, the trees being 38 to 40 years old and standing about 40 feet apart with plenty of room for efficient spraying. It is located just north of a highway and three plots with two check trees were laid out as follows:

Plot 1 was 2 trees north of the highway and 2 trees east of the western boundary.

Plot 2 was 9 trees north of the highway and 2 trees east of the western boundary.

Plot 3 was 2 trees north of the highway and 8 trees east of the western boundary.

The check trees were 13 trees north of the highway and 2 trees east of the western boundary.

Plots 1, 2 and 3 were therefore well separated by the usual barrier trees, 2 on each side though but 1 tree separated the northern trees of plot 2, namely, A and B, from the check trees X and Y.

The spraying was done May 20th, Rex lime and sulphur being used at the rate of 1 to 40 and Ansbacher arsenate of lead at the rate of 3 pounds to 50 gallons of water; 15 pounds of freshly slaked,

good stone lime were also added to each 200 gallons of the spray. The pressure was maintained at about 175 pounds. Two lines of hose were used, one man being upon the outfit and the second working from the ground. At the time of spraying more than two-thirds of the blossoms were off and the others were dropping rapidly. There was a light breeze, the day was bright and bees were not working in the orchard. One tank full, or 200 gallons, sufficed for 22 trees, the time of application being approximately 35 minutes. It required from 20 to 25 minutes to fill the tank. The distribution was very satisfactory, few or no leaves being skipped and there was very little dripping. Freedom from insect pests, especially leaf roller and aphis, was evident though a few case-bearers were observed.

The second spraying was made on plots 2 and 3 June 9th. The same formula was employed as before, the day was bright and 200 gallons sufficed to spray 33 trees. The work began at 8.43 a.m. and was completed by 11.30. Leaf roller work was evident, some pupae being observed, and a number of case-bearers occurred here and there, their work being somewhat evident both upon foliage and fruit.

Observations July 14th showed some leaf roller injury and more damage by the case-bearer than appeared in other orchards. There was also a perceptible amount of hail injury. The side injury caused by young codling moth larvae was prevalent to some extent, though the infestation was decidedly less than in any other of the experimental orchards. The conditions approximated those we would expect to find in similar orchards in the Hudson valley.

The third spraying was given plot 3 July 29th, 200 gallons being used for 40 trees; 3 pounds of arsenate of lead, lime-sulphur 1 to 50 was the formula employed. No eggs and comparatively little side injury were seen.

**Webster orchard, plot 1 (sprayed once), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| A | Drops..... | 307 | 145 | 115 | 37 | 36 | 2 | 34 | 0 |
| | Picked..... | 2 789 | 1 495 | 1 077 | 215 | 133 | 1 | 133 | 4 |
| | Total..... | 3 096 | 1 640 | 1 192 | 252 | 169 | 3 | 167 | 4 |
| | Per cent.... | ..... | 52.97 | 38.50 | 8.13 | 5.45 | ..... | 5.39 | ..... |
| B | Drops..... | 329 | 181 | 93 | 45 | 35 | 3 | 33 | 0 |
| | Picked..... | 3 610 | 1 724 | 1 627 | 281 | 104 | 2 | 97 | 5 |
| | Total..... | 3 939 | 1 905 | 1 720 | 326 | 139 | 5 | 130 | 5 |
| | Per cent.... | ..... | 48.35 | 43.51 | 8.27 | 3.52 | ..... | 3.30 | ..... |
| C | Drops..... | 98 | 53 | 20 | 6 | 23 | 6 | 19 | 0 |
| | Picked..... | 2 074 | 1 051 | 948 | 111 | 104 | 2 | 104 | 0 |
| | Total..... | 2 172 | 1 104 | 968 | 117 | 127 | 8 | 123 | 0 |
| | Per cent.... | ..... | 50.71 | 44.56 | 5.37 | 5.71 | ..... | 5.66 | ..... |
| D | Drops..... | 358 | 143 | 146 | 33 | 49 | 6 | 44 | 0 |
| | Picked..... | 4 634 | 1 979 | 2 538 | 210 | 234 | 1 | 230 | 4 |
| | Total..... | 4 992 | 2 122 | 2 684 | 243 | 283 | 7 | 274 | 4 |
| | Per cent.... | ..... | 42.50 | 53.76 | 4.86 | 5.66 | ..... | 5.48 | ..... |
| E | Drops..... | 342 | 150 | 133 | 27 | 45 | 3 | 42 | 1 |
| | Picked..... | 4 431 | 2 137 | 2 095 | 210 | 200 | 0 | 196 | 1 |
| | Total..... | 4 773 | 2 287 | 2 228 | 237 | 245 | 3 | 238 | 2 |
| | Per cent.... | ..... | 47.91 | 46.67 | 4.96 | 5.13 | ..... | 4.98 | ..... |
| F | Drops..... | 125 | 50 | 59 | 9 | 20 | 1 | 19 | 0 |
| | Picked..... | 4 406 | 2 183 | 1 984 | 153 | 241 | 1 | 237 | 14 |
| | Total..... | 4 531 | 2 233 | 2 043 | 162 | 261 | 2 | 256 | 14 |
| | Per cent.... | ..... | 49.28 | 45.08 | 3.57 | 5.75 | ..... | 5.65 | ..... |
| Grand total... | | 23 503 | 11 291 | 10 835 | 1 337 | 1 224 | 28 | 1 188 | 29 |
| Per cent..... | | ..... | 48.04 | 46.10 | 5.68 | 5.20 | .11 | 5.05 | .12 |

The crop on this plot was large, ranging for individual trees from 2172 to 4992, the percentage of wormy apples varying from 3.52 to 5.75. This range is by no means large, though it would have been much smaller but for the side injury caused by late-hatching larvae, this ranging from 3.30 to 5.66 per cent. A very small proportion, only .11 per cent, was end wormy. These gratifying results are in part due to the large crop though they are mostly to be accounted for, in our judgment, by the thorough and systematic spraying which appears to have been the rule for several years past.

**Webster orchard, plot 2 (sprayed twice), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| A | Drops..... | 124 | 125 | 50 | 25 | 15 | 2 | 13 | 0 |
| | Picked..... | 2 498 | 1 763 | 592 | 124 | 46 | 0 | 46 | 0 |
| | Total..... | 2 622 | 1 888 | 642 | 149 | 61 | 2 | 59 | 0 |
| | Per cent.... | ..... | 72. | 24.48 | 5.68 | 2.32 | ..... | 2.25 | ..... |
| B | Drops..... | 281 | 133 | 90 | 39 | 35 | 3 | 33 | 0 |
| | Picked..... | 2 168 | 1 489 | 499 | 164 | 49 | 0 | 48 | 0 |
| | Total..... | 2 449 | 1 622 | 589 | 203 | 84 | 3 | 81 | 0 |
| | Per cent.... | ..... | 66.23 | 24.05 | 8.28 | 3.42 | ..... | 3.30 | ..... |
| C | Drops..... | 171 | 100 | 43 | 19 | 18 | 1 | 18 | 0 |
| | Picked..... | 2 125 | 1 514 | 493 | 102 | 49 | 0 | 49 | 1 |
| | Total..... | 2 296 | 1 614 | 536 | 121 | 67 | 1 | 67 | 1 |
| | Per cent.... | ..... | 70.29 | 23.34 | 5.27 | 2.91 | ..... | 2.91 | ..... |
| D | Drops..... | 109 | 62 | 28 | 9 | 8 | 0 | 8 | 0 |
| | Picked..... | 1 888 | 1 263 | 475 | 118 | 69 | 0 | 69 | 1 |
| | Total..... | 1 997 | 1 325 | 503 | 127 | 77 | 0 | 77 | 1 |
| | Per cent.... | ..... | 66.34 | 25.18 | 6.35 | 3.85 | ..... | 3.85 | ..... |
| E | Drops..... | 399 | 223 | 95 | 51 | 49 | 3 | 45 | 1 |
| | Picked..... | 2 341 | 1 681 | 484 | 162 | 47 | 0 | 44 | 3 |
| | Total..... | 2 740 | 1 904 | 579 | 213 | 96 | 3 | 89 | 4 |
| | Per cent.... | ..... | 69.48 | 21.13 | 7.77 | 3.50 | ..... | 3.24 | ..... |
| F | Drops..... | 454 | 242 | 136 | 39 | 52 | 3 | 50 | 0 |
| | Picked..... | 3 046 | 1 934 | 1 097 | 235 | 74 | 1 | 73 | 2 |
| | Total..... | 3 500 | 2 176 | 1 233 | 274 | 126 | 4 | 123 | 2 |
| | Per cent.... | ..... | 62.17 | 35.22 | 7.87 | 3.6 | ..... | 3.51 | ..... |
| Grand total... | | 15 604 | 10 529 | 4 082 | 1 087 | 511 | 13 | 496 | 8 |
| Per cent..... | | ..... | 67.47 | 26.15 | 6.97 | 3.27 | .08 | 3.17 | .05 |

The yield of plot 2 is considerably less than that of plot 1, the crop from individual trees ranging from 1997 to 3500 apples. The percentage of wormy fruit is perceptibly lower than in the preceding, it varying from 2.32 to 3.85, by far the greater proportion, as in the preceding plot, being due to side injury. The end wormy in this plot amounted to only .08 per cent.

**Webster orchard, plot 3 (sprayed three times), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| A | Drops..... | 484 | 261 | 145 | 65 | 30 | 1 | 29 | 1 |
| | Picked..... | 3 056 | 2 475 | 377 | 168 | 82 | 1 | 80 | 2 |
| | Total..... | 3 540 | 2 736 | 522 | 233 | 112 | 2 | 109 | 3 |
| | Per cent.... | ..... | 77.28 | 14.74 | 6.58 | 3.16 | ..... | 3.07 | ..... |
| B | Drops..... | 226 | 145 | 44 | 26 | 17 | 1 | 17 | 0 |
| | Picked..... | 2 684 | 2 146 | 361 | 128 | 69 | ..... | 69 | 0 |
| | Total..... | 2 910 | 2 291 | 405 | 154 | 86 | 1 | 86 | 0 |
| | Per cent.... | ..... | 78.72 | 13.91 | 5.29 | 2.95 | ..... | 2.95 | ..... |
| C | Drops..... | 403 | 232 | 104 | 42 | 34 | 2 | 32 | 0 |
| | Picked..... | 3 459 | 2 607 | 673 | 110 | 97 | ..... | 97 | 0 |
| | Total..... | 3 862 | 2 839 | 777 | 152 | 131 | 2 | 129 | 0 |
| | Per cent.... | ..... | 73.51 | 20.11 | 3.95 | 3.39 | ..... | 3.34 | ..... |
| D | Drops..... | 400 | 241 | 99 | 37 | 38 | 4 | 35 | 0 |
| | Picked..... | 2 900 | 2 097 | 637 | 139 | 69 | 0 | 69 | 0 |
| | Total..... | 3 300 | 2 338 | 736 | 176 | 107 | 4 | 104 | 0 |
| | Per cent.... | ..... | 70.84 | 22.30 | 5.33 | 3.24 | ..... | 3.15 | ..... |
| E | Drops..... | 342 | 109 | 81 | 42 | 57 | 0 | 57 | 0 |
| | Picked..... | 4 622 | 3 455 | 927 | 148 | 160 | 0 | 160 | 2 |
| | Total..... | 4 964 | 3 564 | 1 008 | 190 | 217 | 0 | 217 | 2 |
| | Per cent.... | ..... | 71.79 | 20.30 | 3.82 | 4.37 | ..... | 4.37 | ..... |
| F | Drops..... | 310 | 221 | 20 | 29 | 49 | 1 | 48 | 0 |
| | Picked..... | 3 153 | 2 712 | 203 | 104 | 161 | 0 | 160 | 1 |
| | Total..... | 3 463 | 2 933 | 223 | 133 | 210 | 1 | 208 | 1 |
| | Per cent.... | ..... | 84.40 | 6.43 | 3.84 | 6.06 | ..... | 6. | ..... |
| Grand total... | | 22 039 | 16 701 | 3 671 | 1 038 | 863 | 10 | 853 | 6 |
| Per cent..... | | ..... | 75.77 | 16.65 | 4.70 | 3.91 | .04 | 3.87 | .02 |

The yield of this plot approximates that of the first, individual trees varying from 2910 to 4964 apples and the percentage of wormy ranging from 2.95 to 6.06. There is a wider variation in the wormy fruit than obtains on trees in the other plots, though the average for the plot is decidedly less than in plot 1 and only a little more than in plot 2. This discrepancy is probably explainable by variations in application which it is almost impossible to avoid under practical conditions. Here as in the preceding plots, the greater proportion of the wormy fruit has been injured by the late-hatching larvae of the first brood, only .04 per cent being end wormy.

**Webster orchard, checks (unsprayed), 1915**

| TREE | | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | End | Side July | Side August |
| X | Drops..... | 246 | 119 | 91 | 24 | 45 | 4 | 40 | 1 |
| | Picked..... | 1 892 | 499 | 1 295 | 133 | 81 | 1 | 78 | 3 |
| | Total..... | 2 138 | 618 | 1 386 | 157 | 126 | 5 | 118 | 4 |
| | Per cent.... | ..... | 28.90 | 64.82 | 7.34 | 5.89 | ..... | 5.51 | ..... |
| Y | Drops..... | 352 | 78 | 187 | 50 | 92 | 11 | 77 | 1 |
| | Picked..... | 2 929 | 440 | 2 479 | 196 | 127 | 1 | 122 | 7 |
| | Total..... | 3 281 | 518 | 2 666 | 246 | 219 | 12 | 199 | 8 |
| | Per cent.... | ..... | 15.78 | 81.25 | 7.49 | 6.67 | ..... | 6.06 | ..... |
| Grand total.... | | 5 419 | 1 136 | 4 052 | 403 | 345 | 17 | 317 | 12 |
| Per cent..... | | ..... | 20.96 | 74.77 | 7.43 | 6.36 | .31 | 5.84 | .22 |

The two check trees bore 2138 and 3281 apples, the percentage of wormy fruit being 5.89 and 6.67 respectively. Most of the affected apples bore the side injury of late-hatching worms of the first brood, though there is a perceptibly larger percentage of end-wormy fruit. The extremely low percentage, for check trees, of wormy apples is surprising and can be accounted for only by the very thorough and systematic spraying of earlier years. This view is further supported by the fact that examinations under nearby trees just across the road from the experimental orchard showed that 75 per cent of the apples lying on the ground were badly injured by the codling moth. This plainly indicates that the insect, if left to itself, would have been extremely abundant, and at least suggests that there may be great value in annual treatments whether the trees be in fruit or not.

**Webster orchard, summary of plots, 1915**

| PLOTS | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | End | Side July | Side August |
| 1 Total..... | 23 503 | 11 291 | 10 835 | 1 337 | 1 224 | 28 | 1 188 | 29 |
| Per cent..... | ..... | 48.04 | 46.10 | 5.68 | 5.20 | .11 | 5.05 | .12 |
| 2 Total..... | 15 604 | 10 529 | 4 082 | 1 087 | 511 | 13 | 496 | 8 |
| Per cent..... | ..... | 67.47 | 26.15 | 6.97 | 3.27 | .08 | 3.17 | .05 |
| 3 Total..... | 22 039 | 16 701 | 3 671 | 1 038 | 863 | 10 | 853 | 6 |
| Per cent..... | ..... | 75.77 | 16.65 | 4.70 | 3.91 | .04 | 3.87 | .02 |
| Total sprayed Plots..... | 61 146 | 38 521 | 18 588 | 3 462 | 2 598 | 51 | 2 537 | 43 |
| Per cent..... | ..... | 62.99 | 30.39 | 5.66 | 4.24 | .08 | 4.14 | .07 |
| Checks, total..... | 5 419 | 1 136 | 4 052 | 403 | 345 | 17 | 317 | 12 |
| Per cent..... | ..... | 20.96 | 74.77 | 7.43 | 6.36 | .31 | 5.84 | .22 |

The yield in this orchard was so uniform that the figures need comparatively little explanation, the one exception being that plot 2 produced a distinctly lighter crop than either plots 1 or 3. Despite this, there is a progressive increase with the number of sprayings from 48.04 to 75.77 per cent of perfect fruit and a correlated decrease from 46.10 to 16.65 per cent of scabby apples. It will be noted that a great reduction in scab infection resulted from the second spraying. These figures are in marked contrast to the 20.96 per cent perfect and the 74.77 per cent scabby fruit on the check trees. There is comparatively little, as in other plots, variation in the percentage of apples injured by the leaf roller. This amounts, for the three plots, to 5.68, 6.97 and 4.70, respectively. These discrepancies are more easily explained as normal differences among groups of trees to be found in every orchard rather than as results from the applications or minor deficiencies in treatment. The second spraying reduced the percentage of wormy fruit in this orchard approximately by 2 per cent, while the plot sprayed three times did not give quite so good results. This latter is presumably due to normal and unavoidable variations either in the trees or the treatment. It will be observed that most of the wormy apples were injured by the late-hatching larvae of the first brood and that only .08 per cent of the fruit on all the plots was entered at the end. The relatively small difference between the sprayed and the unsprayed trees, so far as wormy apples are concerned, has already been commented upon.

**Summary of the one spray treatment, 1915**

| ORCHARD | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | End | Side July | Side August |
| Newfane | | | | | | | | |
| Total | 5 391 | 662 | 4 316 | 709 | 729 | 91 | 512 | 272 |
| Per cent | ..... | 12.20 | 80.05 | 13.15 | 13.52 | 1.68 | 9.49 | 5.04 |
| Kendall | | | | | | | | |
| Total | 5 598 | 2 107 | 2 042 | 1 680 | 1 549 | 28 | 1 419 | 126 |
| Per cent | ..... | 37.63 | 36.45 | 30.01 | 27.67 | .50 | 25.34 | 2.25 |
| Webster | | | | | | | | |
| Total | 23 503 | 11 291 | 10 835 | 1 337 | 1 224 | 28 | 1 188 | 29 |
| Per cent | ..... | 48.04 | 46.10 | 5.68 | 5.20 | .11 | 5.05 | .12 |
| Grand total | 34 492 | 14 060 | 17 193 | 3 726 | 3 502 | 147 | 3 119 | 427 |
| Per cent | ..... | 40.76 | 49.84 | 10.80 | 10.15 | .42 | 9.04 | 1.23 |

For the purpose of comparing results in different orchards following the same treatment, the data relating to the three plots receiving

only one spraying are compared above. It will be noted that there is a wide discrepancy in either the number or percentage of perfect apples, due largely to local conditions and resulting particularly from scab infection. There is also a considerable, though not such a wide variation in the amount of fruit injured by the leaf roller. The number and percentage of apples infested by the codling moth vary greatly in the different orchards and range from 5.20 to 27.67 per cent. This percentage difference is to be accounted for partly by the much larger crop in the Webster orchard, though it will be noted on comparing the results obtained in the Newfane and Kendall orchards, that the yield for each plot was approximately the same, while the percentage of infested apples was twice as great in the latter. Injury by larvae entering at the blossom end was comparatively small, while by far the greater part of the damage is to be attributed to late-hatching larvae entering the apples in July.

**Summary of the two spray treatment, 1915**

| ORCHARD | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | End | Side July | Side August |
| Newfane | | | | | | | | |
| Total | 5 638 | 2 352 | 2 258 | 732 | 723 | 38 | 574 | 266 |
| Per cent | ..... | 41.71 | 40.04 | 12.98 | 12.82 | .67 | 10.10 | 4.71 |
| Kendall | | | | | | | | |
| Total | 2 847 | 1 092 | 343 | 1 194 | 901 | 15 | 837 | 55 |
| Per cent | ..... | 38.35 | 12.04 | 41.93 | 31.64 | .52 | 29.39 | 1.93 |
| Webster | | | | | | | | |
| Total | 15 604 | 10 529 | 4 082 | 1 087 | 511 | 13 | 496 | 8 |
| Per cent | ..... | 67.47 | 26.15 | 6.97 | 3.27 | .08 | 3.17 | .05 |
| Grand total | 24 089 | 13 973 | 6 683 | 3 013 | 2 135 | 66 | 1 907 | 329 |
| Per cent | ..... | 58. | 27.74 | 12.50 | 8.86 | .27 | 7.91 | 1.36 |

The three plots compared in the table present considerable differences as in the case of those receiving but one application, the percentage of perfect fruit being decidedly greater in the Webster orchard. This latter is easily accounted for to some extent at least, by the large crop and, within certain limits, relative freedom from scab infection. There are wide variations in the percentages of apples injured by the leaf roller, these varying from 6.97 per cent in the case of the Webster orchard to 41.93 per cent for the Kendall orchard. There is nearly as wide a range in the percentage of apples infested by the codling moth, by far the greater part of the damage being due to larvae hatching from late-deposited eggs.

**Summary of the three spray treatment, 1915**

| ORCHARD | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | End | Side July | Side August |
| Newfane | | | | | | | | |
| Total | 6 108 | 3 367 | 1 440 | 679 | 1 015 | 36 | 750 | 261 |
| Per cent | ..... | 55.10 | 23.57 | 11.11 | 16.61 | .58 | 12.27 | 4.27 |
| Kendall | | | | | | | | |
| Total | 1 683 | 589 | 195 | 697 | 582 | 5 | 564 | 6 |
| Per cent | ..... | 34.99 | 11.52 | 41.41 | 34.52 | .29 | 33.51 | .35 |
| Webster | | | | | | | | |
| Total | 22 039 | 16 701 | 3 671 | 1 038 | 863 | 10 | 853 | 6 |
| Per cent | ..... | 75.77 | 16.65 | 4.70 | 3.91 | .04 | 3.87 | .02 |
| Grand total | 29 830 | 20 657 | 5 306 | 2 414 | 2 460 | 51 | 2 167 | 273 |
| Per cent | ..... | 69.24 | 17.78 | 8.09 | 8.24 | .17 | 7.26 | .91 |

The plots receiving three applications differed most widely in the size of the crop, ranging from 1683 apples in the case of the Kendall orchard to 22,039 in the Webster orchard. The perfect fruit ranged from 34.99 to 75.77 per cent, a considerable proportion of this difference being due to variations in scab infection, although the leaf roller and codling moth were also responsible for many imperfect apples. The percentage injured by the former ranged from 4.70 to 41.41, and of the latter from 3.91 to 34.52, the greater relative injury invariably being on the plot bearing the smallest crop. End-wormy apples for the three plots amount to only .17 per cent, by far the greatest damage being done by larvae hatching in July.

**Summary of check (unsprayed) tree records, 1915**

| ORCHARD | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | End | Side July | Side August |
| Newfane | | | | | | | | |
| Total | 979 | 13 | 866 | 99 | 681 | 293 | 684 | 331 |
| Per cent | ..... | 1.32 | 88.45 | 10.11 | 69.56 | 29.92 | 69.86 | 33.81 |
| Kendall | | | | | | | | |
| Total | 651 | 63 | 419 | 178 | 430 | 18 | 373 | 33 |
| Per cent | ..... | 9.52 | 62.82 | 27.34 | 67.58 | 2.76 | 57.29 | 5.06 |
| Webster | | | | | | | | |
| Total | 5 419 | 1 136 | 4 052 | 403 | 345 | 17 | 317 | 12 |
| Per cent | ..... | 20.96 | 74.77 | 7.43 | 6.36 | .31 | 5.84 | .22 |
| Grand total | 7 049 | 1 212 | 5 337 | 680 | 1 456 | 328 | 1 374 | 376 |
| Per cent | ..... | 17.19 | 75.71 | 9.64 | 20.65 | 4.65 | 19.49 | 5.33 |

The two check trees in each of the three unsprayed plots show wide variation in yield, ranging from 651 to 5419 apples for the Kendall and Webster orchards, respectively. The perfect fruit varied from 1.32 to 20.96 per cent, scab infecting 88.45 per cent of the apples in the Newfane orchard and 74.77 per cent in the Webster orchard. A considerable variation is also noticed in the amount of fruit injured by the leaf roller and the codling moth, this latter being particularly marked when the results obtained in the Webster orchard are compared with the other two plots. The most striking contrast is seen in the percentage of end wormy, this amounting in the case of the Newfane orchard to 29.92, while in the Kendall orchard it was only 2.76 and in the Webster orchard .31. The comparative freedom from codling moth injury of the check trees in the Webster orchard has been commented upon above.

**Comparative tabulation of codling moth results in three orchards 1915**

| TREATMENT | NO. | PERFECT | SCAB | LEAF ROLLER OR GREEN FRUIT WORM | CODLING MOTH, WORMY | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | End | Side July | Side August |
| One spraying | | | | | | | | |
| Total | 34 492 | 14 060 | 17 193 | 3 726 | 3 502 | 147 | 3 119 | 427 |
| Per cent | ..... | 40.76 | 49.84 | 10.80 | 10.15 | .42 | 9.04 | 1.23 |
| Two sprayings | | | | | | | | |
| Total | 24 089 | 13 973 | 6 683 | 3 013 | 2 135 | 66 | 1 907 | 329 |
| Per cent | ..... | 58. | 27.74 | 12.50 | 8.86 | .27 | 7.91 | 1.36 |
| Three sprayings | | | | | | | | |
| Total | 29 830 | 20 657 | 5 306 | 2 414 | 2 460 | 51 | 2 167 | 273 |
| Per cent | ..... | 69.24 | 17.78 | 8.09 | 8.24 | .17 | 7.26 | .91 |
| Checks or unsprayed | | | | | | | | |
| Total | 7 049 | 1 212 | 5 337 | 680 | 1 456 | 328 | 1 374 | 376 |
| Per cent | ..... | 17.19 | 75.71 | 9.64 | 20.65 | 4.65 | 19.49 | 5.33 |

The comparative tabulation of the results obtained from the three sprayed plots and on the check or unsprayed trees, shows in the first place a somewhat uniform total yield from the plots in the orchards treated in the same manner, though as brought out above, in two of the orchards at least, there were considerable discrepancies between the plots receiving the different treatments. It will be noted on referring to the table, that the percentage of perfect fruit increases progressively with the number of sprayings from 40.76 in the case of one application to 58 for two applications, and 69.24 for three applications, there being a similar and related decrease in scab infection. The control of this fungus was the important factor in

increasing the percentages of perfect fruit. The results, so far as control of the leaf roller is concerned, are not illuminating, since for the plot receiving one spraying the infestation amounted to 10.80 per cent, that sprayed twice to 12.50 per cent and that receiving three treatments, 8.09 per cent. It is doubtful if these variations possess much significance and the probabilities are that they can be more easily accounted for by variations in the infestation of the different plots and unavoidable differences in treatment, rather than to the value of late applications for the destruction of this pest.

The codling moth data are worthy of special comment, since they show unmistakably the benefits resulting from one application just after the blossoms fall and the comparatively small returns following later sprayings. The percentage of wormy apples for the three plots sprayed but once, amounted to 10.15, while that for the plots sprayed twice was 8.86, and for that sprayed three times, 8.24. The difference between the plots sprayed once and twice was only 1.29 per cent in favor of the latter, while between this and the plots sprayed three times, there is a difference of only .62 per cent. These figures are not quoted for the purpose of discouraging second and third sprayings for the control of the codling moth, but rather to emphasize the value of the first treatment. We are still of the opinion that control not obtained with the application made just after the blossoms fall, can not be secured in any practical manner by subsequent treatments.

The past season was exceptionally favorable for the development of scab, and in the control of this disease we find ample justification for two or even three applications after the blossoms drop. These later treatments should, in our estimation, be given more for the purpose of controlling this fungus than as a check upon the codling moth, though it is by all means desirable to add poison to the fungicide for the purpose of destroying as many codling moth larvae and various leaf feeders as practical.

### SIDE INJURY

Approximately nine-tenths of the wormy apples on the sprayed trees showed the typical blemish (plate 1) caused by the late-hatching larvae of the first brood. These come from eggs deposited on the fruit the latter part of June and early in July. The young larvae enter the exposed, smooth surface of the developing apple and excavate a shallow gallery having a radius of approximately one-sixteenth of an inch and frequently marked by a reddish or reddish brown spot. This is probably a manifestation of the leaf-mining

habit of the young larvae, recorded by a number of observers in relation to those hatching from eggs deposited upon the foliage. A few days after entering the fruit many of the larvae desert the initial point of injury and make their way to the blossom end. This tendency to forsake an apparently perfectly satisfactory shelter is probably an inherited one and is analogous to the action of the larva leaving the temporary leaf mines in the search for fruit.

Investigations relative to the prevalence of this type of injury show its somewhat general occurrence along the south shore of Lake Ontario and in the vicinity of Lake Erie, as evidenced by the following observations.

In an examination September 18th of a "tree-run" of greening apples in the packing shed of Mr H. B. Eaton of Youngstown and said to be below the average, the following conditions were noted: 589 apples were examined of which 73 showed a July side worm infestation, 2 a July and August side worm infestation, and 2 an August side worm injury.

In an Albion orchard a greening tree bearing fruit on one side and presumably unsprayed, had practically 99 per cent wormy, there being 2 to 4 or even 6 side injuries on individual apples.

Counts in two Waterport orchards were kindly made by Mr A. B. Buchholz of Albion and his data are as follows:

In the orchard of B. G. Wilson, 438 Hubbardston apples were examined with the following results: perfect, 345; side wormy, July, 69; side wormy, August, 4; green fruit worm, 22.

In the orchard of H. L. Brown, a lot of 529 Hubbardston apples gave: perfect, 468; end wormy, 0; side wormy, July, 34; green fruit worm, 18.

Mr Brown sprays but once for the codling moth and usually has good results, though formerly he had considerable trouble with this pest. It has taken him several years to bring the insect under control. A later examination of over a barrel of "tree-run" Baldwins from Mr Brown's orchard resulted in finding 365 perfect apples; 58 scabby apples; 9 infested by leaf roller; 18 side wormy, the larvae having penetrated deeply into the fruit in 6 of these. Approximately a bushel of Baldwins from an old orchard belonging to Mr Brown was also classified with the following results: perfect, 75; sooty blotch or scab, 57; roller and scab, 1; end and side wormy, 1; side wormy, 3; side wormy, July, 19.

Mr J. B. Achilles made an examination of a sample lot of fruit in a Batavia orchard and tabulated his data as follows: perfect, 55; scab, 283; end wormy, 7; end and side wormy, 5; side wormy,

July, 27; side wormy, August, 28; green fruit worm, 13; total number of apples examined, 418. This orchard, it was stated, had been sprayed three times, arsenate of lead being used twice.

The orchard of Mr G. H. Rudman of Irondequoit, was examined and several heavily loaded Baldwin trees appeared to have an infestation which would compare favorably with conditions obtaining in the Webster orchard, though no precise counts were made.

An examination of a greening orchard at Charlotte showed a serious infection by scab and side injury which would probably approximate 20 per cent or over, a lot of 28 apples showing 1 injured by the leaf roller, 26 infected by scab, 1 end wormy and 13 side wormy.

One hundred king apples, " tree-run," from the orchard of Mr C. F. Kraus of Clarence, Erie county, were classified by Mr Strickland as follows: end wormy, 0; side wormy, July, 42; side wormy, August, 2; perfect, 56. This orchard had been sprayed once after the falling of the blossoms.

Again, 674 Baldwins from the orchard of Mr G. H. Wilder of Akron, Erie county, were classified by Mr Strickland as follows: perfect, 207; end wormy, 13; side wormy, July, 440; side wormy, August, 69; total wormy fruit, 468. It was stated that the trees in this orchard had been sprayed in the pink of the blow, again following the drop of the blossoms and two weeks after the blossoms fell, with lime-sulphur and arsenate of lead.

It will be seen by referring to this data from the different orchards, that side injury was not only prevalent but also rather serious in many orchards within 25 miles of the Great Lakes.

In this connection it may be desirable to add that in Mr Strickland's estimation one-fourth of the crop in many orchards in 1914 was marred by this characteristic side blemish.

The conditions in the western part of the State varied markedly from those obtaining in the Hudson valley. In the first place eggs were decidedly more common upon the fruit during July in Niagara county, it being comparatively easy to find one, two, three or even four upon individual apples while there were almost none upon the leaves, whereas at about the same time in Rensselaer county, recently deposited eggs and egg shells were more abundant on the foliage than upon the apples, there being two of the former to one of the latter. This latter was upon Siberian crabapples and the marked difference may possibly be explainable in part by the smaller size of the fruit.

The discrepancy in side injury is evident from the following data:

An examination of 97 Baldwins in the orchard of Mr Edward Van Alstyne of Kinderhook, just as the apples came from the tree,

resulted in finding only 12 showing side injury, and of these but 2 were probably entered to any depth.

An average run of greenings in the orchard of Mr John S. Baker of Muitzeskill gave 8 side wormy, 3 being inhabited, out of a total of 89 apples, 1 being end wormy.

Similar conditions prevailed in and about Poughkeepsie. For example, out of 33 Baldwin apples from the orchard of Mr Peter Cornell of Arlington, only 1 showed side injury, and an estimate in Mr Hart's Titusville orchard, based upon the fruit as it was brought to the packing shed, led us to place the side injury at less than 4 per cent, most of the damage being caused by the second or August brood. Very little codling moth injury was to be seen upon either old or young trees in the orchards of Mr Fred Pulling and Ernest Emans of La Grangeville.

Injury in well-cared for orchards in and about New Paltz was by no means excessive, and in the case of that of Mr A. E. Jansen the total infestation would hardly run over 3 per cent. The effective spraying in these localities for the control of codling moth is limited almost entirely to the one application just after the blossoms fall, though Mr Jansen states that he commonly makes two sprayings after blossoming, to spys and McIntosh, largely because of their susceptibility to fungous attack.

Somewhat different conditions were observed in a lot of picked apples belonging to Mr L. L. Morrell of Kinderhook. It was found, for example, in going over a barrel to obtain some perfect fruit for exhibition, that 40 apples out of a half barrel, approximately 20 per cent, were injured by codling moth. Some showed the characteristic end worm injury though by far the greater portion was due to the usual side worm injury of the Hudson valley, the pests working deep into the fruit and causing conspicuous scars. The trees from which these apples were obtained did not bear large crops and this may, to a certain extent, explain the relatively high percentage of wormy apples.

It is evident from an examination of these data, that side injury occurs to a more or less extent throughout the State and that the damage resulting therefrom is liable to be much more serious in the western apple-growing sections. It is also apparent from a study of the situation as a whole that fruit growers here and there, even in regions where side injury is very prevalent, are growing apples with a minimum of loss from insect damage.

We have had an opportunity of watching the actual spraying in different portions of the State and we are unwilling to admit

that it is impractical to control this pest or that failure to do so is due to carelessness in individual applications. We are also unable to see the necessity of making a later application, say the latter part of June, for the purpose of destroying the late-hatching caterpillars though a spraying at that time would probably help more in controlling the codling moth than a treatment given two or three weeks after blossoming. There is a practical difficulty in attempting to destroy these late-hatching individuals by spraying at about the time they are entering the fruit, because the apples are then growing rapidly and observations have shown that the period of entry may extend over two or three weeks, making it almost impossible to keep the expanding surface of the young fruit well covered with a poison.

### OVIPOSITION AND EVENING TEMPERATURES

Side injury has been so marked in certain apple regions in the western part of the State that Mr L. F. Strickland, horticultural inspector stationed at Lockport, made records concerning oviposition and injuries caused by the young larvae.

These records we have compared with a series of evening temperatures calculated from minimum temperatures of Chatham, Wappingers Falls and Appleton, published by the United States Weather Bureau Service and corrected by adding thereto the difference between the minimum temperatures for the localities given and the mean hourly temperatures for Albany and Rochester based on a five-year record, 1891–95, kindly calculated and placed at our disposal through the courtesy of Dr P. C. Day, chief of the United States weather bureau. The Albany data were used for the correction of the Chatham and Wappingers Falls temperatures and the Rochester data for the Appleton records, the difference between the mean minimum of this period for June and July and the mean temperature at 8 p.m. being added to the recorded minima, this correction amounting for June and July for Chatham and Wappingers Falls, to 8° and 9° respectively, while for Appleton the difference was 9° and 10° respectively.

July 2, 1912 Mr Strickland records that codling moth larvae were entering the sides of apples in Mr John Garbott's orchard at Johnsons Creek, adding that almost every apple was entered at the side and that it was by no means necessary for another apple or leaf to touch. At that time very few unhatched eggs were observed, and on referring to the corrected evening records for Appleton, we find that the thermometer reached 60° or over on the 15th to the 17th, on the 20th and 21st, and from the 24th onward there was a

six day period when the evening temperature was above 60°. It is quite probable that the eggs referred to above were deposited mostly during the last of June.

Again, in 1913 he made the following record dated July 3d: "Not many side worm eggs." On the 8th he observed that a few larvae had entered the apples and that scattering eggs were also to be found. On the 19th he states that this late side injury seems to be distributed over a period of time, adding that unhatched eggs were still found and that most of the larvae entered the sides of the fruit. Referring once more to the calculated evening temperatures for Appleton in June 1913 it will be observed that they rose to 60° or above on the 13th to the 17th inclusive and that there was another period of moderately high evening temperatures from the 25th to the 30th inclusive, the latter continuing to the 10th of July. This long period of warm evenings was undoubtedly favorable to a protracted oviposition.

In 1914 the first codling moth eggs were found by Mr Strickland June 25th, and on referring to the calculated evening records for Appleton it will be noted that there was a period from the 8th to the 14th when the mercury stood above 60°, while from the 15th to the 20th it ranged below this figure, and from the 21st onward above, this latter apparently coinciding closely with the deposition of numerous eggs as noted above. The former warm period was probably a little early for the laying of many eggs. Later, in connection with apple inspection work, Mr Strickland recorded a very large proportion of side injury in Niagara county, in some instances this amounted to nearly 20 per cent of the barreled crop. In his judgment red fruit, especially Baldwin, king, wealthy and spy, was most seriously affected.

Very few codling moth eggs were found by Mr Strickland June 14 and 15 of the past season, and on the 28th and 29th he observed a few freshly laid eggs. On referring to the calculated evening temperatures for Appleton, it will be seen that the mercury was at 60° or above on the 13th to the 15th and did not remain at this point and above for a series of evenings until the 30th, while on July 8th large numbers of eggs were found by Mr Strickland in the orchard of Mr W. Briggs of Olcott, and Mr W. H. Cowper of Newfane. They were almost all unhatched, though nearly ready to disclose larvae, a condition indicating oviposition at about the time the rise in evening temperatures occurred.

Low evening temperatures could easily check the deposition of the eggs without greatly hindering the growth of the tree and such

appears to be the case. Consequently the apples become more conspicuous and smoother by the latter part of June or early in July, at the time when most of the eggs responsible for this type of injury are laid and there is a reversal of the usual habits of the moth, in that she then deposits, as shown by our observations, more eggs upon the fruit than upon the leaves. There appears to be no good reason why the recently hatched caterpillar should attack the smooth surface of the fruit, except that it is impelled by hunger and it naturally begins to feed soon after issuing, in this instance attacking the smooth surface of the fruit and causing material loss instead of the better known and comparatively harmless mining of the foliage.

Evening temperatures corrected from minimum records, 1912–15

| | June | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chatham . . | 1912 | 52 | 62 | 72 | 65 | 59 | 59 | 57 | 43 | 49 | 52 | 57 | 58 | 54 | 46 | 54 | 63 | 70 | 59 | 53 | 66 | 72 | 62 | 58 | 60 | 70 | 74 | 57 | 64 | 73 | 56 |
| | 1913 | 55 | 65 | 52 | 65 | 55 | 60 | 72 | 51 | 42 | 43 | 49 | 54 | 58 | 67 | 56 | 73 | 73 | 52 | 56 | 65 | 73 | 65 | 59 | 64 | 70 | 68 | 76 | 71 | 57 | 61 |
| | 1914 | 63 | 54 | 52 | 63 | 55 | 66 | 70 | 69 | 64 | 64 | 61 | 64 | 61 | 59 | 62 | 58 | 47 | 56 | 60 | 48 | 50 | 65 | 63 | 73 | 73 | 62 | 66 | 67 | 64 | 63 |
| | 1915 | 53 | 59 | 54 | 54 | 54 | 57 | 70 | 58 | 57 | 62 | 58 | 68 | 58 | 71 | 65 | 68 | 70 | 72 | 69 | 67 | 57 | 58 | 62 | 58 | 56 | 63 | 71 | 56 | 60 | 75 |
| Wappingers Falls . . . . | 1912 | 66 | 60 | 69 | 66 | 60 | 57 | 58 | 54 | 56 | 52 | 66 | 68 | 60 | 54 | 58 | 63 | 60 | 68 | 70 | 66 | 62 | 67 | 70 | 73 | 75 | 70 | 69 | 70 | 77 | 64 |
| | 1913 | 67 | 70 | 56 | 68 | 57 | 60 | 69 | 57 | 50 | 49 | 53 | 57 | 60 | 70 | 65 | 70 | 75 | 62 | 60 | 67 | 70 | 67 | 63 | 67 | 72 | 70 | 69 | 70 | 59 | 64 |
| | 1914 | 70 | 54 | 55 | 55 | 60 | 50 | 54 | 70 | 66 | 66 | 66 | 62 | 69 | 60 | 62 | 57 | 55 | 57 | 55 | 54 | 55 | 66 | 67 | 77 | 74 | 68 | 64 | 70 | 66 | 66 |
| | 1915 | 53 | 57 | 57 | 48 | 53 | 61 | 70 | 73 | 60 | 62 | 61 | 69 | 60 | 70 | 70 | 70 | 73 | 70 | 70 | 67 | 60 | 56 | 63 | 58 | 54 | 63 | 64 | 56 | 66 | 70 |
| Appleton . . | 1912 | 61 | 67 | 66 | 64 | 54 | 52 | 55 | 45 | 53 | 52 | 57 | 63 | 53 | 49 | 66 | 69 | 62 | 58 | 52 | 65 | 62 | 55 | 57 | 64 | 67 | 69 | 63 | 63 | 75 | 59 |
| | 1913 | 59 | 56 | 53 | 54 | 48 | 58 | 59 | 51 | 53 | 47 | 54 | 58 | 62 | 66 | 66 | 69 | 62 | 57 | 55 | 53 | 63 | 52 | 59 | 59 | 68 | 80 | 71 | 72 | 62 | 66 |
| | 1914 | 65 | 55 | 61 | 55 | 53 | 48 | 58 | 76 | 73 | 79 | 66 | 71 | 64 | 61 | 56 | 57 | 51 | 50 | 59 | 48 | 62 | 63 | 64 | 74 | 71 | 61 | 67 | 60 | 61 | 60 |
| | 1915 | 53 | 60 | 58 | 51 | 52 | 62 | 64 | 59 | 51 | 56 | 60 | 54 | 60 | 63 | 63 | 59 | 61 | 57 | 66 | 62 | 56 | 62 | 56 | 55 | 63 | 61 | 55 | 56 | 61 | 70 |

**Evening temperatures corrected from minimum records, 1912–15** (*concluded*)

| | July | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chatham.... | 1912 | 51 | 63 | 66 | 78 | 80 | 77 | 77 | 74 | 78 | 74 | 78 | 76 | 74 | 78 | 78 | 78 | 64 | 78 | 71 | 53 | 68 | 72 | 55 | 53 | 54 | 68 | 59 | 58 | 72 | 70 | 63 |
| | 1913 | 79 | 77 | 66 | 77 | 80 | 82 | 64 | 55 | 65 | 74 | 58 | 64 | 71 | 65 | 60 | 60 | 62 | 72 | 60 | 64 | 62 | 76 | 77 | 75 | 66 | 58 | 77 | 78 | 77 | 71 | 67 |
| | 1914 | 54 | 66 | 64 | 63 | 64 | 66 | 63 | 71 | 73 | 73 | 74 | 69 | 70 | 67 | 69 | 75 | 80 | 78 | 65 | 54 | 55 | 57 | 59 | 69 | 72 | 68 | 65 | 68 | 61 | 62 | 59 |
| | 1915 | 73 | 72 | 66 | 78 | 72 | 66 | 59 | 65 | 73 | 66 | 73 | 66 | 65 | 69 | 70 | 76 | 81 | 71 | 79 | 69 | 68 | 66 | 67 | 68 | 66 | 68 | 75 | 64 | 77 | 70 | 84 |
| Wappingers Falls..... | 1912 | 56 | 63 | 69 | 71 | 85 | 75 | 75 | 81 | 79 | 79 | 82 | 81 | 78 | 81 | 78 | 81 | 73 | 81 | 78 | 58 | 71 | 70 | 63 | 61 | 60 | 71 | 63 | 62 | 71 | 71 | 64 |
| | 1913 | 81 | 79 | 69 | 81 | 79 | 81 | 66 | 64 | 71 | 73 | 61 | 63 | 74 | 71 | 63 | 63 | 71 | 70 | 78 | 77 | 67 | 66 | 71 | 70 | 71 | 60 | 66 | 74 | 81 | 76 | 74 |
| | 1914 | 57 | 68 | 67 | 66 | 67 | 69 | 65 | 69 | 71 | 75 | 73 | 73 | 77 | 71 | 69 | 78 | 79 | 74 | 68 | 59 | 64 | 61 | 62 | 71 | 73 | 71 | 71 | 69 | 61 | 63 | 59 |
| | 1915 | 73 | 68 | 71 | 72 | 71 | 65 | 60 | 70 | 59 | 65 | 65 | 68 | 64 | 68 | 71 | 74 | 77 | 69 | 71 | 72 | 69 | 67 | 67 | 64 | 61 | 61 | 71 | 64 | 77 | 72 | 79 |
| Appleton..... | 1912 | 50 | 60 | 74 | 76 | 78 | 76 | 76 | 77 | 77 | 80 | 78 | 70 | 70 | 78 | 77 | 68 | 65 | 65 | 65 | 57 | 67 | 68 | 67 | 66 | 63 | 69 | 70 | 66 | 76 | 70 | 59 |
| | 1913 | 83 | 72 | 67 | 72 | 76 | 66 | 65 | 60 | 68 | 68 | 57 | 64 | 70 | 60 | 59 | 60 | 72 | 71 | 65 | 69 | 63 | 58 | 59 | 73 | 59 | 60 | 67 | 78 | 73 | 73 | 66 |
| | 1914 | 62 | 68 | 64 | 60 | 69 | 67 | 67 | 72 | 74 | 73 | 73 | 76 | 77 | 77 | 75 | 74 | 81 | 70 | 65 | 57 | 72 | 71 | 74 | 73 | 74 | 76 | 73 | 69 | 66 | 60 | 62 |
| | 1915 | 69 | 67 | 70 | 64 | 70 | 64 | 65 | 67 | 63 | 67 | 73 | 70 | 73 | 70 | 74 | 76 | 77 | 67 | 74 | 64 | 63 | 64 | 60 | 61 | 71 | 72 | 64 | 67 | 74 | 74 | 78 |

## SUMMARY AND CONCLUSIONS

A general survey of the conditions in the apple belt of the western part of the State shows that some growers are able to obtain practically worm-free apples with one spraying for the codling moth, others with two or three applications, while many suffer great losses in spite of frequent and apparently thorough treatments. We believe that practically all these conditions can be found throughout the belt. It logically follows that if one man can control the pest, his neighbor should be able to do equally well, and the difference depends largely upon the thoroughness with which the work is done. It is no easy matter to control this pest effectively, especially during seasons when many eggs are deposited late in June and early in July. The peculiar habits of the young apple worms hatching from late-deposited eggs, make it very difficult to destroy many by late spraying, and consequently freedom from side injury one season is determined in considerable measure by the treatment of the preceding year. We can hardly expect, under conditions prevailing in the western part of the State, to clean up badly infested orchards in one season. It will require two and possibly more. Generally speaking, unsatisfactory results are due to some deficiency or weakness in the treatment which can be eliminated only by careful search for the weak point.

The first spraying for the codling moth, the treatment just after blossoming, is by far the most effective application which can be made for controlling the pest.

The presence of abundant " side injury " is a most potent argument for thorough annual sprayings for the codling moth whether the trees be fruiting or not. This may be unnecessary where " side injury " is not serious as, for example, in the Hudson valley.

The second spraying for the codling moth would probably be more effective in reducing " side injury " if it were made the latter part of June, though so far as checking this pest is concerned, it does not seem to be essential.

Both the second and third sprayings for the codling moth, even if they have comparatively little influence in reducing the numbers of this pest, are abundantly justified in localities where scab is more or less prevalent, assuming, of course, that a fungicide is universally added to the poisoned spray.

## CHRYSANTHEMUM MIDGE

*Diarthronomyia hypogaea* H.Lw.

Specimens of badly infested chrysanthemum plants were received under date of March 27, 1915 from Prof. R. H. Pettit of the Michigan Agricultural College, accompanied by the statement that this midge was causing serious injury in the houses of a commercial chrysanthemum grower at Adrian, Mich. A few plants accompanying this communication were so badly swollen and distorted by the numerous galls upon the leaves and stems that it was evident they could not develop normally and were therefore practically valueless. This was followed by the reception the latter part of September, of both galls and adults from Arthur Gibson, first assistant government entomologist, Department of Agriculture, Ottawa, Canada, and from Prof. E. O. Essig, Berkeley, Cal., indicating that the species, a European form, had become established in at least three widely separated American localities. The pest has also been received from Oregon.

**Injuries.** The damage is caused by a small, reddish midge about one-fifteenth of an inch long, which deposits its eggs upon the developing plant, the type of damage depending largely upon the time and manner of infestation. An abundant deposition of eggs upon young plants 3 to 5 inches high may result in greatly enlarged, irregularly swollen stems (these sometimes being twice their normal diameter), deformed rudiments of leaves caused by an arrested development, and a failure to produce blossoms, the plant making an ill-shaped head.

A less serious infestation, especially if this occurs after the plant has secured a good start, may result in a few comparatively insignificant swellings or galls on the stems, the presence of similar growths, frequently rather scattered (plate 13) on the leaves and more or less deformation of the flowers. Professor Pettit has found the galls on leaves, stems, buds and calyxes, though no plants coming into our hands have borne affected flowers.

**Food plants.** This insect has been recorded from central and southern Europe as infesting Chrysanthemum leucanthemum, C. corymbosum, C. atratum, C. japonicum and C. myconis, the first named, at least, being deformed as seriously and as variously as described above for the cultivated chrysanthemum in this country. It was first noticed in America on the variety known as mistletoe. Most cultivated chrysanthemums appear to be susceptible though, owing to the apparently local habits of the midges, the infestation is apt to be very uneven.

**Recognition characters.** The injuries briefly described above are the work of small maggots, which are pale greenish while young, later showing the characteristic yellowish or yellowish orange color of gall midge larvae. These irritate the tissues and produce irregular, ovoid swellings, each with a length of about one-twelfth of an inch and very frequently projecting at a rather marked, oblique angle above the normal surface of the affected tissues. A series of these galls side by side result in irregular, confluent swellings.

One of the easiest methods of detecting the young, inconspicuous galls is to allow the leaf to slip through the loosely closed fingers, a process which will readily disclose the presence of slight swellings. It is particularly desirable to recognize even the smallest galls if an attempt is made to eradicate the insect in a greenhouse, since the transformations occur within the plants. The small developing gall appears as a slight, nodular elevation with a darker center protected to some extent by an unusually abundant mass of short, white hairs, while the fully developed gall has comparatively few of these short hairs and the discolored apical portion makes it relatively conspicuous. The deformations containing insects nearly ready to escape may be recognized by the small, withered, discolored, free tip. Scattering galls may occur almost anywhere along the stem, on the petiole of the leaf, on the leaf surface, along the veins of the leaves, and occasionally at the very tip of a lobe.

**Technical description.** *Egg.* Reddish orange, length .15 mm, diameter .03 mm, the extremities narrowly rounded.

*Gall.* An irregular, oval, concolorous swelling (plate 13) with a length about 2 mm, usually at a distinct angle to the surface of the plant tissues and frequently causing large, confluent swellings of the stem, leaf or flower head.

*Larva.* Length 1 mm, yellowish or yellowish orange when full grown, moderately stout, the extremities rounded; segmentation distinct and the skin smooth.

*Pupa.* Length 1.25 mm, stout, narrowly oval, the cephalic horns distinct, conical, the thorax yellowish orange, the wing pads fuscous in pupae nearly ready to transform, the leg cases dark yellowish brown, the abdomen a variable orange, narrowly rounded apically.

*Male.* Length 1.75 mm. Antennae nearly as long as the body, sparsely haired, fuscous yellowish; 17 or 18 segments, the fifth with a stem about three-fourths the length of the subcylindric basal enlargement, which latter has a length about twice its diameter and a rather thick subbasal whorl of long, stout setae; terminal segment variable, usually somewhat reduced, irregular, elongate, ovate. Palpi; the first segment subquadrate, the second narrowly oval. Mesonotum dark brown, the submedian lines yellowish. Scutellum and postscutellum fuscous yellowish, the abdomen mostly a pale yellowish orange. Wings hyaline, costa light straw, halteres yel-

lowish transparent. Legs a pale straw, the pulvilli a little longer than the long, slender claws, the latter with a long, slender tooth basally. Genitalia; basal clasp segment moderately long, stout; terminal clasp segment short, stout, with a distinct spur; dorsal plate short, deeply and roundly emarginate, the lobes short, broad, obliquely truncate apically; ventral plate short, deeply and roundly emarginate, the lobes rather long and tapering to a narrowly rounded apex.

*Female.* Length 1.75 mm. Antennae extending to the third abdominal segment, sparsely haired, fuscous yellowish; 16 or 17 segments, the fifth with a stem about one-third the length of the cylindric basal enlargement, which latter has a length a little over twice its diameter; terminal segment reduced, sometimes compound and tapering to a narrowly rounded apex. Palpi; the first segment subquadrate, the second subconical and with a length a little greater than the first. Mesonotum fuscous brown, the submedian lines, the posterior median area, the scutellum and post scutellum mostly fuscous yellowish, the apex of the scutellum narrowly fuscous. Abdomen reddish orange, apically fuscous yellowish, the ovipositor about one-half the length of the body; terminal lobes short, broad, broadly rounded and sparsely setose apically. Other characters practically as in the male.

**Life history.** This insect, like allied greenhouse species, probably breeds continuously when conditions are favorable and presumably displays a marked preference for buds or tissues just unfolding from the buds. The transformations of this midge occur within the gall and it is probable that hibernation or aestivation may take place either in the adult or possibly as larvae in slowly developing, subterranean, presumably root stalk galls.

April 13, 1915 a number of infested plants were received from Michigan, a few midges emerged the following day and others were observed in the cages from day to day until the 26th. April 27th several males and females were put on a clean plant at about 10 a.m., and at 2.35 p.m. two females were observed investigating various leaves; one appeared to be much agitated and repeatedly thrust her long, slender ovipositor among the leaf hairs along the surface of the leaf. An examination of this leaf under a three-fourths inch compound objective revealed an elongate, oval, pale orange egg lying on the surface, almost horizontally and nearly completely hidden by the overlying leaf hairs. One female found dead in a cage had attached to her a string of extruded eggs, there being over forty and possibly nearly fifty, and on examination under a high power, streaming movements were observed in certain of the eggs, which lead us to believe that the egg stage is probably twenty-four hours or less. Owing to unfavorable conditions it was not possible to carry the insect through a life cycle, though the probabilities are

that this latter, as in the case of the allied rose midge and Hessian fly, may be completed in four weeks or less.

Observations in a commercial greenhouse show that the insects are comparatively inactive during the winter when temperatures are kept low (about 50 degrees), but as the houses warm up in the spring the pests become more active and a serious infestation may prevail for a time. This seems to be followed by a quiescent period which probably persists through the summer and then there is a resumption of activities in the fall, since rather badly infested plants and emerging flies were again to be found about the middle of October. Plants growing outdoors appear to be relatively free from infestation.

**Distribution and future probabilities.** This species has been recorded from central and southern Europe and, as stated above, it has already become established in several widely separated localities in this country, probably by the shipment of infested plants or cuttings. It was very likely brought to America without the normal quota of parasites and for a time at least it may prove to be a somewhat difficult insect to control, though it would seem as if the native parasites of our large and varied gall midge fauna might in time prey most successfully upon this midge.

**Control measures.** It is desirable to ascertain the present distribution of the chrysanthemum midge in America, and growers of this popular flower would do well to adopt every reasonable precaution to keep their stock free from the insect, especially since it lives also upon the common white daisy, Chrysanthemum leucanthemum, a widely distributed, introduced weed which would probably mean the persistence of the insect in a locality once it becomes well established, with presumably more or less perennial infestation and injury to cultivated chrysanthemums.

Badly infested plants should be burned (they are practically worthless) and it is possible that by cutting off and destroying the infested portions of others, it may be practical to exterminate the insect in greenhouses without resorting to more drastic measures. Fumigation with hydrocyanic acid gas has been practised by one large grower with considerable success, and so long as this treatment was given nightly the infestation was comparatively light, though if for any reason it was impossible to fumigate, midges were likely to be numerous the next day. Data at hand incline us to believe that this treatment can hardly be considered as more than repressive, and on that account we would emphasize the desirability of starting with clean stock and adopting every reasonable means to avoid infestation.

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## WHITE GRUBS

The white grub outbreak of last season, predicted the preceding fall, was very serious in southern Rensselaer and northern Columbia counties in particular, though the damage was mitigated to a considerable extent by an unusually copious and well-distributed rainfall during the summer months. Grasslands, including both old pasture and recently seeded ground, were badly infested though the damage was more restricted and " spotty " than in 1912, probably due in part to the activity of natural enemies and partly to the unusually vigorous growth of grass at the time the grubs were feeding most actively.

There was also in this connection serious injury to susceptible crops planted on land badly infested by young grubs. In some instances this was so severe as to result in the practical loss of 30 to 75 per cent of the potato crop (see plate 12). Fodder corn, and especially field corn, was also seriously damaged.

Collections of adults in various sections of the State in 1914 clearly show that Lachnosterna fusca Froh. is by far the most abundant and injurious species in the upper Hudson valley, though L. fraterna Harr. was somewhat numerous. The most destructive species on Long Island, as evidenced by these collections, were L. hirticula Knoch. and L. tristis Fabr. These beetles resemble each other so closely that there is little probability of most

[1] Not available for reference.

people attempting to distinguish the various species. Fortunately they are so distinct from other insects that there is little danger of their being confused therewith, and so far as practical considerations are concerned, there is small need to distinguish between the closely related forms, since all have very nearly the same habits. The feeding of these beetles, while rarely seriously injurious to affected trees, may be taken advantage of to some extent to indicate the approximate amount of injury which may be expected from the grubs the following season.

**Preventives and remedies.** The three-year life cycle of these pests and the marked tendency of the beetles to deposit their eggs in the more luxuriant adjacent grass, makes it comparatively easy to anticipate injuries, especially if some attention is paid to the amount of feeding by the beetles upon forest and other trees. It should be remembered that damage by the beetles precedes by approximately twelve months the most severe injury likely to accompany the feeding of the grubs.

Again, the eggs are laid in June and in September or early October small white grubs one-fourth to half of an inch long are readily found about grass roots and usually within three inches of the surface of the soil. Land badly infested in this manner should be plowed as soon as possible, disked once or twice and, if practical, fowls or hogs allowed to run over the ground for a time and destroy many of the pests. Such land should not be planted with potatoes, corn or other susceptible crops. Small grains, especially rye, buckwheat, clover and vetch, may be sown and if the seeding is early enough it may be possible to avert the damage which would normally occur the following season if nothing were done. Land in good cultivation at the time the beetles fly is rarely badly infested by eggs though occasionally grubs may work into such ground from adjacent strips of sod such as that lying along a fence or the margin of another field.

Land badly infested with grubs one-half to three-fourths grown, the condition obtaining in the fall of 1915 in many localities, may be planted with susceptible crops in the spring of 1916 with a moderate degree of safety if the planting is delayed until the early part or possibly the middle of June, since at about that time the grubs will have largely ceased feeding.

The extended life cycle of these pests and their restriction to grasslands make it apparent that systematic rotation of crops is one of the most important preventive measures that can be employed. A rotation which does not allow land to remain in sod for more than two or three years, if generally followed in a neighborhood, will

reduce the danger of serious injury to a minimum. Such a rotation is also in accord with good agricultural practice.

The danger of losing crops when corn, potatoes or strawberries are planted upon recently turned, infested sod should be more generally recognized. The small white grubs are, as pointed out above, by far the most dangerous and it is by no means difficult to recognize them either in the fall or in the spring just before planting time, since they have practically the same appearance as when larger. The serious consequences following planting upon such land is due mostly to the great reduction in the number of plants to the square yard and the inevitable concentration of the grubs upon those allowed to grow. There is nothing to show that white grubs migrate to any extent, that is, more than a rod or two through the soil. Susceptible crops, if they must be put on infested land, should be fed liberally and cultivated thoroughly in order to assist the plants to outgrow the partial destruction of their roots.

## GRASSHOPPERS

The outbreak of last year continued through the present summer and in some localities was very severe, though in most sections, especially where active measures were adopted in 1914, the injury was relatively light. Our investigations the past season were confined largely to Fulton and Saratoga counties. The lesser red-legged grasshopper, *Melanoplus atlanis* Riley, was by far the most destructive species, as was the case the year before, though there was some injury by the two-striped grasshopper, *Melanoplus femoratus* Burm., a species easily distinguished by its larger size, greenish or yellowish brown color and the two distinct yellowish lines on the back.

The infestation in Fulton county was decidedly less than that of the preceding year, due in large measure to the wholesale poisoning of 1914. At our request an examination of this section was made in early June by Mr P. M. Eastman of the Department of Agriculture. He found in the vicinity of Union Mills, especially near Clipp Hill, large numbers of grasshoppers and so far as he could learn very little poisoned bait had been used in that section last year. The wild country in and around Meco, and also west of Gloversville and extending beyond Garoga, was badly infested, which was also true in a similar section 2 or 3 miles beyond Berkshire toward Broadalbin. His investigations in the vicinity of St Johnsonville and Middlesprite resulted in finding relatively few of the insects, though certain residents of the latter place had feared a serious outbreak. The

consensus of opinion in and about Broadalbin, as disclosed by investigations by Mr D. B. Young the last of June, was that grasshoppers were not nearly so numerous as they had been last year.

The infestation in Saratoga county, a section where relatively little poisoned bait was used last year, appeared to be decidedly more serious than in Fulton county. Young grasshoppers appeared in early May and an examination made the 12th of that month on the farm of Mr Daniel Brown of Malta, showed a rather abundant and general prevalence of the insects on land which had been allowed to lie fallow for several years. There were at that time few or no grasshoppers in adjacent cultivated fields. Mr Brown stated that he had used some poisoned bait last year and was undecided as to what to do the present season. There was a more serious infestation on the farm of Mr Charles H. Carr in the town of Wilton, the young grasshoppers being so numerous that it was comparatively easy to count from twenty-five to fifty on a square foot, though this by no means represented average conditions. Mr Carr's land is in a sandy region adjacent to elevated, sandy knolls, the latter being badly wind-swept and showing numerous "blowouts." Last year Mr Carr found it necessary to use poison as many as three times on some fields and even then his vegetable garden was practically destroyed. Both he and Supervisor Clarence C. Smith were of the opinion that the insects flew readily, rising in swarms and repeatedly devastated certain fields. The farm of Mr Daniel McNeil, also of the town of Wilton, was rather badly infested, though the conditions did not seem to be so serious as those on Mr Carr's place.

Just outside of Saratoga on the farm of Mr George A. Supportus, and in sections nearby, there was an exceptionally severe infestation. This was so marked on the place of Mr W. H. Harris that although he had put out poisoned bait three or four times in certain areas, and in spite of the fact that he thus destroyed hosts of the grasshoppers, others drifted in from adjacent fields the latter part of July after the grass was cut and there was serious injury to asparagus, rhubarb and celery.

A bad state of affairs prevailed in and about the farm of Mr Stark Dake of Greenfield Center. Mr William C. Wilsie estimated that he had at least fifty acres which were badly and generally infested and on Mr Dake's farm there was approximately one hundred acres in this condition. Mr Dake estimated that there were in that section between three and four thousand acres badly infested with grasshoppers.

**Development and habits of the pest.** Small numbers of first stage lesser red-legged grasshoppers, the preeminently destructive species, were found in sandy places at Karner on May 11th and had apparently hatched only a day or so before, since they were by no means well colored. Young grasshoppers were most abundant on the edges of a "blowout" where the soil was sparsely covered with vegetation. Most of them were about three-sixteenths of an inch long, one or two being possibly one-fourth of an inch long. The next day many small grasshoppers, mostly well colored, were to be found in sandy situations at Malta. Hatching of the eggs by no means occurred at the same time and in some instances this may mean the appearance of several lots or swarms at irregular intervals covering a period of two to three or possibly four weeks. The young grasshoppers display a marked partiality for clover, defoliating or partly skeletonizing this first and then attacking various grasses. Infestations in new seeding are such as to suggest that the insects may have originated from eggs deposited in the firmer grass sod along the fences. May 27th the young grasshoppers were one-fourth to one-half of an inch long, and on June 17th most of the pests were half grown, a few winged ones, perhaps one-tenth of one per cent being observed. Pairing had already commenced. By the latter part of the month practically all the insects had developed wings.

The two-striped grasshopper is a later developing species than the lesser red-legged grasshopper, yet in spite of this, one light-colored nymph about three-eighths of an inch long and recently hatched was observed at Karner on May 11th and was probably one of the earliest of this species. Observations of last year show that most of the nymphs develop considerably later than is the case with the preceding species.

**Natural enemies.** Grasshoppers are subject to attack by a number of natural enemies, most of which escape ordinary observation and a detailed discussion of them would therefore not be particularly serviceable in this connection. We do, however, wish to place on record two observations.

At Corinth June 22d, Mr D. B. Young captured a species of Chalcis, as it was attempting to oviposit in a third stage grasshopper.

A large, predaceous wasp, Sphex ichneumonea Linn., was observed July 23d at Saratoga, flying about holes, some three-eighths of an inch in diameter, in a barnyard, and at least one of these wasps was seen carrying a grasshopper. This species is one of our well-known forms and in sections where it is abundant, usually

sandy situations, it very probably is of material service in destroying grasshoppers.

**Control work.** The very successful poisoning of last year was confined almost exclusively to fully developed grasshoppers and it was considered advisable to determine by practical field tests, the efficiency of various baits for the destruction of the young. This work was done in cooperation with the State Department of Agriculture and the Saratoga County Farm Bureau. The sodium arsenite mixture was prepared according to a formula recommended by Prof. F. L. Washburn, state entomologist of Minnesota, which is as follows: 3 pounds of sodium arsenite, 1½ gallons of molasses, and 180 gallons of water. This preparation was applied May 27th to a new seeding of clover and timothy, clover predominating, on the farm of Mr Charles H. Carr of Wilton, and badly infested with young grasshoppers one-fourth to one-half of an inch in length. The day was cold and the insects were rather inactive. Fifteen to twenty-five could easily be counted on a square foot. The clover next to the road was nearly destroyed, the leaves being badly ragged. The application began at about 10.35 a.m. and was continued until early afternoon, the more thickly infested portion being sprayed twice, since one treatment resulted in using only about 26 gallons to the acre. Where possible, the spraying should be gauged to apply about 50 gallons to the acre. Many of the grasshoppers jumped on the recently sprayed clover and remained apparently feeding or drinking up the minute particles for several minutes at a time. The mixture has a pungent molasses odor and seems to be very attractive to the insects.

An examination about 1 p.m. of the next day resulted in finding a number of dead grasshoppers in the clover patch, especially in that portion which received the two sprayings. The hoppers were so small and the debris so abundant that some care was necessary in order to recognize the insects. A number of sick ones were also observed here and there.

On June 2d it was found that from three-fourths to nine-tenths of the young grasshoppers in that portion of the clover field which had been sprayed twice with the arsenate of soda had succumbed to the poison and fewer, probably 50 per cent, had been killed in the part sprayed but once.

The arsenite of soda was also applied on the afternoon of May 27th about 4 p.m. on the margin of a sparsely grassed field where young grasshoppers were very abundant. This was for the purpose of testing the effect of the preparation under totally different conditions.

An examination the next day, the 28th, disclosed a very few dead grasshoppers and some sick ones. On June 2d it was evident that there had been a marked reduction in the pests, although comparatively few dead ones were found. This was probably due in part to the absence of shelter and also to the abundance and activity of ants.

This poison can be quickly and economically applied with a potato sprayer and in fields abundantly infested with young grasshoppers, especially if there be considerable clover, it is perhaps the most satisfactory method of destroying the insects. The dilution of the poison is such that it is not dangerous to either plants or stock if used as directed, though precaution should always be taken to prevent cattle from feeding freely in sprayed fields immediately after the treatment.

The Kansas bait is one of the most satisfactory poisons for half-grown and larger grasshoppers. The following is the formula generally recommended: 1 pound of Paris green, 20 pounds of bran, 2 quarts of cheap syrup or molasses, 3 oranges or lemons, 3½ gallons of water. The bran and Paris green are thoroughly mixed while dry, and if large quantities are to be used it is important that the men preparing the bait should protect the nostrils with a moistened sponge and avoid breathing the poisoned dust. The juice of the lemons or oranges should be squeezed into the water and the remaining pulp and peel chopped fine or run through a meat grinder and put in the water and the syrup added. The poisoned bran is then well dampened or mixed with the liquid and when prepared should be moist and sufficiently mealy so that it can be easily sown broadcast. The quantity given above is sufficient for five acres.

This bait, prepared as directed above, was distributed along badly infested fence rows at about 8.30 a.m. May 27th, and an examination at 4 o'clock that afternoon resulted in finding no dead insects. The next day, about 4 p.m., numbers of dead and sick grasshoppers were to be found in and near the poisoned strip, and on June 2d remarkably satisfactory results were observed. In one area of approximately 3 square inches, eighteen dead grasshoppers were counted, while in another of about one-fourth of a square foot, eighty dead were found. It was estimated that fully nine-tenths and perhaps 95 per cent of the young grasshoppers had been destroyed during the preceding six days. The Kansas bait, especially in a sparsely grassed, badly infested area, gives somewhat more satisfactory results than the arsenite of soda preparation.

The coarseness of the Kansas bait resulted in our mixing up a small lot and substituting therein middlings for wheat bran. This was applied May 27th about 5 p.m. in a lane and also in a field where the young grasshoppers were moderately thick. An examination the next day resulted in finding some dead insects, though this modified form of the bait was decidedly more difficult to sow evenly and tends to bake in rather hard masses. These undesirable features made it impossible to advise the use of this bait, though there is a chance that some other modification might be advantageous.

Attempts to destroy young grasshoppers are not always so successful as those outlined above, and we are satisfied that by no means all failures can be explained in the same way. In the first place, the young grasshoppers are so small that it is very difficult, without more careful search than the ordinary farmer will give, to find the dead ones and, as a consequence, the efficiency of the treatment is greatly underestimated. Secondly, the prolonged period of hatching or the appearance of several different lots or swarms from approximately the same area, might easily lead to an erroneous conclusion as to the value of the poison. It is very probable, especially in the case of fields where there is an abundance of clover, that the young hoppers feed less freely upon the bait than in places where there is comparatively little attractive vegetation. It should be noted that our best results in destroying young grasshoppers with the poisoned bait were obtained where the grass was very thin. Furthermore, weather conditions have a material effect upon the activities of the young insects, and if the poison is put out during a cold or rainy spell, the chances of the pests eating much for several days, are decidedly small. Finally, in the case of the young grasshoppers, it seems advisable to make a fairly uniform and fine distribution of the bait in order to bring it within easy reach of as many of the insects as possible and where there is an abundant vegetation we would urge putting it out early in the morning at the time the young insects begin feeding for the day. Studies conducted by Messrs Webster and Urbahns in Massachusetts, show that apparently better results in destroying young grasshoppers may be secured if more fruit is added to the formula and they advise the use of six, rather than three lemons.

The poisoning of the young insects, although somewhat more difficult than the destruction of the larger grasshoppers, is the most economical method of controlling these pests. It is usually possible to kill very large numbers of them in comparatively restricted areas and, best of all, before there has been any material damage to crops.

These considerations, we believe, justify giving special attention to methods of destroying the young grasshoppers, even if it be necessary to distribute bait or spray with a dilute poison two or three times in order to accomplish the desired end.

The work of last year and that of the past season have abundantly demonstrated the practicability of killing the full-grown grasshoppers by the use of the Kansas bait, directions for the preparation of which are given above. If for any reason it is impossible to check the pests while young, the best we can advise is systematic and thorough distribution of a poisoned bait, making, if necessary, several applications in order to prevent serious damage. We are still of the opinion that grasshoppers are sufficiently local in habit so that the inaction or refusal to cooperate on the part of one or more will not as a rule seriously mitigate the benefits accruing to those who make timely applications of the poison, though there is no question that hearty cooperation of all in regions subject to grasshopper invasion is highly desirable.

## MOSQUITO STUDIES

The region in and about Sodus bay presents peculiar conditions, in that there are within 3 miles of Sodus Point, as shown by surveys made by the Pennsylvania Railroad, about 220 acres of practically lake-level swamp, some 60 of these being in the immediate vicinity of the village. There has been more or less trouble from mosquitoes for some years, and in September 1914 the Entomologist was called into consultation by the Sodus Bay Improvement Association. A preliminary survey was made which resulted later in practical field work during June, July and August of the past season.

On the recommendation of the Entomologist, Mr H. H. Stage of Crittenden was engaged to do the actual field work, the Entomologist, owing to the peculiar conditions obtaining, directing and supervising. The undertaking was primarily practical in nature, though it was deemed advisable to secure accurate biological data in regard to the more annoying forms at least, since knowledge of this kind is necessary if the best results are to be secured, consequently Mr Stage was directed to familiarize himself thoroughly with the entire section and to make systematic collections in typical localities as well as to watch for the appearance of large numbers of larvae and see that they were destroyed by an application of oil before it was possible for them to mature.

The relation existing between the lake and the swamp made it impractical to attempt draining, and the large area of lowland rendered filling out of the question because of the expense involved.

The information gained in connection with the preliminary survey of September 1914, indicated a probable variation in the number and presumably the variety of annoying mosquitoes. There is a local belief to the effect that mosquitoes are much less numerous at periods of low water, which is very probably true. An examination of the monthly mean record of water levels, obtained through the courtesy of the Federal Government, shows that there has been during the past eight years, a variation in lake level of three and one-half feet. This, it will be seen at once, might have a marked influence upon the production of mosquitoes, and it is probable that some species are more troublesome during periods of high water, while others are annoying forms at times of low water. These changes in conditions and their effect upon the mosquito fauna are of practical value in any attempts to control the insects, and for that reason studies such as have been conducted the past season should be continued for a series of years for the purpose of obtaining exact information as to mosquito breeding under the varying conditions. There is also, aside from the influence of high water, more or less modification in habits and abundance of the various species, due to purely climatic changes.

The most serious menace to comfort appears to lie in the relatively small, swampy areas in and about Sodus Point and, to a less extent, in the extended cat-tail and sedge marshes in and about Second and Third creeks in particular, and possibly the considerably larger area south of Port Glasgow. The bearing these latter have upon the problem of mosquito annoyance can be determined only after more data have been secured relative to the breeding and flight of the irritating mosquito, a species which depends for its air supply upon the roots of aquatic plants, especially cat-tails, and one which would very probably find greatly increased opportunities for multiplication during seasons of high water.

The most practical outcome of the work of the past season is the demonstration that mosquitoes, even under very unfavorable conditions, can be controlled to a considerable extent at least, at a very moderate expenditure. In the case of this somewhat unusual problem, one man devoted his entire time for three months to the work and applied less than seven barrels of oil, this treatment being restricted to areas where larvae were actually found in considerable abundance. The cost of the entire work was less than $250. By far the greater number of communities in the State are not confronted with any such serious problem, and therefore a considerably smaller expenditure should give very satisfactory results.

At the inception of the work we made the following tentative recommendations:

Burn over the sedge and cat-tail areas in the winter so as to make the swamps more open and facilitate cutting, if that be advisable, the following season.

Eliminate, so far as possible, the small, permanent pools in the residential section. A very little filling will greatly reduce the possible breeding areas and much work of this character could legitimately be charged to real estate improvement rather than to mosquito control.

Supplement the burning in winter by cutting the sedges and cat-tails, so far as practical, the last week in May.

Follow this up by oiling, using a fairly heavy fuel oil wherever wrigglers appear to be abundant.

By no means were all these recommendations adopted, though some of the cat-tail areas were burned, and in the vicinity of the residential section there was more or less filling, nevertheless the comparative freedom from mosquitoes was apparent to all, and it may be stated in general terms that the work was highly satisfactory to those best situated to pass thereupon.

## BIOLOGICAL OBSERVATIONS

BY E. P. FELT AND H. H. STAGE

This portion of the work was based partly upon personal observations by the Entomologist and largely on the field work of the junior author, who collected the specimens and transmitted them to the office for identification, together with data respecting their occurrence and abundance.

The most annoying species, as will be seen by referring to the following accounts, are probably the irritating mosquito, *Mansonia perturbans* Walk., the large meadow mosquito, *Aedes abfitchii* Felt, the woodland pool mosquito, *Aedes canadensis* Theo., and the swamp mosquito, *Aedes sylvestris* Theo., all forms likely to breed in numbers and become more or less troublesome in and about dwellings. The golden-scaled mosquito, *Aedes aurifer* Coq., occurs in large numbers in woodland swamps and fortunately rarely leaves its native haunts. Of the long-tubed mosquitoes, the house mosquito, *Culex pipiens* Linn., and the little black mosquito, *Culex territans* Walk., are probably the most important, though the white-dotted mosquito, *Culex restuans* Walk., may sometimes be nearly as abundant as the house mosquito. These three forms breed in standing, frequently artificial collections of water, though the little black

mosquito appears better adapted to swamp conditions and, as a consequence, it is sometimes present in much larger numbers than the others. It may become a serious nuisance because of its ability to pass through the ordinary mosquito netting. In addition to the fifteen species noticed below, we have records of two others occurring in and about Sodus Point, namely Aedes magnipennis Felt, a species which was found breeding in a temporary pool and is probably not particularly annoying, and also the small Uranotaenia sapphirina O.S., an interesting and practically harmless form.

**Malarial mosquito** (Anopheles punctipennis Say). Larvae and adults of this well-marked form were met with in small numbers during June, July and August. The larvae, as is well known, occur most frequently in grassy pools, while the adults are rarely abundant enough to be troublesome.

**Fringed-legged mosquito** (Psorophora ciliata Fabr.). This giant mosquito, easily recognized by its brownish black color, the bands of upright black scales on the femora and the white banded legs, was taken in July and August, though it was by no means abundant. This species is beneficial rather than injurious, since the larvae prey upon the wrigglers of other mosquitoes. The adult, though it bites, is rarely troublesome.

**Large meadow mosquito** (Aedes abfitchii Felt). Specimens of this common, rather large mosquito were taken in and about swamps, frequently in association with the golden-scaled mosquito, Aedes aurifer Coq., from June 16th to July 22d, they being particularly common in the boggy swamp east of Lake Bluff. Occasionally at least, this species is troublesome about houses, though only one specimen, in the course of the season, was taken upon a porch. This spring form breeds rather abundantly in open, grassy pools, the larvae being associated with other early species and occurring as late as July 10th.

**Woodland pool mosquito** (Aedes canadensis Theo.). Larvae of this medium-sized mosquito, easily recognized by the tarsal segments being banded at both extremities and the posterior segment of the hind tarsi being white, were taken in stagnant water in a small swamp near the village. Adults were captured July 20th at Third creek. The species does not appear to be particularly abundant or troublesome.

**Brown woods mosquito** (Aedes subcantans Felt). Larvae pupae and adults of this species were taken the latter part of August

though only in small numbers. It does not appear to be a particularly troublesome form locally.

**Swamp mosquito** (Aedes sylvestris Theo.). This medium or small mosquito has the tarsi narrowly white-banded basally. It was taken the latter part of June, during July and also in August, mostly in and about swamps, especially at First and Second creeks and Wintergreen point. Larvae were extremely abundant on Sand point August 14th following heavy rains, and were also found at this time in the large swamp area near the village. Under certain conditions this species is probably very abundant and annoying.

**Golden-scaled mosquito** (Aedes aurifer Coq.). This medium-sized, black mosquito with its conspicuous golden yellow scales on the sides of the thorax, is preeminently a woodland swamp form and was found abundantly under such conditions from June 7th to July 22d, it being particularly numerous in and about Lake Bluff swamp, though it was also found in a large swamp near Sodus Point village and in the vicinity of Second and Third creeks. This mosquito is one of the most bloodthirsty, attacking quickly and in numbers whenever there is an opportunity, though on account of its being limited so closely to sylvan conditions it is not troublesome to any extent in and about human dwellings.

**Aedes impiger** Walk. Larvae of this common native species were taken in temporary pools in early July near Sodus Point, though in no case were they very abundant. This species appears to breed largely in small, temporary, woodland or swamp pools in association with A. canadensis and the series of species usually occurring under such conditions. It does not appear to be particularly important as an annoying form.

**Three-striped mosquito** (Aedes trivittatus Coq.). Two specimens of this mosquito were taken July 26th on Newark island. The adults have three black, longitudinal stripes with a yellow background on the thorax, while the legs and beak are unbanded. The wings are unspotted and the abdominal segments have lateral, basal white marks, which frequently unite to form transverse bands. This woodland form is reported as a fierce biter. It appears to fly low most of the time, since attacks are usually confined to the lower extremities, it rarely biting above the knees.

**Tree Hole mosquito** (Aedes triseriatus Say). This is another comparatively rare mosquito which breeds very largely in tree holes, hence its common name. A few larvae were met with August 24th in a characteristic depression near Second creek.

The adults are medium sized, the legs and beak black, the abdomen with white lateral patches basally on the distal segments, and the thorax with the lateral areas covered with long, silvery, grayish scales. The species is too rare to be of economic importance.

**Aedes abserratus** Felt & Young. One specimen doubtfully referred to this species was taken at Lake Bluff July 15th, presumably in a swamp inhabited by Aedes aurifer and A. abfitchii.

**House mosquito** (Culex pipiens Linn.). Larvae and pupae of this common species were found during June, July and August, being taken mostly in dirty or stagnant water, and particularly in water barrels, in one instance being found in a tree hole which was also inhabited by the tree hole mosquito, Aedes triseriatus Say.

The house mosquito breeds so generally in artificial collections of stagnant water near human dwellings that it should be comparatively easy to prevent its occurrence in great numbers.

**White-dotted mosquito** (Culex restuans Walk.). This common species is closely related to the house mosquito and, like it, breeds in artificial collections of water. Adults and larvae were taken in July and August, though at no time in such abundance as to warrant ranking this form as a pestiferous one.

**Little Black mosquito** (Culex territans Walk.). This is a small, black species which may be easily recognized by the white bands at the apex of the abdominal segments. The larvae are found almost everywhere in running or stagnant waters, though usually not abundant in that which is foul. Larvae and pupae were taken during June and July, adults being found the last of the latter month. Breeding appears to occur as in the related house mosquito and whitedotted mosquito, throughout the warmer part of the year.

The collections of the past season failed to demonstrate an unusual abundance of the adults, though larvae were frequently taken. Statements regarding conditions of earlier years, however, indicate that this species is frequently sufficiently abundant to constitute a real nuisance. The dark color of the adults in connection with their ability to make their way through ordinary mosquito netting, leaves little doubt that this species is occasionally exceedingly numerous and troublesome.

**Dyar's mosquito** (Culex dyari Coq.). This rare species, first taken at Center Harbor, N. H., was met with in the larval form June 8th near Second creek, only one specimen being taken. It is apparently an early spring form which rarely becomes abundant and is therefore of very little economic importance.

**Irritating mosquito** (Mansonia perturbans Walk.). This large species is easily recognized by the strongly contrasting colors, especially the broad, white band near the middle of the beak and the similar bands on the legs, the broad one on the posterior tarsi being characteristic. The abdomen is distinctly white-banded at the base of each segment and the wings with their large, white and dark-colored scales have a somewhat peculiar, mottled appearance.

Adults of this species were first observed on the wing June 14th and continued to fly till August 30th. A recently emerged adult, indicated by its nearly perfect condition, was taken on that date at Lake Bluff. The continuance of small numbers of adults, even later in the season, is probable, since a full-grown larva was taken at Wintergreen point August 31st. This species appears to be one of the most troublesome in that locality, as illustrated by collections on Sodus Point July 15th, at which time some twenty annoying mosquitoes were captured and every specimen was found to be of this species. These mosquitoes were rather numerous near the large swamp (25.8) just on the edge of the village. Again, July 23d, collecting on Eagle island near the center of the bay and remote from any suitable mosquito-breeding area, resulted in the capture of this species, and on visiting the south shore between First and Second creeks every mosquito captured proved to be this species. Similar conditions obtained on the evening of July 27th at Lake Bluff, except that a specimen of another species, Anopheles punctipennis, was also taken. The evening was especially favorable for mosquitoes, being rather warm and with little or no breeze. This species is well known as one of the fiercest and hardest biters. It enters houses readily and has very likely been responsible for much of the annoyance caused by mosquitoes in and about Sodus Point.

The tendency of this species to fly or drift some distance with the wind is indicated by the capture of specimens referred to above on Eagle island and also the finding of numbers at least half of a mile from any floating cat-tails.

It has been well known for several years that the larvae of this mosquito are peculiar in that they do not come to the surface but rely upon the collections of air in the roots of various aquatic plants. The wrigglers or larvae are easily distinguished from those of all other native mosquitoes by the strongly tapered, acute air tube which is thrust into the roots of cat-tails, Typha latifolia, and also the water loosestrife, Docodon verticillatus. It is possible also that they may live upon the roots of some other plants,

though so far we have not been able to demonstrate this. Full-grown larvae and pupae were found July 7th at Wintergreen point, attached to the roots of aquatic plants. Some idea of the abundance of this species may be gained from the following data: July 10th typical areas, each about 1 foot square, were examined and the results secured on five such plots are as follows: 6 larvae, 2 pupae; 8 larvae, 1 pupa; 2 larvae, 2 pupae; 4 larvae, 2 pupae and 1 larva, 4 pupae, respectively, an average of over 6 to the square foot. A similar examination made on the 10th resulted in the following data: 2 larvae, 3 pupae; no larvae or pupae; 12 larvae, 7 pupae; no larvae, 1 pupa; no larvae or pupae; 4 larvae, 2 pupae, respectively, an average of over 5 insects to the square foot. It is hardly probable that in any of these counts all the insects were secured and it is evident that comparatively small areas may produce enormous numbers of this annoying mosquito. The larvae and pupae were in all cases found only where the water was deep and with an abundance of debris covering the roots of the plants. Most of the areas were in the immediate vicinity of small pools, sometimes close to the main channel and almost invariably in connection with floating or semi-floating plants. The transformation of larvae evidently begins in early June, since pupae, pupal skins and recently transformed adults were found June 14th. At this time four recently emerged adults with limp wings were taken from the surface of the water. It is probable that most of these insects complete their transformations between the middle of June and the middle of July, stragglers only issuing after this time. There is no reason for thinking that there may be more than one generation; the adults are presumably long-lived. Repeated examinations of localities where full-grown larvae were abundant up to and including early September, have been without results so far as finding young larvae is concerned, though they have been found upon the roots of aquatic plants by other observers.

An attempt was made to determine the possibility of preventing the development of this species by the application of oil, and a number of larvae and pupae well established upon cat-tail roots were put into a bottle and the surface covered with a film of oil. No insects were reared under such conditions, though a few were obtained from similar plants in water which had not been oiled. This test was repeated twice under practically the same conditions and it is very probable that judicious oiling, especially during the period indicated above, when the adults issue in large numbers, would be a very effective method of destroying the insects. Unfortunately we were unable to test this out under natural conditions.

## AN OIL COMPOUND AND YOUNG TREES

Insect injuries to trees have been exceptionally serious during the last few years in the vicinity of New York City. This has been especially true of the hickory bark beetle, Eccoptogaster quadrispinosa Say, and the lined chestnut borer, Agrilus bilineatus Weber, and as a consequence various methods have been recommended for controlling these insects or destroying them after they have entered the trees. Observations have shown that it is possible to kill the young of the former insect by making applications of oils or oily compounds to the bark shortly after the adults have commenced operations, and there is a current belief to the effect that such treatment may also be a valuable deterrent to invasion. This has resulted in a number of preparations being placed on the market and widely advertised as effective against these pests and not injurious to the trees. There has been a natural tendency to use these compounds freely, and in some instances the outcome has not been what was expected. The following observations are placed on record for the purpose of showing the danger of the indiscriminate use of oil preparations upon the bark of trees, since if serious injury may develop within a few months upon young trees, it is reasonable to expect that damage may result, even if long delayed, in the case of those much larger.

The material upon which the following observations are based is an oily preparation which has been widely recommended under a trade name. A sample of the compound was secured and through the courtesy of the Honorable Edwin Duffey, State Commissioner of Highways, was examined in the laboratory of that department. The following is a transcript of the analysis:

| | |
|---|---|
| Per cent water present | 1.0 |
| Homogeneous | Yes |
| Specific gravity | 1.062 |
| Per cent free carbon | 0.23 |
| Per cent distilling | 110° C.–170° C. (light oil) 4.3 |
| Per cent distilling | 170° C.–235° C. (carbolic oils) 13.4 |
| Per cent distilling | 235° C.–270° C. (creosote oil) 9.9 |
| Per cent distilling | 270° C.–300° C. (anthracene oils) 45.2 |
| Per cent pitch | 27.2 |
| Specific gravity of total distillate | 1.022 |

Bureau of tests, by J. E. Myers, chemist.

Several red maple limbs with a diameter of approximately 1½ inches were cut March 2d, and after being rather thickly painted with this preparation, were set with the cut ends in jars of water to hinder evaporation so far as practical, and kept in a room at ordinary indoor temperatures. Two days later some penetration

of the inner bark, evidenced by a marked brownish discoloration, was apparent and ten days later, namely March 12th, there was an evident invasion of the compound, the inner bark and the outer portion of the sapwood being dark brown. At this time the untreated upper portion of the limb was green and normal, there being an abundance of sap in the inner bark and the sapwood, though there was some drying back at the very tip of the small branches. With a knife the outer bark was then carefully shaved from the entire stick in order to remove all the oily portion and thus show more clearly the condition of the inner bark and sapwood. This uncovered a series of plainly discolored areas having a transverse diameter of one-half to three-fourths of an inch, a length of an inch or more and extending frequently through the inner bark and into the sapwood. This shows clearly that under certain conditions an oily compound may penetrate the outer bark, pass through the inner bark and invade the sapwood. It is not claimed that this limb was under normal conditions and that therefore this result would invariably follow when such treatment was given to trees standing in the open.

This test was supplemented by applications March 8th to healthy forest trees standing in a location where there was no reason to suspect that unnatural conditions might influence the outcome in the slightest. The material was applied rather thickly from near the ground to a height of about 6 feet between 3.30 and 5.30 p.m. of a moderately warm, clear day, the sap in the sugar maples flowing abundantly. All the trees were so well protected by the surrounding growth that there could be no unusual exposure of trunk or branches to the sun.

Tree 1 was a sugar maple with a trunk diameter of 1¼ inches and a height of approximately 12 feet. On May 29th the bark was moist, greasy, and the leaves full size, though beginning to dry and presenting an unhealthy, brownish green appearance. This tree stood in a moderately open place so that the foliage received considerable light. The inner bark showed a brown discoloration in its outer layers and below a brownish green, unhealthy appearance. June 28th the tree was mostly dead, the inner bark was light brown and somewhat sappy. On November 10th the tree was dead save for some evidences of life at the very base and below the treated part. The oiled portion of the bark was brown and showed a distinct, dark line just beneath the surface. The tree had been entered by Ambrosia beetles, indicating an earlier, unhealthy condition.

Tree 2 was a sugar maple with a trunk diameter of 1½ inches and a height of 12 feet. The bark was lightly scored with a knife just

before the application of the oily compound and the sap issued so profusely that it ran down and washed off the insecticide to some extent. On May 29th there was a more evident discoloration and to a greater depth than in the case of tree 1. The leaves were light green and apparently unhealthy, though the foliage was not so discolored as that of tree 1, due possibly to its being more sheltered from the sun. On June 28th the leaves were a light yellowish green though the inner bark was dark brown and lifeless and slightly moist with sap. On November 10th the tree was dead except the very base which was not oiled, and showed a more evident discoloration of the inner bark than in the case of tree 1. There were markedly deeper and more extensive stains in and near the wounds made just before the application of the insecticide.

Tree 3 was an ironwood with a diameter of about 1½ inches. On May 29th the inner bark was badly discolored, though the foliage appeared to be normal. On June 28th the leaves were light yellowish green, there being a perceptible difference between its foliage and that of other nearby treated trees. The inner bark was dead, dark brown and with little sap. On November 10th the tree was dead and the bark showed a marked discoloration to the sapwood. The treated portions were easily recognizable by the rich purplish brown color and the markedly greater fungous infection of the bark with a more or less evident discoloration extending into the sapwood.

Tree 4 was a hornbeam with a diameter of 1¾ inches. On May 29th both the inner bark and the foliage were apparently normal. On June 28th the inner bark was brownish green, though otherwise the tree appeared unharmed. On November 10th the tree was nearly dead and showed a plain and uneven discoloration in the inner bark. The treated portion had the bark plainly looser and the wood beneath showed a discoloration not evident in sections taken above the oiled part. Sections from the latter showed a moderately bright green condition quite different from that obtaining below.

Tree 5 was a white oak with a diameter of 1¼ inches. On May 29th the tree was dead and the inner bark was badly discolored, having a distinct oily odor. On June 28th fungus had begun to develop in spots here and there on the trunk. On November 10th a little sap was still evident at the very base of this tree.

Tree 6 was a hornbeam with a diameter of approximately 1½ inches. On May 29th it had partly leaved out and was dead, the inner bark being badly discolored. On June 28th fungus was developing in spots here and there on the base of the tree. On November 10th a little sap was evident at the very base of this tree.

Tree 7 was a red oak with a diameter of $1\frac{1}{4}$ inches. On May 29th the foliage was much retarded in development, the leaves being less than one-fourth the normal size and the inner bark showing a variable amount of penetration and injury. On June 28th one limb was dead and the leaves on the others were only one-half the normal size and pale green. The inner bark showed a little discoloration. On November 10th this tree was still alive though the oiled portion of the bark was manifestly browner and more discolored than that which was not treated with the insecticide.

Tree 8 was a red maple with an approximate trunk diameter of $1\frac{1}{2}$ inches. On May 29th the oil had penetrated the bark very little or not at all and the foliage appeared to be normal. On June 28th the foliage was yellowish green and possibly somewhat abnormal. The inner bark was hardly discolored. On November 10th this tree was alive though the bark showed a deep and marked discoloration in spots, in certain sections this evidently extending to the sapwood and in some instances probably into it, in somewhat the same manner as recorded above for the cut red maple limb.

Tree 9 was a large hornbeam with a diameter of about 2 inches. On May 29th there was very little evidence of penetration of the bark by the oil and the foliage appeared to be normal. On June 28th the inner bark was possibly somewhat discolored though the foliage was normal or nearly so. On November 10th the tree was alive though apparently with some discoloration of the inner bark.

Tree 10 was a large hornbeam with a diameter of 2 inches. On May 29th there was very little penetration of the bark by the oil and the foliage appeared to be normal. On June 28th the inner bark was possibly somewhat discolored and the foliage normal or nearly so. On November 10th there was apparently some discoloration of the inner bark by the oil.

It will be noted that six out of ten trees died within six months after the treatment and under conditions which hardly justify any other verdict than that of death as a result of oil injury. It is true that ordinarily much larger trees would be treated with this or similar preparations and therefore the probabilities of injury would be less, owing to the thickness of inert outer tissues which must be penetrated before the oil can invade the living and necessary vital cells of the inner bark and outer sapwood. It is well known that a heavy lubricating oil, the green grease of the machinist or the anthracene of the chemist is a very dangerous material to apply to the trunks of trees, and in a preparation containing such a high percentage of this

series of hydrocarbons as the one under consideration, we would rather expect injury, possibly serious, to develop some time after the treatment, possibly two to three years, much depending upon the species and the age of the tree. There is no question, for example, but that sugar maples are much more susceptible to oil applications than many other trees, and the data at hand indicate a much greater liability to injury in the case of the younger, thin-barked wood, be it the trunk of a young tree or the branches of older trees. The main point we wish to establish is that oils or oily compounds can not be used with impunity upon the bark of living trees, and that apparent freedom from damage for a season or two by no means indicates that all danger of injury has passed.

In this connection we would call attention to the case of two hickory trees which we examined in 1912. The trunks had been lightly coated with gas tar September 3d or 4th of that year for the purpose of determining its value in protecting the trees from invasion by the hickory bark beetle. Under date of October 22, 1914 we were informed that the trees had died and had been cut out in spite of the fact that prior to treatment they were two of the best trees on the estate. Others within 25 feet of those tarred were still in excellent condition, indicating that gas tar as well as certain oily compounds are inimical to the welfare of forest trees.

## NOTES FOR THE YEAR

The depredations of the apple tent caterpillar, Malacosoma americana Fabr., have been severe in many localities, though the injury was not so general as in the preceding two years. The forest tent caterpillar, Malacosoma disstria Hübn., was also locally abundant and destructive, particularly in certain parts of Long Island.

There have been records during the last few years, of extended flights by the cotton moth, Alabama argillacea Hübn., a species unable to maintain itself in the north. It is interesting to record, in this connection, the capture of a specimen at Albany November 3d, on a cool day following two moderately warm ones. The moth was somewhat torpid but otherwise seemed uninjured.

A noteworthy capture of another southern species, the giant Erebus odora Linn., merits more than passing mention because twenty years have elapsed since a specimen of this insect was brought into the office. The species is recorded as being abundant in southern Florida and the warmer portions of the Gulf States.

## FRUIT TREE INSECTS

**Apple maggot** (Rhagoletis pomonella Walsh). This species is becoming locally abundant in some sections of the State, especially in certain Hudson river localities, and as a consequence there is a keen interest in methods of control. The work of the pest is easily recognized by the irregular, brown, sometimes rotting channels in the flesh or pulp of the fruit. The insect displays a marked preference for the late summer and early fall varieties, though it also attacks winter apples. The evidence at hand indicates it to be a somewhat local form and while there may be some disagreement as to the best methods of controlling it, there is little question but that material benefit may be secured by the collection and destruction, through feeding or otherwise, of the late summer and early fall varieties twice a week and of the fall and winter varieties once a week. The object of this procedure is to destroy the maggots before they have had an opportunity of escaping from the fruit and entering the soil where they pass the winter within a few inches of the surface. Thorough cultivation is doubtless of value, since it produces conditions more or less unfavorable to hibernation.

The collecting of the fruit is obviously necessary only in the case of unusual infestations. It should be stated in this connection that there is some evidence to show that spraying with arsenical poisons for the destruction of leaf-feeding insects, especially the applications made about midsummer, appear to be somewhat effective in checking this insect.

**Red bugs.** The red bug (Heterocordylus malinus Reut.) and the lined red bug (Lygidea mendax Reut.) are both widely distributed in the Hudson valley and where unchecked have frequently inflicted serious injury upon the apple crop. The lined red bug appears to be the most numerous in this section, though the other species is also found in numbers.

Young red bugs were abundant in the orchard of Mr W. H. Hart of Arlington April 27th, some days before the Baldwin and greening blossoms opened. On April 30th investigations showed large numbers of the pests, four or five being found on individual blossom clusters, though this was distinctly above the average. The true red bug was at this time far more abundant, though some young lined red bugs were to be seen. The latter had evidently just hatched and were approximately one-tenth as numerous as the other species. Some of the true red bugs were even then approaching the second stage and evidently had been abroad some days. The young true red bug may be recognized in the first stage by its

bright red color, the black tip of the beak and its smooth body, while the young lined red bug is a grayish or slaty reddish brown, ornamented with numerous short, black hairs.

An application just before the blossoms opened, using one pint of tobacco extract, 40 per cent nicotine to 100 gallons of water, together with a lime-sulphur wash 1 to 25 and the usual amount of arsenate of lead, resulted in killing many of the small red bugs as well as protecting the trees from fungous infection and early leaf feeders. An examination of the trees sprayed in this manner showed a relatively much greater freedom from infestation than was secured in 1914 by nicotine applications after the blossoms had dropped. Observations the latter part of June showed that the earlier conclusions were by no means erroneous, since there was a gratifying freedom from infestation except in the case of a few trees which did not receive a nicotine application just prior to blossoming. These latter showed perceptibly more injury by red bugs.

The experience of the past season has demonstrated the advisability of watching closely for the appearance of red bugs and spraying early so as to destroy the insects before they have attained any size. In this connection the earlier signs of damage are of considerable importance and are indicated by an indistinct reddish brown spotting of the more tender opening or recently unfolding leaves. This discoloration has been compared to the appearance presented after a light dusting with red pepper. It is usually easy to find the small red bugs, only one twenty-fifth of an inch or so in length at this time, near the leaves showing the first signs of attack. As the injured leaves age the discoloration becomes somewhat darker and after a time the central portion of the more seriously affected tissues may die and drop, leaving an irregular series of reddish, brown-margined holes in the somewhat crumpled, curled leaves, very characteristic signs of earlier injury.

The earliest evidence of injury to the small apple is a slight exudation accompanied by a local discoloration and hardening. The young fruit is frequently pierced to the core and as growth continues, depressions with pithy centers extending deep into the tissue may be noted. There is usually a marked irregularity in the shape of the apple and many of those most seriously affected are dwarfed and drop about midsummer.

**San José scale** (Aspidiotus perniciosus Comst.). This pest has not bred very abundantly, as a rule, in the Hudson valley and examination last fall in unsprayed orchards which had been under observation for several years, showed that, if anything,

the insect was less numerous than two years earlier. This condition had evidently been brought about by natural agents, since in each of these orchards there had been no marked change in horticultural practices. There was no difficulty in finding the scales here and there, showing the characteristic circular holes made by the small parasites which have attracted so much notice in recent years, and the probabilities are that these tiny agents have been important factors in keeping the scale from multiplying unduly. In this connection it should be stated that none of these orchards are in what would be considered an ideal horticultural condition. The best of the trees are stunted, the foliage being rather small and with a deficient color, while most of them show a small to a considerable amount of dead wood.

There is nothing in the conditions recorded above which seem to justify the abandonment of spraying for San José scale, especially as the incidental benefits resulting from this application are, in our estimation, more than sufficient to cover the cost of the treatment. The parasites, if they are destined to have an important effect upon their hosts, will gradually become more abundant in the smaller, unsprayed orchards and here we may expect them to render their best service, since it is relatively more costly and difficult for the owner of a few trees to spray. The most that these scale parasites can do at the present time is so unsatisfactory that we believe they are practically unworthy of consideration by the commercial grower.

**Sinuate pear borer** (Agrilus sinuatus Oliv.). This destructive and extremely dangerous European borer became established in New Jersey some years ago and is now extending its range slowly in New York State where it is already known to occur in several localities. The parent insects are slender, shining, bronzy brown beetles about one-third of an inch long. They may be found on bright, sunny days on the trunk and branches, the female depositing her eggs in crevices and under slightly raised bark scales. The eggs hatch in early July and the slender, whitish grubs begin their narrow, winding burrows in the inner bark and the outer sapwood. The galleries of the young larvae have a markedly serpentine course and a width of one-sixteenth of an inch or less. A badly infested limb may show, upon the removal of the outer bark, series of these galleries winding back and forth and seriously interfering with, if not cutting off, the supply of sap. The early operations of this borer do not produce conspicuous swellings, hence limbs or even entire trees may be practically destroyed before there are marked, outward indications of the trouble, though as time advances the

older, sinuous galleries become very conspicuous, especially on the smooth bark because of an external, somewhat characteristic cracking. A sickly condition of pear trees, not readily explainable by known causes, should lead to a careful examination, since this borer may be responsible for the trouble. The death of large trees is usually preceded by a weakened condition and the gradual loss of limbs. The slender, white grubs, easily recognized by the larger, flat head and the pair of minutely toothed, brown, curved processes at the posterior extremity, require two years for their development and when full grown are about one and one-half inches long. The second winter is spent in the pupal cell, an excavation made at a depth of about one-fourth of an inch and connected with the bark by an exit gallery.

Badly infested limbs or trees should be cut out some time during the winter and destroyed prior to the latter part of May so as to prevent the escape of the contained insects. We are informed, through the courtesy of Prof. P. J. Parrott of the State Experiment Station, that recent studies by Doctor Glasgow have shown that the beetles feed readily on the foliage, which makes it possible that they may be controlled to some extent by the use of an arsenical spray the latter part of May or shortly before the beetles commence to appear.

Professor Parrott also informs us that he is experimenting with a deterrent wash composed of 60 to 80 pounds of lump lime, 2 pounds of copper sulphate and 100 gallons of water. The copper sulphate is dissolved and diluted with about 25 gallons of water, the lime is slaked, then run through a fine screen and diluted with the remainder of the water. The copper sulphate solution and the lime wash are then mixed together and the application made with a spraying machine. This wash or some modification should be thoroughly tested in orchards where the insect has become established.

It is perhaps needless to add that fruit growers in regions where this insect is not known, should exercise every reasonable precaution to prevent its introduction into uninfested orchards. It would be much better to destroy, unnecessarily, a number of trees than to take the chance of introducing such a serious pest.

**Pear thrips** (Euthrips pyri Dan.). Depredations by the pear thrips have continued in the Hudson valley and in some instances were exceptionally severe, the damage probably being much greater because of the unusual weather conditions. There was an early and extremely warm period which caused the pear buds to start very rapidly and gave the thrips an opportunity to enter. This was

followed by comparatively cool weather, accompanied by a slow development of the leaves and flowers, a condition favorable for severe damage by any insects which might have gained entrance to the buds during the warm weather.

The suddenness of attack by this insect is shown by the conditions observed in the orchard of Mr M. C. Albright at Athens April 17th. At this time there was a rather general infestation, the blossom buds had started a little and the thrips were making their way down into the center of the buds. It was easy to find blossom buds here and there on the lower branches with one to two or three thrips, and near the top of the trees, blossom buds with four to five insects endeavoring to enter were not at all uncommon. The pests were noticed for the first time, according to Mr Albright, on the 16th, and weather conditions were such that it would hardly seem as though they could have issued much earlier. This orchard, so far as known, was not injured to any extent by thrips the preceding year.

The sudden appearance of large numbers of the thrips is also borne out by conditions observed in the afternoon of the 17th in the pear orchard of Mr Robert McHench at Clarksville. This orchard lay at a considerably higher elevation, the difference between the Athens and Clarksville orchards being approximately 800 feet. The pear buds in the latter orchard were just beginning to start and there was no evidence of thrips above ground, though a few of the insects were observed in a pear orchard near the village of Clarksville and at a lower elevation, probably about 700 feet.

On April 24th the trees in this orchard had started perceptibly and in not a few instances two to four or even six thrips were to be found in the buds. The insects are able to make their way down among the bud tissues even when there is comparatively little breaking or spreading of the bud scales at the tips. Spraying was in progress at this time, a thin lime wash composed of 75 to 80 pounds of lime to 100 gallons of water, to which three-fourths of a pint of black leaf 40 was added, being used. Dead thrips were to be seen on the treated trees. The branches and wood were rather thickly covered with a lime wash, though the buds for the most part were not satisfactorily protected. The lime wash did not seem to adhere with any degree of thoroughness to the bud tissues after the scales had commenced to spread to some extent, though those which had hardly started at all were fairly well covered on one side, the other not being thoroughly protected and indicating a somewhat deficient spraying. The treatment in this orchard was delayed a little later

than desirable, owing to the difficulty of securing the spray materials and the necessary help. We believe that better results from the application of the lime wash would be obtained if the spraying is done before the buds have started appreciably, and under most conditions this would be comparatively easy, though last spring it was far from the case, due to the unusually early warm weather.

No other treatment was given in this orchard for pear thrips and the trees developed an exceptionally full bloom and set a large crop of fruit. This latter was reduced to some extent by an abnormally late drop which may have been caused by thrip injury to the stems, though subsequent observations showed a moderately severe psylla infestation in the orchard.

In addition to this injury, serious damage was observed in pear orchards at Milton and at Bangall. In the former the insects appeared in large numbers and nearly destroyed the Seckel bloom and there was serious injury to the Seckels at Bangall in spite of an early spraying with tobacco, due probably to the treatment being given a little too late. At the time of examination May 6th, white nymphs were rather numerous on one or two of the trees.

The developments of the past season have shown that a thick whitewash such as that mentioned above, is a valuable protective in warding off thrips attack, though the spraying should be done before the buds have started to any appreciable extent. Spraying with a tobacco extract, 40 per cent nicotine, is the best that can be advised for the destruction of the insects after they have appeared, and the notes given above emphasize the advisability of having everything in readiness so that the spraying can be done just as soon as the insects appear in numbers. Apparently they need only a little time in which to establish themselves within the buds, where they are comparatively safe from any application. It is practical, if many of the insects have escaped this first contact application, to spray just as soon as the young pears have separated sufficiently so that the insects at the base of the fruit stems are exposed, and a special effort should be made to drive the insecticide into all crevices of the fruit clusters. A third treatment with tobacco may be advisable after the blossoms fall, for the purpose of destroying the young insects. Four to 6 pounds of soap should be added to the tobacco preparation if the latter is not used with any other insecticide, to facilitate spreading, since this greatly increases the efficiency of the treatment.

**Pear psylla** (Psylla pyricola Forst.). This insect maintains itself as a serious pest in many pear orchards in the Hudson

valley, though outbreaks are usually very limited and are, as shown by observations of the preceding year, frequently closely related to unusually favorable winter shelters, such as nearby brush heaps, fences or stone walls and their accompanying weedy growths.

The temperature variations were so unusual and rapid last spring that it was exceedingly difficult to regulate spraying practices so as to kill the San José scale and destroy all the eggs and at the same time not injure the trees. Observations at Athens April 17th revealed numerous psylla eggs and a number of active adults, the latter probably still depositing eggs. The indications were that oviposition would be completed before the blossom buds had advanced so far as to make it unsafe to spray with the lime-sulphur wash at winter strength. The warm weather at this time, however, left a very narrow margin between the completion of oviposition and the development of buds to such an extent that it was unsafe to use the strong lime-sulphur wash.

**Quince curculio** (Conotrachelus crataegi Walsh). This insect is a serious pest and is not easily controlled. The practical difficulties are probably due to the marked variations in the appearance and development of the beetles. The late Professor Slingerland records that in 1896 adults appeared the last week in May, while in 1897 they did not begin feeding until about two months later or the last of July. Observations upon some infested quinces, in company with Mr L. F. Strickland at Newfane July 26th, showed that eggs and young larvae of this pest were rather abundant. Many of the quinces had been injured either by oviposition scars or feeding punctures, and the indications were that a considerable proportion of the fruit would be seriously damaged before the end of the season.

An examination the latter part of September in the quince orchard of Mr H. E. Wellman at Kendall, showed almost no injury from this pest, though there had been, according to statements by the owner, very serious damage the preceding year. He also added that the pest had been rather troublesome for a number of years. The past season he made three poisoned applications; one just after blooming, a second about two weeks later, and a third the latter part of July; in other words, he gave practically the same treatment as for the codling moth, and our observations failed to show any material injury from the Curculio, though there were a few places here and there where the adults had evidently eaten to some extent.

It is quite possible, in view of the erratic appearance of the adults, that the earlier applications were unnecessary, especially since recently laid eggs and young larvae were repeatedly found in that

section the latter part of July. It is probable that many of the insects succumbed to the last treatment. The evidence at hand indicates considerable protection from a poisoned spray, and the most economical and practical method of controlling this insect, with our present knowledge, would doubtless be to watch for the earliest feeding punctures and then spray thoroughly at once, and if this treatment be given early, make a second application a week to two weeks later, the greater delay being presumably advisable if the earliest feeding occurs the latter part of May.

**Cherry leaf beetle** (Galerucella cavicollis Lec.). This small, red leaf beetle was exceptionally abundant in Chautauqua, Cattaraugus, Erie and Niagara counties in particular, though it was also reported from some other portions of the State. It excited considerable attention and some apprehension because of depredations on peach and cherry trees, it displaying a marked preference for sour cherries. The feeding in most instances did not seriously damage the trees, though in some cases it amounted to partial defoliation. This is a common species in the Adirondacks, occasionally becoming so numerous as nearly to defoliate the somewhat abundant wild red cherry, Prunus pennsylvanica, frequently known as the bird, fire or pin cherry.

This outbreak is by no means unprecedented, since several similar though not such widespread depredations have been recorded by the late Doctor Lintner (11th Rep't, N.Y. State Ent., pages 197–98, 1896). This peculiar condition of affairs may have been due, in the opinion of Mr F. Z. Hartzell, to an unusual abundance of the beetles in connection with the general defoliation of wild cherry trees by apple tent caterpillars. The appearance of this insect in Niagara county, according to Mr J. B. Achilles, was preceded by about thirteen days of northeast winds, which suggests a possibility that the beetles may have drifted from the Adirondacks where they appear to be much more abundant than on wild cherry trees in the western part of the State.

This beetle, like other leaf-feeding insects, is susceptible to arsenical poisons, and experiments conducted by Mr Hartzell at Fredonia, showed that the trees could be protected if arsenate of lead was used at the rate of 4 pounds to 50 gallons of water and the application made to the lower as well as the upper surfaces of the leaves. The most satisfactory results are obtained when the poison is combined with bordeaux mixture. Tobacco extract, 40 per cent nicotine, will also destroy the beetles but affords no subsequent protection to the plants, since the volatile contact insecticide destroys only

those actually hit by the preparation. Small, badly infested trees can be protected by jarring the insects into pans containing a little kerosene and water.

## FOREST TREE INSECTS

**White pine weevil** (Pissodes strobi Peck). The depredations of this well-known insect are becoming of increasing importance owing to its presence in large numbers in recent plantings. Two years ago last spring, after consultation with the Entomologist, Mr Waldo C. Johnston of Cooperstown began a systematic collecting of the weevils on fifty acres set with about sixty thousand young pines. The work was started a little late (about May 21st) and the trees carefully collected over four times at intervals of approximately four or five days each. At the outset two to four weevils were taken on a tree and toward the last only one or two insects for each row of about four hundred trees. The cost of these four collections amounted to $64 or only $1.28 an acre. An examination made in early July of that year resulted in finding very few insects.

Collecting along the same lines was continued during 1914 and the season of 1915. The latter part of last June Mr Johnston reported that they had been able to collect comparatively few weevils this past season and finally stopped work because a man would average only one to four weevils after a good day's work. These figures indicate a very large reduction in the numbers of the pests and presumably mean practical extermination and comparative freedom from injury for the entire planting.

This method possesses the decided advantage of being positive in action. There can be no question but that the weevils are destroyed, though the expense may be somewhat greater than that of collecting the infested tips or attempting to protect the trees by some spray application. It can be practised most successfully only on considerable areas of small trees, conditions where it is usually most desirable to check the pest.

**Ugly nest cherry worm** (Archips cerasivorana Fitch). The characteristic nests of this species were rather common in early summer on chokecherry in southern Rensselaer county in particular, and occasioned some apprehension for fear that the pests would extend their operations to other trees. A well-developed nest of this species was found June 16th by Mr C. B. Cutler at East Greenbush on Lombardy poplar, and on further examination it is presumable that the insects first defoliated some nearby chokecherry

bushes and then migrated to the poplar. There was a little feeding though by no means much upon this latter plant.

**Dioryctria abietella** Zinck. Specimens of the work of this insect were received November 4, 1915 from Mr G. G. Atwood, chief of the bureau of horticulture, who states that the specimens were from Austrian pines growing at Rochester, N. Y.

The buds, evidently young growth, have been badly tunneled by the caterpillars of this species, and in one recurved shoot, suggesting somewhat the work of Evetria bouliana, the remains of a caterpillar were observed. Irregular, rather coarse particles of reddish brown frass were attached here and there to the affected shoots and in one instance formed a mass half an inch long and about one-fourth of an inch broad. One woody twig with a length of 3 inches had been neatly tunneled by the borer, the gallery having a diameter of nearly one-eighth of an inch.

**Periodical Cicada** (Tibicen septemdecim Linn.). The appearance of this insect, more generally known as the seventeen-year locust, is always interesting, particularly if it occurs in large numbers. Brood six of the seventeen-year race has been characterized by Doctor Marlatt as "an unimportant scattering brood," and the published map showing its distribution indicates a wide range from the state of Wisconsin south to Georgia, with an evident concentration in western North Carolina, northwestern South Carolina and northern Georgia, and a secondary center ranging along the eastern boundary of Pennsylvania, through New Jersey into New York, where it has been recorded more or less authentically from Greene, New York, Richmond and Schenectady counties.

Mr William T. Davis of New Brighton states that though he has records from many localities it was nowhere quite so common in 1915 on Staten island as it was in 1881 or in 1898 and the distribution appears to be sparing. He reports the insect from the government reservation at West Point, Orange county, a new record, and a living specimen was received from Mr J. L. Livingston, Tivoli-on-Hudson, Dutchess county. Mr W. H. Hart and his nephew, Mr C. S. Hubbard, both reported having heard Cicadas in the town of La Grange, Dutchess county, and another gentleman at La Grangeville stated that he had also heard a few Cicadas in nearby woods. This is a locality where brood two, which appeared last in 1911, was exceedingly common and there is every reason for giving these reports full credence. There is also a statement by Mr D. V. Haggerty to the effect that this insect occurred in small numbers near Wiccopee, the extreme southern portion of the county. Further-

more, near the northwestern edge of Whaley pond and close to the tracks of the New England Railroad running from Poughkeepsie to Waterbury, Conn., the writer noted a group of oaks upon a knoll which, from the car window, gave every indication of having been injured by Cicada oviposition. These facts indicate a probable wide and sparse distribution of this brood in Dutchess county and it is possible that similar conditions may obtain in the wild regions on the western bank of the Hudson river though no definite reports were received. Correspondence with several New Baltimore persons failed to locate an infestation, which is also true of East Glenville, Schenectady county, a locality from which the insect had been reported in earlier years.

## GRASS INSECTS

**Grass webworms** (Crambus luteolellus Clem.). The grass webworm depredations of last year have been continued this season, in one case a five acre field of corn near Pine Plains being destroyed by the insects. These pests, as has been stated before, live by preference upon grasses and ordinarily their depredations in cultivated fields are limited to portions adjacent to mowings or pastures or to crops planted upon badly infested, recently turned sod. The latter is due to the fact that the grass webworms pass the winter as partly grown caterpillars and when the sod is destroyed they must feed upon whatever else is allowed to remain upon the soil or perish.

There is no very practical method of fighting these pests, owing to the fact that usually severe injury is caused before their presence is suspected and then it is too late to do much to protect the remainder of the crop. In localities where webworms are liable to be abundant it is advisable to keep corn and other crops susceptible to attack at some distance from grasslands and to avoid planting upon recently turned sod. If land badly infested by these insects is plowed in late summer or early fall, say August or early September, many of the caterpillars would perish before the following spring. If this be impractical, spring plowing should be delayed as late as possible so as to give the caterpillars a chance to complete, so far as practical, feeding before the sod is turned under. The putting in of an extra amount of seed and liberal fertilization is also of service in enabling the crop to withstand any such injury. There is considerably less danger of serious infestation where a frequent crop rotation is the rule, which is another consideration in favor of good agricultural practice.

It is possible that many of the young caterpillars could be destroyed

by spraying badly infested grassland in early spring shortly after the young grass has started and at least a week before plowing, with an arsenical poison such as sodium arsenite at a strength recommended on page 60 for the destruction of grasshoppers. This could be applied very cheaply with a potato sprayer and where there is an infestation such as that mentioned above, might easily save replanting of the land and possibly a serious loss in yield.

**Spittle insects.** The white, foamy masses of "spittle" produced by these small insects are sometimes so common on timothy and other grasses as to result in serious injury to the crop. This was the case in several localities in Dutchess county the past summer. There are two rather common and widely distributed spittle insects in this State known as the lined spittle insect, Philaenus lineatus Linn., and the European spittle insect, Philaenus spumarius Linn. The former, so far as the State collections are concerned, appears to be much more common and abundant, occurring alike in the Adirondacks and in the lower Hudson valley. The full-grown insect is an inconspicuous, yellowish brown leaf hopper about three-sixteenths of an inch long and with a somewhat definite, yellowish line along the lower margin of each forewing when the insect is in the normal resting position. The European leaf hopper is a somewhat larger species, measuring a little over one-fourth of an inch in length and very similar in coloring, except that it lacks the rather distinct line mentioned above and bears somewhat indistinct, angular markings near the middle of the forewings. It seems to be more northern in its range, specimens in the State collection being from Adirondack localities only.

The young of both of these species are yellowish or yellowish green, rather stout and are usually found only by pushing to one side the white, foamy spittle, an excretion supposed to protect the tender, immature insects from the drying sun and wind and produced by the little leaf hopper literally beating air with its "tail" into a viscid excretion. The popular and, in some localities widely current, belief that young grasshoppers inhabit the frothy masses, is not supported by facts, the mature spittle insect being quite different from a grasshopper. The eggs are undoubtedly deposited in the stems or crowns of various grasses and remain unhatched till the following spring.

It is well known that old meadows are most liable to be badly infested by these insects. Knowing as we do that the young, with their limited powers of locomotion must hatch in the spring and

develop upon vegetation near at hand, it is easy to see that a frequent rotation of crops, incidentally a good agricultural practice where possible, is also a most efficient method of preventing these pests from becoming extremely abundant. Plowing either in the fall or moderately early in the spring must mean the destruction of millions of the young leaf hoppers.

There are conditions where a moderately frequent rotation of crops is inadvisable or impossible and for such cases we would suggest burning over infested meadows in late fall or preferably in early spring as the most promising method of destroying many of the eggs.

## MISCELLANEOUS

**Thelydrias contractus** Mots. A number of peculiar larvae of this remarkable beetle were received from a New York correspondent, accompanied by the statement that they occurred in great numbers in the house and were found almost everywhere excepting in woolen garments or articles. They occurred in pasteboard boxes where there was apparently nothing to attract them, in perfectly clean garments, in clean muslin bedding and in almost everything covered with white tissue paper, in china closets, in a bookcase and also in a tool chest. The number of larvae sent indicated a considerable degree of abundance.

This sending is of more than ordinary interest, since it relates to an European species first discovered in this country in 1902, and one which may possibly become a pest of considerable importance in museums, probably in stored food products and perhaps in dwellings. The larvae resemble somewhat those of the Buffalo carpet beetle or Anthrenus except that they are considerably smaller in size and may be readily distinguished by the characteristic clavate hairs or scales. The studies of Mr L. H. Joutel of New York indicate that one year may be required to complete the life cycle. He has also ascertained that the larvae may live for three or four years without food and that they are unusually resistant to the fumes of carbon bisulphide. It is quite possible that this insect might establish itself in stuffed natural history specimens, such as birds, animal heads, etc., and from such breeding centers gradually spread throughout a building. The runways and nests of rats would also probably furnish attractive conditions.

Thorough cleaning of the infested rooms and the free use of sodium flouride was advised. This was done and a month later the correspondent reported a comparative freedom from the insects.

## PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1915. The titles,[1] time of publication and a summary of the contents of each are given. Volume and page numbers are separated by a colon.

Notes on Forest Insects. Economic Entomology, Journal, 1914, 7:373–75

Brief notes are given on the forest tent caterpillar, Malacosoma disstria, the apple tent caterpillar, M. americana, the spotted hemlock borer, Melanophila fulvoguttata, the two-lined chestnut borer, Agrilus bilineatus, and the hickory borer, Eccoptogaster quadrispinosa, with observations on the relation of drought to borer injury. A short notice of work with the white pine weevil, Pissodes strobi, is also included.

Borers in Trees. Tree Talk, v. 2, no. 2, p. 11–13, 1914

A popular article discussing several of the more important borers occurring in New York State and general methods of control.

List of Zoophagous Itonididae. Economic Entomology, Journal, 1914, 7:458–59

A list of twenty-nine species with observations on food habits.

Arthrocnodax constricta n. sp. Economic Entomology, Journal, 1914, 7:481

Description of a species preying on red spider in Porto Rico.

Cactus Midge, Itonida opuntiae Felt. Prickly Pear Travelling Commission, Report, p. 77, 78, 1914. Brisbane, Australia.

Summary account of life history and injuries.

Gall Midges as Forest Insects. Ottawa Naturalist, 1914, 28:76–79

A summary discussion of gall midges as forest insects and the description of Rhabdophaga swainei n. sp.

New Genera and Species of Gall Midges. U. S. National Museum, Proceedings, 1915, 48:195–211

A table for the separation of the genera in the Asphondylariae is given and the following new genera and species described: Microcerata buscki, Rubsamenia multinoda, Ctenodactylomyia n. g., C. watsoni, Xenasphondylia n. g., X. albipes, Proasphondylia n. g., P. braziliensis, Oxasphondylia n. g., O. re-

[1] Titles are given as published. In some instances articles appearing in a number of papers have been given different titles by the various editors.

ticulata, Asphondylia altana, Eocincticornia n. g., E. australasiae, Eohormomyia n. g., E. howardi, Scopodiplosis n. g., and S. speciosa.

Fumigation for the Box Leaf Miner. Economic Entomology, Journal, 1915, 8:94–95

Summary of experiments with carbon bisulphide, ammonia, naphthalene and potassium cyanide.

Mycodiplosis macgregori n. sp. Economic Entomology, Journal, 1915, 8:149

Description of a species reared from larvae preying on red spider on cotton.

Scurfy Scale on Norway Maple. Economic Entomology, Journal, 1915, 8:160

Records occurrence of Leucaspis japonica Ckll. on Norway maple and privet at Stamford, Conn.

Early Spring Pests. New York Farmer, March 18, 1915, p. 8; Catskill Recorder, March 19, p. 7; Buffalo Commercial, March 29

Brief practical accounts of the pear psylla, pear thrips, red bugs, apple tent caterpillars, and June beetles.

Report of the Committee on Entomology. New York State Fruit Growers, Proceedings, 1915, p. 28–35

A general discussion of entomological problems with special mention of San José scale parasites, the leaf roller, codling moth, apple maggot, red bugs, pear psylla, pear thrips, and the army worm and grasshopper outbreaks.

Red Bugs and Other Insect Pests in the Hudson Valley. New York State Fruit Growers, Proceedings, 1915, p. 180–86

Summary accounts are given of the red bugs, pear thrips and pear psylla, with mention of the raspberry Byturus and red spider.

Insect Outbreaks: Their Causes and Control. Western New York Horticultural Society, Proceedings, 1915, p. 51–58

A general consideration of the causes, possible prediction and prevention of insect outbreaks with special mention of the army worm and grasshopper devastations.

A New Chrysanthemum Pest. The American Florist, April 10, 1915, 44:612; Economic Entomology, Journal, 8:267; Tree Talk, v. 2, no. 4, p. 27

Brief descriptive account of the recently established Diarthronomyia hypogaea Lw. of Europe.

29th Report of the State Entomologist on Injurious and Other Insects of the State of New York, 1913 (issued April 15, 1915), p. 1–257, 16 pls.

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Remedies and Preventives for Plant Enemies and Diseases. The Ball Canning and Preserving Recipes, Edition F., p. 56–62, 1915

A comprehensive spray calendar for trees and small fruits.

Grasshopper Control in New York State. Economic Entomology, Journal, 1915, 8:227–29

Summary of results obtained with poisoned bait for the control of *Melanoplus atlanis* Riley.

Juniper Plant Bug (*Chlorochroa uhleri* Stal.). Economic Entomology, Journal, 1915, 8:308

Records injury to peas, corn, tomatoes and other garden crops and details observations on feeding habits and also those of *Euschistus variolarius* Pal. Beauv.

Apple Red Bugs. Catskill Recorder, May 7, 1915

Brief warning notice.

Seventeen-year Cicada. Catskill Recorder, June 25, 1915

The capture of a specimen in northern Dutchess county is recorded and a request made for specimens and data from other localities.

New North American Gall Midges. Canadian Entomologist, 1915, 47:226–32

The genus Kalodiplosis, with K. *multifila* as the generic type, is erected and the following new species described: *Lestremia floridana*, *Microcerata aldrichii*, *Porricondyla wellsi*, *Asteromyia sylvestris*, *Kalodiplosis floridana* and *Hormomyia fenestra*.

New Gall Midges. Economic Entomology, Journal, 1915, 8:405

The following species are described as new: Dasyneura torontoensis, Feltiella davasi, Mycodiplosis fungiperda, Parallelodiplosis corticis and Retinodiplosis palustris. One sex is described of Prionellus monilis and Asteromyia leviana.

A Breeding Record of Anthrenus verbasci Linn. Economic Entomology, Journal, 1915, 8:430

Records continuous breeding in dry corn for over thirteen years.

Pine Insects. Tree Talk August, 1915, 3:6

The white pine weevil, the pine bark louse and the pine leaf scale insect are discussed briefly.

White Grubs. New York Farmer, September 2, 1915, p. 8; Catskill Recorder, September 3

Summary account of injuries, with a forecast of probable damage another season.

New Asian Gall Midges. New York Entomological Society, Journal, 1915, 23:173–84

Two new genera, Xiphodiplosis and Androdiplosis, are erected and the following species described: Didactylomyia ceylanica, Microperrisia pulvinariae, Dentifibula ceylanica, D. obtusilobae, Mycodiplosis simulacri, Diadiplosis smithii, D. hirticornis, Xiphodiplosis fulva, Arthrocnodax rutherfordi, A. walkeriana, Lowiola costata, Androdiplosis coccidivora and Dyodiplosis generosi. A table for the separation of the males of Diadiplosis is also given.

The Gall Midges of the Pine. Brooklyn Entomological Society, Bulletin 10:74–76, 1915

A resumé of the habits and economic importance of the American species recorded from pine.

## ADDITIONS TO COLLECTIONS, OCTOBER 16, 1914–OCTOBER 15, 1915

The following is a list of the more important additions to the collections:

### DONATION

*Hymenoptera*

Abia inflata Nort., honeysuckle sawfly, larva on honeysuckle, July 6, G. A. Bailey, Geneseo

Trichiosoma tibialis Steph., Hawthorn sawfly, cocoon, March 4, J. H. Dodge, Rochester

Pontania hyalina Nort., gall on Salix fragilis, July 19, S. H. Burnham, Hudson Falls. Same, gall on willow, October 5, Mrs E. P. Gardner, Canandaigua

P. pomum Walsh, willow apple gall on willow, October 5, Mrs E. P. Gardner, Canandaigua

Kaliosysphinga ulmi Sund., European elm leaf miner, larvae and work on elm, June 26, C. I. Bucknam, West Newton, Mass.

Monophadnoides caryae Nort., larvae on butternut, August 20, Jannette W. Hill, Malden. Through State Department of Agriculture

Neuroterus umbilicatus Bass., galls on burr oak, July 19, S. H. Burnham, Hudson Falls

Holcaspis globulus Fitch, gall on oak, October 5, Mrs E. P. Gardner, Canandaigua

Amphibolips inanis O. S., empty oak apple, August 30, S. H. Burnham, Hudson Falls

Callirhytis futilis O. S., gall on white oak, S. H. Burnham, Hudson Falls

C. ceropteroides Bass., galls, April 15, R. S. Walker, Chattanooga, Tenn.

Andricus batatoides Ashm., potato gall, gall and adults on live oak, March 16, Ortego, Fla. Through Mrs E. P. Gardner, Canandaigua

A. excavatus Ashm., galls on Quercus velutina, S. H. Burnham, Hudson Falls

A. lana Fitch, woolly oak gall, November 16, H. E. Ruggles, St Paul, Minn. Same, gall on oak, October 5, Mrs E. P. Gardner, Canandaigua

A. petiolicola Bass., galls on oak, May 21, Walter Luke, Scarsdale

A. turneri Ashm., gall on oak, April, T. R. Baker, Winter Park, Fla. Through W. W. Yothers

Aylax taraxaci Ashm., gall on dandelion, S. H. Burnham, Hudson Falls

Rhodites dichlocerus Harr., long rose gall on Rosa blanda, S. H. Burnham, Hudson Falls

R. rosae Linn., mossy rose gall on rose, June 24, Miss Mabel Cooke, Lake George

R. fulgens Gill., gall, February 2, A. E. Stene, Kingston, R. I.

Megarhyssa lunator Fabr., lunate long sting, August 14, O. S. Edwards, Rensselaer

Vespa diabolica Sauss., yellow jacket, adults, July 20, Mrs E. P. Gardner, Canandaigua

Sceliphron caementarium Dru., mud dauber, nest, March 6, Mrs Horace L. Greene, Fort Plain

*Coleoptera*

Hylesinus opaculus Lec., dark elm borer, adult on elm, June 24, Mrs Walter A. Wood, Hoosick Falls. Through State Department of Agriculture

H. aculeatus Say, ash timber beetle, work on ash, January 18, S. H. Burnham, Hudson Falls

Eccoptogaster rugulosa Ratz., hickory bark beetle, adult and work on hickory, July 29, J. H. Livingston, Tivoli

Conotrachelus crataegi Walsh, work in quince, September 29, L. R. Simons, Mineola

Ceutorhynchus sericans Lec. var. and Rhinoncus pyrrhopus Boh., adults on pine, May 1, W. C. Johnston, Cooperstown. Same, L. T. Shumway, Cooperstown

Cryptorhynchus lapathi Linn., mottled willow and poplar borer, grubs and work on Carolina poplar, June 24, J. G. Sweigert, Plattsburg. Same, work and adults on poplar, July 19, John Dunbar, Rochester

Pissodes strobi Peck, white pine weevil, adult and work on pine, March 6, M. A. Brown, Delhi. Same, larvae and pupae on Norway spruce, July 7, J. A. Sweigert, Plattsburg

Epicaerus imbricatus Say, imbricated snout beetle, adult on grape, May 1, David Hunter, San Antonio, Tex. Sent with specimens of Fidia cana

Rhynchites bicolor Fabr., rose curculio, adults on rose, June 14, F. M. Rice, Albany

Pomphopoea sayi Lec., Say's blister beetle, adults on locust, June 21, J. A. Ennis, Pattersonville. Through State Department of Agriculture

Nacerdes melanura Linn., adults, July 20, J. E. Barkley, Albany

Diaperis maculata Oliv., larvae on Polyporus, September 9, S. H. Burnham, Hudson Falls

Coptocycla bicolor Fabr., golden tortoise beetle, May 31, L. R. Simons, Mineola. Same, on hickory, June 3, G. A. Lintner, Summit, N. J.

Chalepus dorsalis Thunb., locust leaf miner on locust, May 31, L. R. Simons, Mineola. Same, adult, August 11, C. H. Zimmer, Lynbrook. Through State Department of Agriculture

Galerucella cavicollis Lec., cherry leaf beetle, adults on sour cherry, June 24, F. J. Rose, South Byron. Same, on ornamental cherry, June 24, J. H. Dodge, Rochester

Diabrotica vittata Fabr., striped cucumber beetle, adults, June 21, J. O. Thompson, Jonesville

Fidia cana Horn, adults on grape, May 3, David Hunter, San Antonio, Tex.

Saperda concolor Lec., gall on poplar, March 30, S. H. Burnham, Hudson Falls

Phymatodes amoenus Say, work on Vitis riparia, April 22, S. H. Burnham, Hudson Falls

Callidium antennatum Newm., blue pine borer in rustic work, June 24, S. B. Ferris, Upper Saranac

Osmoderma scabra Beauv., rough flower beetle, adult, August 12, Miss Katherine D. Phelps, Canton

Euphoria inda Linn., bumble flower beetle, adults, May 21, D. V. Haggerty, Wiccopee. Same, on corn, August 31, A. M. Hollister, Saratoga Springs. Same, adults on maple, October 14, F. P. Bowles, Gloversville

Cotalpa lanigera Linn., goldsmith beetle, adult, June 9, T. F. Niles, Mount Kisco. Through State Department of Agriculture

Anomala lucicola Fabr., light loving grapevine beetle, adult, July 10, Benjamin Hammond, Garden City

Lachnosterna tristis Fabr., June beetle, adults, May 28, L. R. Simons, Mineola

Macrodactylus subspinosus Fabr., rose beetle, adults, July 10, Benjamin Hammond, Garden City

Hoplia sackenii Lec., adults on birch, June 29, Garden City. Through State Depa rtment of Agriculture

Photuris pennsylvanica DeG., fire fly, larvae, September 16, Mrs E. P. Gardner, Canandaigua

Agrilus otiosus Say, gall on Ostrya, March 30, S. H. Burnham, Hudson Falls

A. sinuatus Oliv., sinuate pear borer, work on pear, October 7, H. W. Merkel, New York City

Dicerca divaricata Say, divaricate Buprestis, adults, June 7, A. L. Kniffen, West Coxsackie

Agriotes mancus Say, wheat wireworm, larvae on corn, June 26, L. R. Simons, Mineola

Alaus oculatus Linn., eyed elater, adult, July, G. L. Flanders, North Chatham

Dermestes lardarius Linn., larder beetle, adult, August 7, Mrs H. G. Reist, Schenectady

Byturus unicolor Say, raspberry Byturus, adults and wo k on raspberry, May 12, C. G. Velie & Son, Marlboro

Thelydrias contractus Motsh., larvae, October 15, Miss Mary Darrow, New York City

Carabus nemoralis Mull., adults, May 6, Ward's Natural Science Establishment. Through State Department of Agriculture

*Diptera*

Culex sollicitans Walk., salt marsh mosquito, August 31, J. G. Livingston, New York City

Rhabdophaga aceris Shimer, maple leaf midge, larvae on soft maple, July 27, M. J. Adams, Rensselaer. Same, larvae and cocoons on soft maple, July 28, J. M. Ropes, Albany. Same, adult, August 24, S. B. Fracker, Madison, Wis.

R. batatas O. S., willow potato gall on willow, October 5, Mrs E. P. Gardner, Canandaigua

R. salicis Schrk., European willow stem gall, galls and adults on willow, July 3, A. Cosens, Toronto, Ont.

Dasyneura communis Felt, galls on maple, June 8, D. A. Ricker, West Springfield, Mass. Same, gall on sugar and soft maple, June 14, October 5, Mrs E. P. Gardner, Canandaigua

Diarthronomyia hypogaea H. Lw., Chrysanthemum midge, adult and gall, March 27, R. H. Pettit, Adrian, Mich. Same, larvae and galls on Chrysanthemum, April 13, October 9, 13, E. D. Smith & Company, Adrian, Mich. Same, adults and galls, September 24, E. O. Essig, Berkeley, Cal. Same September 25, Arthur Gibson, Ottawa, Can.

Phytophaga ulmi Beutm., elm bud gall, on elm, October 5, Mrs E. P. Gardner, Canandaigua

Rhopalomyia anthophila O. S., fuzzy goldenrod gall, on goldenrod, September 7, Mrs E. P. Gardner, Canandaigua. Same, galls on Solidago, September 29, S. H. Chubb, Kings Bridge. Through G. Clyde Fisher

R. fusiformis Felt, fusiform goldenrod gall on Solidago, September 19, G. C. Fisher, Leonia, N. J.

R. millefolii H. Lw., galls on Yarrow, October 2, E. Bethel, Denver, Col.

Walshomyia texana Felt, adults and galls on wild Texas cedar, Sabina sabinoides, October 4, Mrs L. T. Binkley, Austin, Tex.

Asteromyia carbonifera Felt, black blister gall on Solidago graminifolia, September 19, G. C. Fisher, Leonia, N. J.

Lasioptera clavula Beut., dogwood club gall on Cornus, March 19, Frost & Bartlett Company, Stamford, Conn.

L. corni Felt, ocellate leaf gall on Cornus, September 7, Mrs E. P. Gardner, Canandaigua

L. farinosa O. S., warty blackberry gall, October 5, Mrs E. P. Gardner, Canandaigua

Lasioptera vitis O. S., tumid grape gall, June 2, T. J. Headlee, New Brunswick, N. J. Same, gall on grape, August 12, H. G. Kirk, Harrisburgh, Pa.

Neolasioptera cornicola Beutm., dogwood stem gall on dogwood, March 30, S. H. Burnham, Hudson Falls

N. eupatorii Felt, snakeroot stem gall, September 7, Mrs E. P. Gardner, Canandaigua

N. hamata Felt, September 24, Mrs E. P. Gardner, Canandaigua

Asphondylia eupatorii Felt, snakeroot bud gall, Mrs E. P. Gardner, Canandaigua lake. Through S. H. Burnham

Contarinia virginianiae Felt, chokecherry midge, galls on chokecherry, August 8, J. C. Chapais, Quebec, Canada

Monarthropalpus buxi Lab., box leaf midge, larvae on Box, April 2, L. R. Simons, Mineola. Same, galls and adults on Box, April 10, H. D. Smith, Sacramento, Cal. Same, May 6, E. O. Essig, Berkeley, Cal.

Parallelodiplosis cattleyae Moll., orchid root gall, galls on orchid roots, November 12, D. K. MacMillan, Chicago, Ill.

Itonida foliora Rssl. & Hkr., oak leaf fold gall on oak, July 20, Mrs E. P. Gardner, Canandaigua

Cecidomyia bedeguar Walsh, mossy thorn gall, on Crataegus, June 14, Frank Dobbin, Shushan

C. pellex O. S., on ash, June 14, Mrs E. P. Gardner, Canandaigua

C. viticola O. S., conical grape gall on grape, October 5, Mrs E. P. Gardner, Canandaigua

Eristalis tenax Linn., drone fly, rat-tailed larva, September 24, Mrs B. L. Hand, Elizabethtown

Rhagoletis pomonella Walsh, apple maggot, work in apple, September 7, George Miller, Rhinebeck. Through F. H. Lacy. Same, October 6, A. M. Lane, Schenectady

Pollenia rudis Fabr., cluster fly, adults, September 18, Mrs D. O. Wickham, Champlain

*Lepidoptera*

Papilio glaucus-turnus Linn., black swallow-tail, caterpillar, September 17, Miss Nettie E. Squire, Canton

Callosamia promethea Dru., Promethea moth, adult, July 7, Emma E. Scott, Albany. Same, July 9, Margaret Fahrenkopf, Albany. Same, larva on lilac, August 23, Mrs E. Russel Mead, Albany

Tropea luna Linn., luna moth, cocoon, April 12, Mrs Horace L. Greene, Fort Plain. Same, adult, June 30, Thomas Albright, West Coxsackie

Telea polyphemus Cram., American silk worm moth, June 17, H. T. Wakely, Corinth. Same, adult, September 2, Edward Adriance, Albany

Automeris io Fabr., io moth, larva, August 30, L. A. G. Gale, Albany. Same, larvae, September 3, Miss Laura F. Eldredge, Canajoharie

Basilona imperialis Dru., Imperial moth, caterpillar, September 20, Samuel Hessberg, Albany

Estigmene acraea Dru., Acraea moth, June 4, G. G. Atwood, Jericho. Through State Department of Agriculture. Same, June 23, Miss Eliza S. Blunt, New Russia

Halisidota, caryae Harr., caterpillar, September 20, C. A. Hartnagel, Albany

Agrotis ypsilon Rot., greasy cutworm, larvae on gladioli, June 6, Joseph King, Nassau

Peridroma saucia Hübn., variegated cutworm, caterpillar, February 24, G. G. Atwood, Cayuga county. Through State Department of Agriculture

Noctua clandestina Harr., moths, September 16, Mrs Frances P. Gavit, Stony Creek

Euthisanotia grata Fabr., beautiful wood nymph, adult, July 16, R. F. Avery, Kinderhook

Erebus odora Linn., adult, June 23, Emma E. Scott, Albany. First taken in the State and brought to the Museum in twenty years

Datana major Grote & Rob., larvae on Rhododendron, July 19, P. F. Keil, Westbury

D. integerrima Grote & Rob., caterpillars, August 6, L. R. Simons, Mineola

Hemerocampa leucostigma Sm. & Abb., white-marked tussock moth, eggs on horse-chestnut, March 24, E. H. Cooper, Troy

Euproctis chrysorrhoea Linn., brown-tail moth, nests, February 11, L. C. Griffith, Amagansett. Same, web on Massachusetts stock, May 11. Through State Department of Agriculture

Erannis tiliaria Harr., imago, October 22, J. R. Gillett, Kingston

Ennomos magnarius Guen., notch-wing, adults, November 11, Delbert Bishop, Millerton. Through F. H. Lacy

Sibine stimulea Clem., saddle-back caterpillar, larvae on golden glow, September 5, Mrs J. C. Wheaton, Yonkers

Zeuzera pyrina Linn., leopard moth, larva on Gordonia altamaha, September 9, Leonard Barron, Garden City

Phlyctaenia ferrugalis Hübn., greenhouse leaf-tyer, moth and work on Chrysanthemum, October 22, C. H. Zimmer, Lynbrook. Same, adult and larva, January 23, John Dunbar, Rochester

Plodia interpunctella Hübn., Indian meal moth, adult, July 17, Miss Ruth M. Case, Peconic. Same, larvae in beans, September 29, W. E. Waterbury, East Schodack

Oxyptilus periscelidactylus Fitch, gartered plume moth, caterpillar on grape, May 28, L. R. Simons, Mineola

Evetria buoliana Schiff., European pine twig moth, work, April, Buffalo. Through State Department of Agriculture. Same, larvae, June 1, S. G. Harris, Tarrytown. Same, pupae on Mugho pine, June 15, A. R. Miller, South Jamaica. Through State Department of Agriculture. Same, pupa on pine, June 22.

J. J. de Vyver, Flushing. Same, on Mugho pine, June 29, Buffalo. Through State Department of Agriculture

Archips cerasivorana Fitch, ugly nest cherry worm, in web on Lombardy poplar, June 18, C. B. Cutler, East Greenbush

Yponomeuta malinella Zell., ermine moth, young caterpillars, June 4, G. G. Atwood, Geneva. Through State Department of Agriculture

Ectoedemia populella Busck, ridged leaf stem gall; galls and larva on cottonwood August 23, J. C. Howard, Ogdensburg

Coptodisca splendoriferella Clem., resplendent shield bearer, work on wild cherry, October 19, F. J. Seaver, New York City

Incurvaria acerifoliella Fitch, maple leaf cutter, work on maple, September 10, H. L. Bailey, Bradford, Vt.

*Platyptera*

Corydalis cornuta Linn., horned Corydalis, August 5, W. A. Melius, Ghent

*Odonata*

Aeschna clepsydra Say, dragonfly, adult, June 29, Raymond Sullivan, Albany

*Hemiptera*

Tibicen septemdecim Linn., seventeen year Cicada, adult, June 18, J. H. Livingston, Tivoli

Ormenis pruinosa Say, lightening leaf hopper, nymphs on grape, etc., July 21, R. H. Tedford, Albany

Aphrophora quadrinotata Say, four-spotted spittle insect, adults and larvae on Helianthus, July 7, Alfred Vander Veer, Big Moose lake

Philaenus lineatus Linn., lined spittle insect on grass, June 25, D. V. Haggerty, Poughkeepsie

Oncometopia undata Fabr., adults, June 30, Doubleday, Page & Company, Garden City

Phylloxera caryaecaulis Fitch, hickory stem gall, June 14, Frank Dobbin, Shushan. Same on hickory, Mrs E. P. Gardner, Canandaigua. Same, June 26, Board of Park Commissioners, Rochester. Through John Dunbar

P. foveola Perg., on hickory, June 14, Mrs E. P. Gardner, Canandaigua

Chermes abietis Linn., spruce cone gall on spruce, April 15, Mrs E. P. Gardner, Canandaigua

C. pinifoliae Fitch, pine leaf Chermes, eggs on white pine, January 19, Arthur Cowee, Berlin. Same, young on pine, July 30, P. W. Harter, Utica

C. strobilobius Kalt., woolly larch aphis, adults, eggs and young, June 15, Benjamin Hammond, Beacon. Same, adults and young on larch, July 29, P. W. Harter, Utica

Pemphigus populicaulis Fitch, galls on poplar, July 16, L. R. Simons, Mineola

P. ulmifusus Walsh, slippery elm gall on elm, October 5, Mrs E. P. Gardner, Canandaigua

Colopha ulmicola Fitch, cockscomb elm gall, on elm, June 30, Martha J. Naramere, Ossining

Schizoneura lanigera Hausm., woolly apple aphis, June 19, Benjamin Hammond, Beacon

Aphis mali Fabr., green aphis on apple, April 21, J. S. Langford, Shushan

A. sorbi Kalt., rosy aphis on young orchard trees, June 3, G. A. Lintner, Summit, N. J.

Myzus ribis Linn., currant aphis on currant, May 22, Harold Wilson, jr, Clermont. Same, young, June 18, Mrs Charles S. Phelps, Canton

M. cerasi Fabr., black cherry aphis, adults on cherry, June 18, W. C. Johnston, Cooperstown

Gossyparia spuria Mod., elm bark louse, adults, June 9, F. J. Seaver, New York City. Same, adults on elm, June 12, T. W. Baldwin, Nyack.

Eriococcus azaleae Comst., adults on huckleberry, May 22, C. P. Phelps, Canton

Phenacoccus acericola King, false maple scale, male cocoons, April 30, J. J. de Vyver, Flushing. Same, adults on sugar maple, August 21, A. O. Smith, Mount Vernon

Pseudococcus citri Risso, mealy bug, August 5, Mrs E. Russel Mead, Albany

Coccus hesperidum Linn., soft or brown scale on fern, January 25, Mrs A. C. Aammond, Schenectady

Eulecanium fletcheri Ckll., on Juniper, June 14, Mrs E. P. Gardner, Canandaigua. Same, June 15, Antoine La Clair, Valcour

Eulecanium nigrofasciatum Perg., Terrapin scale on red maple, November 12, F. J. Whaley, Albany

Chionaspis pinifoliae Fitch, pine leaf scale on pine, October 17, J. J. de Vyver, Flushing. Same, eggs on pine, November 5, J. A. Sweigert, Plattsburg. Same, March 17, H. C. Shears, Hyde Park. Same, on spruce, September 18, Richard Harrar, New York City

Aulacaspis rosae Sandb., rose scale, eggs on rose, March 27, Benjamin Hammond, Fishkill

Leucaspis japonica Ckll., on Norway maple and Privet, December 5, Frost & Bartlett Company, Stamford, Conn.

Aspidiotus abietis Schr., on hemlock, September 30, F. J. Seaver, New York City

A. perniciosus Comst., San José scale on birch infested by parasites, October 26, F. J. Whaley, Schenectady

*Orthoptera*

Blatta orientalis Linn., cockroach, adult, September 1, C. E. Eldredge, Leon

*Thysanura*

Thermobia furnorum Prov., silver-fish, bristle-tail or fish moth, adult, March 26, F. J. Stubing, Mount Vernon

*Mallophaga*

Docophorus haleti Osb., on Eagle, June 2, W. G. Van Name, Saranac Lake. Through State Conservation Commission

## EXCHANGE

The following species were received from Dr Nathan Banks, East Falls Church, Va.

Psychoda nigra *Bks.*
P. superba *Bks.*
P. apicalis *Bks.*
P. albitarsis *Bks.*
Clitellaria subulata *Lw.*
Apatolestes comastes *Will.*
Rhachicerus obscuripennis *Lw.*
Dialysis rufithorax *Say*
Chrysopila rotundipennis *Lw.*
C. apicalis *V. d W.*
C. basalis *Say*
Exoprosopa emarginata Macq.
Systropus macer *Lw.*
Geron senilis *Fabr.*
Leptogaster atridorsalis *Back*
L. brevicornis *Lw.*
Holopogon philadelphicus *Schin.*
Cerotania macrocera *Say*
Mallophora clausicella *Macq.*
Asilus autumnalis *Bks.*
Baccha tarchetius *Walk.*
Myrmecomyia myrmecomoides *Lw.*
Euxesta scoriacea *Lw.*
Lipochaeta slossonae *Coq.*

The following Sarcophagidae were received from Mr R. R. Parker, assistant entomologist, Bozeman, Mont.

Wohlfahrtia opaca *Coq.*
Boettcheria latisterna *R. Pkr.*
B. bisetosa *R. Prk.*
B. cimbicis *Towns.*
Sarcophaga sinuata *Meigen*
S. cooleyi *R. Prk.*
S. aldrichi *Mans.*
S. haemorrhoidalis *Meigen*
S. falculata *Pandellé*
S. dalmatina *Schiner*
S. sarraceniae *Riley*
S. kellyi *Aldrich*
S. harpax *Pandellé*
S. bullata *Mans.*
S. scoparia *Pandellé*
S. helicis *Towns.*
S. assidua *Walk.*
Ravinia communis *R. Pkr.*
R. peniculata *R. Pkr.*
R. quadrisetosa *Coq.*

## ADDENDA

### **Sarcophaga bullata** R. Parker

The original data given in Museum Bulletin 165, page 80, and the illustrations on plate 7, relate to the above-named species, a recently characterized form, and not to Sarcophaga georgina Wied.

Figure 4, plate 7, of this bulletin illustrates the male genitalia of Phormia regina Meig. and not that of a species of Sarcophaga.

# APPENDIX

## A STUDY OF GALL MIDGES IV

### FAMILY ITONIDIDAE

### TRIBE—ASPHONDYLIARIAE

The tribe comprises mostly large, heavy-bodied insects easily recognized by the long, cylindric, sessile antennal segments and the simple claws. Members of this group breed largely in the flower buds or fruits of various plants. The four known American genera display a considerable variety in food preferences. Asphon-

Fig. 1 Asphondylia monacha. Lateral view of female, enlarged (original)

dylia is represented by a rather large series of species, while the somewhat nearly related Schizomyia possesses very similar habits. The highly specialized Cincticornia is largely, if not entirely restricted to various leaf galls on oak, Quercus.

**Key to North American genera**

*a* Ovipositor protractile, aciculate or nearly so, the terminal clasp segment of the male usually uni- or bidentate
  *b* Palpi quadriarticulate, the flagellate antennal segments with long, whorled hairs and two strongly sinuous and anastomosing circumfili, especially in the male
    *c* Ovipositor aciculate with lamellae apically; larval breastbone bidentate Schizomyia Kieff.
  *bb* Palpi bi- or triarticulate, rarely uniarticulate
    *c* Circumfili in the female consisting of two comparatively simple bands
      *d* Terminal clasp segment of the male uni- or bidentate, not pectinate
        *e* Subcostal cell normal, not opaque, the ovipositor with a lobed pouch proximally, not vesiculate Asphondylia H. Lw.
*aa* Ovipositor exserted, apically with lobes or triangular plates; terminal clasp segments of the male usually serrate apically
  *b* Palpi quadriarticulate
    *c* Terminal clasp segment of the male apical; third and fourth antennal segments fused, the circumfili usually with many fine reticulations in the male, the pulvilli usually shorter than the claws Cincticornia Felt
  *bb* Palpi triarticulate
    *c* Terminal clasp segment of the male serrate apically
      *d* Circumfili of male coarse, very irregular, there being four or five transverse fili to a segment, the plates of the ovipositor triangular Feltomyia Kieff.[1]

## SCHIZOMYIA Kieff.

### *Kiefferia* Mik

1889 **Kieffer, J. J.** Ent. Nachr., 15:183, 184
1892 ———— Wien Ent. Zeit., 11:218
1892 **Rubsaamen, E. H.** Berl. Ent. Zeitschr., 37:328, 381
1895 **Kieffer, J. J.** Wien Ent. Zeit., 14:11
1895 **Mik, Josef.** Wien Ent. Zeit., 14:95, 96 (Kiefferia)
1895 **Rubsaamen, E. H.** Ent. Nachr., 21:4
1897 **Kieffer, J. J.** Syn. Cecid. de Eur. & Alg., p. 18
1900 ———— Soc. Ent. Fr. Ann., 49:449, pl. 16, fig. 6; pl. 19, fig. 7; pl. 20, fig. 1; pl. 32, fig. 1, 2, 10
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:378
1911 ———— N. Y. Ent. Soc. Jour., 19:48
1913 **Kieffer, J. J.** Gen. Insect., fasc. 152, p. 88
1915 **Felt, E. P.** U. S. Nat'l. Mus. Proc. 48:197

Antennae consisting of 14 cylindric, sessile or subsessile segments, those of the male slightly shortened distally and each with remarkably stout, elevated, strongly convolute circumfili. Palpi with 4 segments. The basal clasp segment of the male genitalia projects well beyond the insertion of the terminal clasp segment, which latter bears

[1] Judging from larval characters this genus is closely related to, and may possibly be a synonym of Uleella Rubs., a genus founded upon a larva.

apically a more or less distinct chitinous tooth. Female with the distal antennal segments greatly shortened as in Asphondylia, the

Fig. 2 Schizomyia rubi. Lateral view of body showing extended ovipositor, enlarged (original)

circumfili nearly the same as in this older genus. Ovipositor with a distinct fleshy basal portion, tapering distally and bearing the characteristic though somewhat modified aciculate organ of Asphondylia. The dorsal pouch absent. The seventh abdominal segment with a more or less strongly chitinized ventral sclerite characteristic of this genus. Type S. galiorum Kieff.

Several European species have been reared from enlarged flower buds of various plants. The West Indian S. ipomoeae Felt was obtained in abundance from flower buds of Ipomoea

**Key to species**

*a* Abdomen dark brown
  *b* Wings rather large, narrow
    *c* Scutellum reddish, fifth antennal segment with a length four times its diameter, the fourth palpal segment one-half longer than the third, female; taken on viburnum blossoms....viburni Felt C. 1212
    *cc* Scutellum fuscous yellowish, fifth antennal segment with a length six times its diameter, the fourth palpal segment twice the length of the third, female.....caryaecola Felt C. a1786a
*aa* Abdomen reddish brown
  *b* Antennae unicolorous
    *c* Wings small, narrow.....altifila Felt, C. 177
    *cc* Wings small, broad.....rubi Felt, C. 685
    *ccc* Wings large, rather broad. Reared from Amsinckia galls..... macrofila Felt, C. 855, 1001
  *bb* Antennal segments annulate with yellowish basally. Reared from Ipomoea buds.....ipomoeae Felt, C. a2022
*aaa* Abdomen yellowish or light brown
  *b* Wings large, tarsi unicolorous or nearly so
    *c* Fifth antennal segment with a length six times its diameter, the fourth palpal segment with a length one-fourth greater than the third, female; reared from apical leaf bud gall on grape..... coryloides Walsh & Riley, C. 874
    *cc* Fifth antennal segment with a length five times its diameter, fourth palpal segment with a length three-fourths greater than the third, male; reared from hard, nutlike, polythalamous gall on grape.....pomum Walsh & Riley, a1434b

*bb* Wings small, broad

*c* Posterior tarsi rather broadly yellow banded; fifth antennal segment with a length six times its diameter, the fourth palpal segment one-fourth longer than the third, female; reared from bud galls on Rivina humilis.....rivinae Felt, C. 943

*cc* Posterior tarsi dark brown and broadly whitebanded; fifth antennal segment with a length five times its diameter; fourth palpal segment one-half longer than the third; female....speciosa Felt, C. 1507

*ccc* Posterior tarsi black; fifth antennal segment with a length four or five times its diameter, the fourth palpal segment one and one-half and one and three-fourths the length of the third in the male and female respectively; reared from oval or fusiform tendril or petiole galls on Vitis bicolor.....petiolicola Felt, C. a1784

## **Schizomyia viburni** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:378

This female was taken June 20, 1907 at Old Forge, N. Y., apparently as she was about to oviposit in Viburnum blossoms. It is possible that later rearings may prove this to be the other sex of S. altifila.

*Female.* Length 1.5 mm. Antennae nearly as long as the body, sparsely haired, dark brown; 14 segments, the third with a length fully four times its diameter. Palpi; the first segment short, stout, subquadrate, the second more slender, about one-half longer, the third a little longer and more slender than the second, the fourth one-half longer than the third. Mesonotum dark brown, the submedian lines sparsely clothed with fine hairs. Scutellum yellowish brown with numerous light setae apically, postscutellum a little darker. Abdomen dark brown, the segments rather thickly margined posteriorly with coarse setae; venter lighter. Wings hyaline, costa light brown; halteres pale yellowish. Coxae and base of femora fuscous yellowish, distal portion of femora, tibiae and tarsi a nearly uniform dark brown; claws long, slender, strongly curved, the pulvilli shorter than the claws. Ovipositor probably nearly as long as the body. Type Cecid. 1212.

## **Schizomyia caryaecola** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:378

The one female was reared June 1, 1908 from a jar containing a long, conic leaf gall on Bitternut or swamp hickory, Carya cordiformis and undoubtedly produced by Caryomyia caryaecola O. S. It is probable that the occurrence of the midge in this jar was accidental.

*Female.* Length 2 mm. Antennae nearly as long as the body, thickly short haired, reddish brown; 14 segments, the fifth cylindric, with a length about five times its diameter. Palpi; the first segment short, stout, irregularly quadrate, the second with a length about three times its diameter, the third one-fourth longer than the second, more slender, the fourth three-fourths longer than the third; face yellowish. Mesonotum light brown, the submedian lines thickly clothed with fulvous hairs. Scutellum fuscous yellowish, postscutellum a little darker. Abdomen dark reddish brown, the segments rather thickly margined posteriorly with fulvous setae; venter thickly clothed with setae, the apical segments darker. Wings hyaline, costa light brown; halteres yellowish, fuscous subapically. Coxae, femora and tibiae mostly dark brown, the posterior legs with the basal two-thirds of the femora light fuscous yellowish and with the first tarsal segment, the base and the distal half of the second and the third mostly fuscous yellowish; claws long, slender, evenly curved, the pulvilli about one-third the length of the claws. Ovipositor about as long as the body. Type Cecid. a1786a.

### **Schizomyia altifila** Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110:119 (separate, p. 23 [Asphondylia])
1908 ———— N. Y. State Mus. Bul. 124:378

This species was taken at Lake Clear, N. Y., June 7, 1906, sweeping blueberry, Vaccinium bushes in the vicinity of woods.

*Male.* Length 1.5 mm. Antennae as long as the body, thickly fine white haired, dark brown; 14 segments, the third with a length four times its diameter. Palpi; the first segment short, subquadrate, the second as long as the first, much broader, the third twice the length of the second, more slender, the fourth one-half longer than the third. Mesonotum very dark brown, submedian lines paler with sparse setae. Scutellum and postscutellum reddish brown. Abdomen dark reddish brown, thickly yellow haired laterally. Wings hyaline, costa dark reddish brown. Halteres reddish transparent basally, yellowish white apically. Legs dark straw color, the tarsi slightly darker; claws stout, uniformly curved. Genitalia; dorsal plate broad, the sides parallel, broadly and triangularly emarginate; ventral plate narrow, broadly and roundly emarginate. Type Cecid. 177.

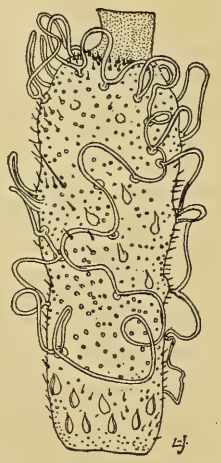


Fig. 3 Schizomyia altifila. Sixth antennal segment of male, enlarged (original)

### **Schizomyia rubi** Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110:119–20 (separate, p. 23 [Asphondylia])
1908 ———— N. Y. State Mus. Bul. 124:379

This species was swept from high blackberry at Karner, N. Y., July 24, 1906.

*Female.* Length 1.5 mm. Antennae extending to the fourth abdominal segment, sparsely haired, dark brown; 14 segments, the third with a length six times its diameter. Palpi; the first segment irregularly subquadrate, the second short, swollen basally, the third a little longer, tapering distally, subquadrate, the fourth nearly twice the length of the preceding, more slender. Mesonotum yellowish brown, submedian lines ornamented with long, yellowish setae. Scutellum reddish brown with sparse apical setae, postscutellum dark brown. Abdomen dark reddish with irregular dark brown markings on the dorsum of the second, third and seventh abdominal segments. Ovipositor yellowish orange. Wings subhyaline, unspotted, costa thickly clothed with dark brown hairs; halteres yellowish basally, the base of club fuscous, tip whitish transparent. Coxae mostly fuscous, anterior and mid femora mostly black, narrowly ringed with pale yellowish, posterior femora with basal half pale yellowish, distal half fuscous; tibiae black with articulations yellowish or tinged with carmine, fore and mid tarsi black,

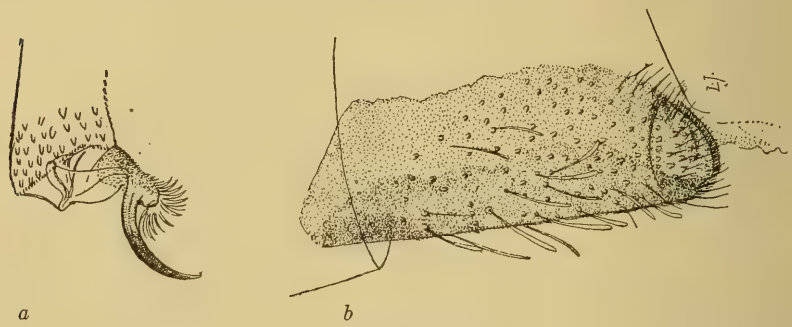



Fig. 4 Schizomyia rubi. *a*, lateral aspect of the distal portion of the last tarsal segment and claw; *b*, ventral plate of female, enlarged (original)

the segments narrowly ringed basally with yellowish or yellowish white, posterior tarsi mostly yellowish with sparse, irregular, fuscous markings on the middle of the second segment, distal segments dark brown or fuscous; claws long, rather stout, evenly curved. Ovipositor very slender (fig. 2), nearly twice the length of the body. Type_Cecid. 685.

### **Schizomyia macrofila** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 16 (Asphondylia)
1908 ———— N. Y. State Mus. Bul. 124:297, 379

This species was reared May 4, 1887 from galls on Amsinckia lycopsoides collected by Mr A. Koebele April 8th at Los Angeles and Alameda, Cal. The gall was also taken in California and adults reared by the late D. W. Coquillett.

*Male.* Length 2 mm. Antennae nearly as long as the body, sparsely haired, light brown; 14 segments, the third with a length five times its diameter. Palpi; the first segment narrowly oval, the second one-fourth longer, more slender, the third one-half longer than the second, broader, the fourth one-half longer than the third, slender. Face reddish yellow. Mesonotum dark brown, the submedian lines sparsely yellow haired. Scutellum pale yellowish, sparsely setose apically, postscutellum dark brown. Abdomen thickly clothed with fine hairs, reddish brown. Genitalia fuscous yellowish. Wings hyaline, costa light brown. Halteres yellowish, reddish brown subapically. Legs reddish brown, the tarsi slightly darker; claws long, slender, evenly curved, the pulvilli shorter than the claws. Genitalia; dorsal plate short, stout, deeply and narrowly incised, the lobes obliquely truncate, the lateral angles greatly produced; ventral plate short, stout, broadly and roundly emarginate.

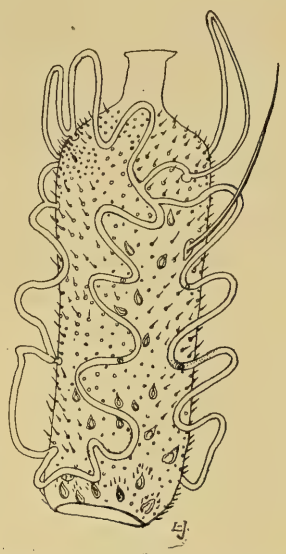


Fig. 5 Schizomyia macrofila. Sixth antennal segment of male, enlarged (original)

*Female.* Length 2 mm. Antennae shorter than the body, sparsely haired, dark brown; 14 segments, the third with a length five times its diameter. Palpi; the first segment broadly oval, the second longer, nearly as stout, the third one-half longer than the second, more slender, the fourth nearly twice the length of the third, more slender. Other characters nearly as in the male. Type Cecid. 855.

## **Schizomyia ipomoeae** Felt

1910 **Felt, E. P.** Ent. News, 21:160–61

This interesting species, described elsewhere, was reared in large numbers by William H. Patterson of St Vincent, B. W. I., from flower buds of Ipomoea. It is most easily distinguished from American forms by its small size, the reddish brown abdomen and in particular by the varicolored antennae, the segments basally being a more or less distinct yellowish.

*Larva.* Length 3 mm, rather stout, yellowish or yellowish orange. Head small; antennae rather long, stout; breastbone well chitinized, bidentate, tapering and somewhat obsolescent. Skin coarsely shagreened. Posterior extremity broadly rounded.

## **Schizomyia coryloides** Walsh & Riley

*Grape filbert gall*

1864 **Walsh, B. D.** Ent. Soc. Phil. Proc., 3:588–91 (Cecidomyia)
1867 ———— Ent. Soc. Phil. Proc., 6:224 (Cecidomyia)
1868 ———— **& Riley, C. V.** Amer. Ent., 1:106–7 (Cecidomyia vitis-coryloides)
1869 **Packard, A. S.** Guide Study Ins., p. 376–77 (Cecidomyia vitis-coryloides)
1873 **Riley, C. V.** Ins. Mo., 5th Rep't, p. 116–17 (Cecidomyia vitis-coryloides)
1906 **Felt, E. P.** Ins. Affect. Prk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:745 (Cecidomyia)
1908 ———— N. Y. State Mus. Bul. 124:379
1909 **Burrill, A. C.** Wis. Nat. Hist. Soc. Bul. 7:130 (Cecidomyia)
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2:44

The gall of this species occurs on grape. Apparently the same gall is found on wild frost grape in Illinois and was described and figured by Messrs Walsh and Riley in 1868. They state that the gall develops from a common center at a point where a bud would ordinarily occur. Occasionally a normal leaf grows from some portion of the mass and sometimes bears two galls at the juncture of the stem with the leaf. Each gall is one celled, the cavity being


Fig. 6 Schizomyia coryloides. *a*, fifth and sixth antennal segments of male, the reverse shown in outline; *b*, palpus, enlarged (original)

about one-fourth of an inch long, one-fourth as wide and containing a single larva. Large specimens of this gall bear a general resemblance to a bunch of filbert or hazelnuts as they grow on a bush, which led to the designation " vitis-coryloides." Galls of this species

were collected at Georgiana, Fla., by Mr William Wittfeld. They were received by the division of entomology June 25, 1883, adults issuing in March 1884.

*Male.* Length 2 mm. Antennae shorter than the body, thickly haired, light brown; 14 segments, the third with a length about two and one-half times its diameter. Palpi; the first segment short, stout, subquadrate, the second one-half longer, slender, the third a little longer and more slender than the second, the fourth about two and one-half times the length of the third, strongly flattened. Mesonotum reddish brown, the base of the wings and the anterior lateral angles yellowish, the submedian lines rather thickly clothed with yellowish brown hairs. Scutellum light yellowish brown, postscutellum a little lighter. Abdomen mostly yellowish brown; genitalia reddish brown, the segments rather sparsely margined posteriorly with long, yellowish hair, this being most abundant on the eighth segment. Wings hyaline, costa light brown. Halteres yellowish basally, fuscous apically. Coxae and base of femora light yellowish brown, the other portion of the legs a variable reddish brown; claws long, slender, evenly curved, the pulvilli almost rudimentary. Genitalia; dorsal plate long, broad, deeply and narrowly incised, the lobes roundly tapering; ventral plate long, stout, tapering, deeply and roundly emarginate, the lobes short, obtuse.

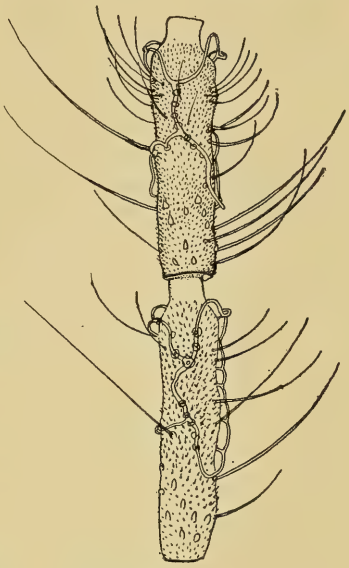


Fig. 7 Schizomyia coryloides. Fifth and sixth antennal segments of female, enlarged (original)

*Female.* Length 2.5 mm. Antennae extending to the fourth abdominal segment, thickly fine haired, light reddish brown, the basal segments yellowish; 14 segments, the third with a length about five times its diameter. Palpi; the first segment stout, swollen, narrowly oval, the second one-half longer, more slender, the third a little longer and more slender than the second and the fourth about as long as the third, strongly flattened; face yellowish. Ovipositor yellowish orange, about as long as the body. Otherwise nearly as in the male. Cecid. 874.

## **Schizomyia pomum** Walsh & Riley

*Grape apple gall*

1869 **Walsh, B. D., & Riley, C. V.** Am. Ent., 1:106 (Cecidomyia vitis-pomum)

1869 **Packard, A. S.** Guide for the Study of Ins., p. 378 (Cecidomyia)

1873 **Riley, C. V.** Nox. & Other Ins. Mo., 5th Rep't, p. 114–16 (Cecidomyia)
1874 **Glover, Townend.** MS. Notes from My Journ. Dipt., pl. 9, fig. 17 (Cecidomyia)
1883–1889 **Saunders, William.** Ins. Inj. Fruits, p. 295–96 (Cecidomyia)
1892 **Beutenmueller, William.** Am. Mus. Nat. Hist. Bul. 4:272 (Cecidomyia)
1899 **Smith, J. B.** List Ins. N. J., p. 621 (Cecidomyia)
1904 **Beutenmueller, William.** Am. Mus. Nat. Hist. Guide Leaflet 16, p. 32 (Cecidomyia)
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:379
1909 ———— Ent. Soc. Ont., 39th Rep't, p. 45
1909 **Burrill, A. C.** Wis. Nat. Hist. Soc. Bul. 7:130 (Cecidomyia vitis-pomum)
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2:44

This species was first brought to notice by Messrs Walsh and Riley, who characterized the gall as an applelike growth on grapevines (Vitis cordifolia). This gall is evidently widely distributed. It has been recorded as common in New Jersey, in the vicinity of New York City, in Virginia and from Wisconsin. It is comparatively easy to find a few of the characteristic galls made by this insect in most localities in New York State and in some places it is almost abundant. Numerous large-sized galls were taken at Westfield, N. Y., on the summer grape (Vitis bicolor) while scattered, smaller specimens were found on the northern fox grape (Vitis labrusca) at Hamburg, the larvae from both appearing identical.

The insect is a difficult one to rear, and it was only after repeated trials that we succeeded, May 28, 1908, in obtaining an adult from a number of galls collected the preceding season. The galls are evidently modified buds and, with the advance of the season, ripen and drop probably with the falling foliage. The insects remain in their retreats over winter and by spring the hard, woody tissues of the gall seem to have mostly disappeared and the flies have little difficulty in emerging from their shelters. Larvae may possibly survive a second winter as living examples were found in February 1907 in galls that were probably collected in the fall of 1906. There is presumably but one generation annually. The structure of the gall with its two layers of cells placed end to end and separated by a thin septum, suggests that each is made by a single female depositing her eggs in a symmetrical manner around a young shoot. Polymecus picipes Ashm. and Polygnotus sp. were reared from this gall.

*Gall.* The gall is sometimes quite flattened or depressed though more often subspherical or flattened at the base and somewhat pointed at the tip. The young gall is green and covered with a fine

pubescence. It becomes a rosy red in part with the advance of the season. It is succulent when young and is credited with possessing a pleasant subacid flavor. The fully developed gall usually has 8 or 9 longitudinal ribs somewhat like those of a muskmelon, though smoother. A section reveals an outer fleshy wall and within a hard, woody interior containing a number of longitudinal cells arranged in two tiers, the upper tier of cells being frequently twice as long and more distinctly separated by a hard fiber than the lower.

*Larva.* Length 3 mm, rather stout, pale orange and recognizable by the heavily chitinized, armed, irregular area at the posterior extremity (figure 8). The head is small, with a diameter about one-fifth that of the body; the antennae short, stout, subcylindric;

Fig. 8 Schizomyia pomum. Posterior extremity of larva, enlarged (original)

breastbone short, stout, bidentate; the segmentation is rather distinct and the surface of the skin is minutely papillate. The posterior extremity is broadly rounded and with an irregular, heavily chitinized area, the latter bearing a pair of submedian, irregular, chitinous processes. A broadly triangular, chitinous ventral plate, rounded posteriorly, is observable in some specimens.

*Male.* Length 1.75 mm. Antennae nearly as long as the body, sparsely haired, light brown; 14 segments, the fifth cylindric, with a length about five times its diameter. Palpi; the first segment short, stout, irregularly subquadrate, the second narrowly oval, with a length about two and one-half times its width, the third fully twice the length of the second, slender, the fourth three-fourths longer than the third, slender. Mesonotum dark brown, the sparsely haired submedian lines and lateral and anterior margins fuscous yellowish. Scutellum reddish yellow, postscutellum yellowish. Abdomen sparsely haired, mostly fuscous yellowish, the basal segment and genitalia fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically; coxae and femora

basally fuscous yellowish, the distal portion of femora, tibiae and tarsi variably tinged with reddish, the latter probably abnormal, as the specimen adhered to the glass side of the breeding cage. Claws long, slender, evenly curved, the pulvilli about one-third the length of the claws. Genitalia; dorsal plate rather long, broad, deeply and triangularly incised, the lobes diverging, obliquely rounded; ventral plate broad at base, deeply and narrowly incised. Cecid. a1434b.

### **Schizomyia rivinae** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:379

The female described below was reared from a bud gall on bloodberry, Rivina humilis, June 22, 1882 from specimens collected by William Wittfeld, Georgiana, Fla.

*Gall.* Globular, pubescent, green, the tips whitish and rose colored (Pergande).

*Larva.* Reddish orange, paler toward the head and with yellowish white spottings laterally; breastbone slender, brown; spiracles small, black; on the penultimate segment posteriorly are two tubelike cylindrical projections in addition to the spiracles; the last segment short, round, and without appendages; the body covered with pointed granules, those along the sides directed backward (Pergande).

*Female.* Length 1.5 mm. Antennae about as long as the body, sparsely clothed with fine hairs, light brown; 14 segments, the third with a length fully four times its diameter. Palpi; the first segment short, stout, irregularly subquadrate, the second fully twice the length of the first, the third one-fourth longer than the second, more slender, the fourth one-half longer than the third, more slender. Mesonotum light brown, the submedian lines sparsely haired. Scutellum yellowish brown, postscutellum slightly darker. Abdomen light brown, the ovipositor pale yellowish. Wings hyaline, costa dark brown. Halteres pale yellowish, slightly fuscous subapically. Coxae mostly pale yellowish, a narrow band near the middle on the anterior and mid femora, the basal two-thirds of the posterior femora, a narrow apical band on the tibiae and broad apical bands on the tarsal segments, pale yellowish, the other portions of the legs light brown; claws long, slender, strongly curved at the base, the pulvilli rudimentary. Ovipositor about as long as the abdomen. Type Cecid. 943.

### **Schizomyia speciosa** Felt

1914 **Felt, E. P.** Psyche 20:112

This striking midge, collected by Mrs A. T. Slosson at Franconia, N.H., may be separated from S. rivinae Felt by its somewhat larger size, the darker color of the abdomen, the more distinctly and broadly white-banded posterior tarsi and the relatively longer antennal segments.

## Schizomyia petiolicola Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:379
1909 ———— Ent. Soc. Ont., 39th Rep't, p. 45

This species was reared April 24, 1908 from oval or fusiform petiole or tendril galls occurring on the summer grape (Vitis bicolor). The galls were taken at Westfield, N. Y., in October 1907 and were locally rather abundant. Polygnotus sp. was reared from this gall.

*Gall.* The gall produced by this species has a length of about 2.5 cm and a diameter of .7 cm. The color is usually a light brown, and in the case of those occurring on the petioles at least, there is frequently a rather characteristic striation, due to the rupturing of the outer bark and the light brown color of the recently exposed tissues. Occasionally two galls may occur on the same petiole. The walls are rather thin, hard, and the oval cavity is occupied by brown or black honeycombed, spongy tissue. Four to five larvae may occur in a gall. This gall presents a close resemblance to a smaller, very similar oval or fusiform petiole or tendril gall taken at Hamburg on the northern fox grape (Vitis labrusca). Possibly the two are made by the same insect and the difference in appearance is due to a variation in the habit of growth of the two plants.

*Larva.* Length 4 mm, rather long, slender, yellowish white, the segmentation not very apparent, the skin finely shagreened. Head small, with a width less than one-fourth that of the body and tapering to a narrowly rounded apex. Antennae rather large, the single segment being stout, with a leng about three times its diameter. Breastbone long, slender, distinct, tridentate, the median tooth about one-half the length of the lateral triangular teeth. Posterior extremity broadly rounded, with a few rather short, stout setae; anus slitlike.

The association of this larva with the above-named adult is provisional.

*Male.* Length 1.5 mm. Antennae a little longer than the body, thickly haired, dark brown, the basal segments yellowish, 14 segments; the fifth with a length about five times its diameter. Palpi; the first segment short, stout, somewhat expanded distally; the second rather long, broad, narrowly oval; third one-half longer and more slender than the second; fourth one-half longer and much more slender than the

Fig. 9 Schizomyia petiolicola. Terminal antennal segment of male, enlarged (original)

third; face yellowish. Mesonotum reddish brown; submedian lines thickly haired; scutellum reddish orange; postscutellum dark brown; abdomen fuscous yellowish, sparsely haired; genitalia fuscous; wings hyaline; costa light brown; halteres yellowish basally, fuscous apically; coxae and base of femora yellowish, distal portion of femora and tibiae dark brown; tarsi nearly black. Claws long, slender, strongly curved, the pulvilli a little shorter than the claws. Genitalia; dorsal plate long, broad, deeply and triangularly incised, the lobes well separated, subtriangular; ventral plate long, slender, deeply and broadly incised, the lobes long, slender.

*Female.* Length 1.5 mm. Antennae a little shorter than the body, sparsely haired, dark brown, the basal segment yellowish; 14 segments, the fifth with a length five times its diameter. Palpi; the first segment short, stout, subquadrate; the second one-half longer, somewhat stouter; the third about three-fourths longer than the second, more slender; the fourth nearly twice the length of the third, more slender. Mesonotum slaty brown; the submedian lines thickly haired; scutellum reddish orange; postscutellum fuscous yellowish; abdomen reddish brown, the second segment darker; all rather thickly clothed with fine hairs; costa dark brown. Ovipositor nearly as long as the body. Otherwise nearly as in the male. Type Cecid. a1784.

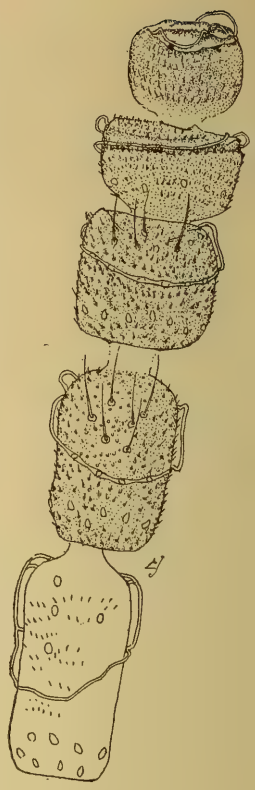


Fig. 10 Schizomyia petiolicola. Distal five antennal segments of female, enlarged (original)

ASPHONDYLIA Lw.

*Phyllophaga* Rond.

*Cylindrocera* Lioy

1850 **Loew, H.** Dipt. Beitr., 4:20, 21
1856 **Rondani,** Prodrom 1, p. 199 (Phyllophaga, C. fusca type)
1861 ———— Soc. Ital. Sci. Nat. Milano Atti, 2: 2, 5, 7
1862 **Osten Sacken, R.** Dipt. N. Am. Mon. 1: 176
1863 **Lioy** ———— Atti del Institut. Veneto S., 3: 503 (Cylindrocera)
1864 **Schiner, J. R.** Fauna Austriaca Dipt., 2:395
1869 **Osten Sacken, R.** Am. Ent. Soc. Trans., 2:301
1876 **Bergenstamm, J. E., & Low, Paul.** Syn. Cecidomyidarum, p. 22
1877 **Karsch, F. A. F.** Revis. d. Gallmucken, p. 15
1888 **Skuse, F. A. A.** Linn. Soc. N. S. Wales Proc., 3:37, 39, 43, 108

1892 **Kieffer, J. J.** Wien Ent. Zeit., 11:220 (A. sarothamni)
1892 **Rubsaamen, E. W.** Berl. Ent. Zeitschr., 37:367
1892 **Theobald, F. V.** Acct. Brit. Flies, p. 51, 85
1895 **Kieffer, J. J.** Wien. Ent. Zeit., 14:10
1897 ———— Syn. Cecid. de Eur. & Alg., p. 11, 19
1900 ———— Soc. Ent. Fr. Ann., 49:446, 447 (Phyllophaga) pl. 16, fig. 4; pl. 20, fig. 7; pl. 22, fig. 6; pl. 28, fig. 4; pl. 33, fig. 16, 18; pl. 34, fig. 12; pl. 36, fig. 2, 11, 12, 13
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:375–76
1911 ———— N. Y. Ent. Soc. Jour., 19:47–48
1913 **Kieffer, J. J.** Gen. Insect., fasc., 152, p. 91
1915 **Felt, E. P.** U. S. Nat'l Mus. Proc., 48:197

The genus is characterized by antennae with 14 cylindric, sessile segments, those of the male only slightly reduced distally, with

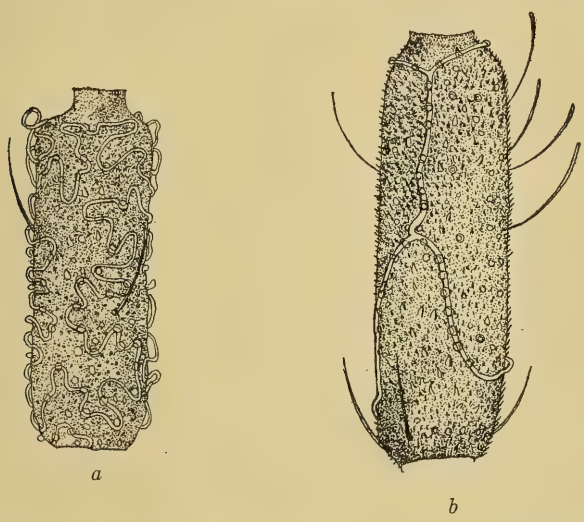



Fig. 11 Asphondylia monacha, sixth antennal segment; *a*, male; b, female, enlarged (original)

rather numerous low strongly convolute circumfili. Palpi with 1 to 3 segments. The terminal clasp segment of the male genitalia short, stout, swollen near the middle, and apically with a heavy, bidentate chitinous process. The female antennae are greatly reduced distally, the twelfth much shorter than the normal, the thirteenth with a length scarcely greater than its diameter, and the fourteenth subglobose or even reduced to a small disk, the circumfili consisting of a low band near the basal third or fourth, the branches produced on one side and fused to form a longitudinal filum which unites with a low apical circumfilum. Ovipositor with a distinct

tapering, fleshy part and a long, slender, aciculate portion. Basally there is a characteristic dorsal pouch consisting of two broadly

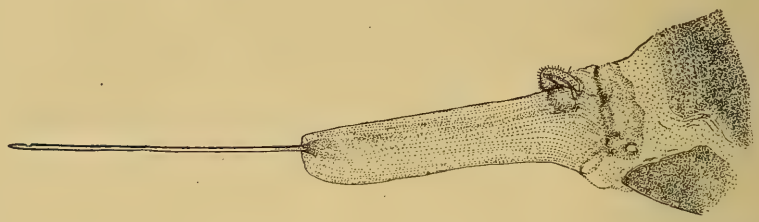


Fig. 12 Asphondylia monacha. Lateral view of ovipositor, enlarged (original)

rounded, thickly haired lobes separated mesially by a broadly rounded emargination. The type is Cecidomyia sarothamni H. Lw.

**Key to species**

*a* Palpi one-segmented
  *b* Length 1.5 mm; abdomen dark reddish brown; scutellum yellowish red.. brevicauda Felt, C. 1040
  *bb* Length 2.5 to 3 mm; abdomen with long, yellowish hairs; reared from gall on Larrea tridentata.....auripila Felt, C. 851
*aa* Palpi two-segmented
  *b* Large, 3 to 4 mm long
    *c* Abdomen dark brown or black
      *d* Tibiae dark brown; reared from brownish, fusiform Azalea buds.....azaleae Felt, C. a1481
        *e* Tarsi dark brown, the posterior yellowish, terminal palp segment not tapering distally; reared from apparently unmodified flower heads of Helianthus strumosus..... helianthiflorae Felt, C. a1718
      *dd* Anterior and mid tarsi dark brown, the posterior yellowish, terminal palp segment tapering; reared from stem gall on Eupatorium.....eupatorii Felt, C. 1288
    *ddd* Tibiae yellowish brown
        *e* Tarsi dark brown; reared from swollen Opuntia fruit..... betheli Ckll., C. a1776
        *ee* Tarsi yellowish.....fulvopedalis Felt, C. 546
    *cc* Abdomen reddish brown; reared from unripe fruits of Sicca disticha.. siccae Felt, C. 1213
*aaa* Palpi three-segmented
  *b* Small, 1.5 to 2.5 mm long
    *c* Abdomen light or reddish brown
      *d* Scutellum pale yellowish; reared from galls on Bumelia lanuginosa.....bumeliae Felt, C. 849
      *dd* Scutellum reddish brown
        *e* Basal abdominal segments yellowish; reared from bud gall on unknown shrub.....florida Felt, C. 873

*ee* Abdomen unicolorous; reared from flower buds of Rhus integrifolia.....integrifoliae Felt, C. 868

*bb* Medium sized, 3 to 4 mm long

*c* Tarsi plainly white-banded; reared from apical rosette gall on Euthamia lanceolata, from apparently unmodified florets of the same, and from oval galls between adherent leaves of Solidago serotina or S. canadensis.....monacha O. S. C. 761, 807, 812, 813, a1195, a1200, a1336, a1568a and y

*cc* Tarsi unicolorous or nearly so

*d* Abdomen yellowish brown

*e* Scutellum pale yellowish; tibiae and tarsi yellowish brown; reared from deformed berries of Smilacina racemosa.. smilacinae Felt, C. 860

*ee* Scutellum fuscous yellowish, basal segments of posterior tarsi yellowish; reared from subglobose stem galls on Helianthus.....globulus O. S., C. 854, 856, 869

*eee* Scutellum fuscous orange; legs light brown; reared from galls on unknown plant in Arizona..... baroni Felt, C. 865

*eeee* Scutellum yellowish brown

*f* Legs yellowish brown; reared from galls on Artemisia artemisiae Felt, C. 861

*eeeee* Scutellum dark brown

*ff* Legs dark brown; reared from woolly apical bud galls on Antennaria...antennariae Whlr. C. 870

*dd* Abdomen reddish brown

*e* Scutellum fuscous orange; reared from galls on Vernonia noveboracensis.....vernoniae Felt, C. 863, 867

*ee* Scutellum dark reddish brown; reared from loose terminal bud galls on Ceanothus....ceanothi Felt, C. 872

*ddd* Abdomen dark brown or fuscous

*e* Scutellum yellowish brown or fuscous yellowish

*f* Third antennal segment with a length six times its diameter, posterior tarsi dark brown, length 4 mm; reared from bud galls on Hydrangea..... hydrangeae Felt, C. 852

*ff* Third antennal segment with a length five times its diameter, tarsi fuscous yellowish, length 3 mm; reared from distorted fruit of Thalictrum..... thalictri Felt, C. a2211

*fff* Third antennal segment with a length four times its diameter, posterior tarsi with the basal segments yellowish; reared from bud gall on Helenium..... autumnalis Beutm.. C. 853, 1238

*ee* Scutellum dark brown, abdomen white-haired; bred from twig gall on Atriplex..... atriplicis Ckll., C. 864, 945

*eee* Scutellum dark reddish, legs black

*f* Wings broad, densely haired; reared from greenish bud gall on Sambucus..... sambuci Felt, C. a1511

*ff* Wings narrow, sparsely haired; reared from bud gall on Diplacus.....diplaci Felt, C. a2318

*eeee* Scutellum slaty gray, legs dark brown

*f* Wings short, broad, terminal palp segment not tapering; reared from Diervilla buds..... diervillae Felt, C. a1469

*ff* Wings long, rather narrow terminal palp segment long, tapering; reared from Encelia..... enceliae Felt, C. a2317

*eeeee* Scutellum pruinose, tibiae black; reared from bud galls on Ilicoides.....ilicoides Felt, C. a1548

*dddd* Abdomen brown, scutellum yellowish brown, legs dark brown; reared from Salix twigs.....salictaria Felt, C. 859

*ddddd* Abdomen reddish brown, legs fuscous yellowish; reared from Solidago.....johnsoni Felt, C. 809

*bbb* Large species, 5 to 6 mm long

*c* Abdomen dark brown or dark reddish brown

*d* Scutellum reddish brown; reared from galls on Opuntia..... opuntiae Felt, C. 848, 858, 862

*cc* Abdomen brown, scutellum yellowish; reared from subglobular enlarged flower heads of Helianthus.....conspicua O. S., C. 544, 806, 808, 810, 854, 866, 869, a1679, a1697

*ccc* Abdomen yellowish brown, scutellum fuscous yellowish, legs yellowish brown; bred from fruitlike enlargement of prickly pear.. arizonensis Felt, C. 857

### **Asphondylia brevicauda** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 14
1908 ———— N. Y. State Mus. Bul. 124:295, 376

This species is based on one specimen collected by the late H. G. Hubbard at Fort Yuma, Ariz.

*Female*. Length 1.5 mm. Antennae nearly as long as the body, sparsely haired, reddish brown; 14 segments, the third with a length four times its diameter. Palp; one short, stout, irregularly oval segment. Mesonotum dark brown. Scutellum yellowish brown, postscutellum a little darker. Abdomen dark reddish brown, rather thickly haired. Wings hyaline, costa yellowish brown. Halteres pale yellowish. Legs mostly yellowish brown, the tarsal segments darker; claws long, stout, strongly curved, the pulvilli as long as the claws. Ovipositor about one-half the length of the abdomen. Type Cecid. 1040.

### **Asphondylia auripila** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 14
1908 ———— N. Y. State Mus. Bul. 124:294–95, 376

The gall of this species was collected by the late H. G. Hubbard on Larrea tridentata at Tucson, Ariz., January 18, 1897, adults issuing shortly and continuing to appear till February 6th.

*Male.* Length 2.5 mm. Antennae extending to the fourth abdominal segment, sparsely short yellow haired, dark brown; 14 segments, the third with a length four times its diameter, the terminal segment broadly rounded. Palp; one long, rather stout, irregular segment. Mesonotum brownish black, the submedian lines distinct, thickly clothed with yellowish hairs. Scutellum reddish brown with a few apical setae, postscutellum slightly darker. Abdomen reddish brown, the second and following segments thickly clothed with long, yellowish hairs. Wings hyaline, costa light brown. Halteres reddish brown, pale yellowish distally. Pleurae and coxae reddish brown, the femora, tibiae and tarsi a variable yellowish brown, the distal tarsal segments reddish brown; claws long, stout, broadly rounded, the pulvilli as long as the claws. Genitalia; dorsal plate broad, deeply and triangularly incised, the lobes broadly rounded. Type Cecid. 851.

Fig. 13 Asphondylia auripila. Palpus of female, enlarged (original)

*Female.* Length 3 mm. Antennae extending to the third abdominal segment, sparsely haired, the third with a length six times its diameter, the twelvth with a length a little less than its diameter, the thirteenth with a length about half its diameter, the fourteenth greatly reduced, oblate. Palpi consisting of one long, somewhat fusiform segment tapering to an acute apex. Ovipositor about as long as the body. Other characters presumably nearly as in the male. Cecid. 851.

## **Asphondylia azaleae** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 14
1908 ———— N. Y. State Mus. Bul. 124:295, 376

Adults were reared in 1907 from June 15th till the 21st from unopened, brownish, fusiform buds of Azalea taken at Albany, N. Y. Normally only one larva occurs in a gall, though occasionally there may be two.

*Larva.* Length 4 mm, stout, pale yellowish. Head small; antennae short, stout, conic; breastbone quadridentate, the inner teeth a little shorter and well divided almost as in A. d i e r v i l l a e (fig. 24). The chitinized area tapers to the apical fourth of the stout shaft, an irregular arcuate expansion distally. Skin shagreened; terminal segment rather slender.

*Male.* Length 4 mm. Antennae nearly as long as the body thickly fine haired, light brown; 14 segments, the third with a length four times its diameter, the fourteenth with a length three and one-half times its diameter. Palp; the first segment stout, with a length three times its diameter, the second one-half longer, more slender; face fuscous yellowish, mouth-parts pale orange. Mesonotum dark

brown, the submedian lines thickly clothed with grayish hairs. Scutellum reddish brown, thickly clothed apically with long setae, postscutellum dark salmon. Abdomen dark brown, sparsely clothed with fine hairs, the segments rather thickly margined posteriorly with long setae, eighth segment mostly pale orange, genitalia fuscous; venter slightly lighter than the dorsum, the pleurae rather thickly clothed with silvery white scales. Wings hyaline, costa dark brown. Halteres yellowish white basally and apically, brown subapically. Coxae and femora fuscous yellowish, tibiae and tarsi mostly dark brown; claws long, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, stout, deeply and narrowly incised, the lobes subtriangular, obtuse apically.

*Female.* Length 4 mm. Antennae nearly as long as the body, thickly short haired, a variable fuscous yellowish, the extremities of the segments slightly darker; 14 segments, the third with a length fully five times its diameter. Palpi; the first segment long, stout, with a length two and one-half times its diameter, the second about twice the length of the first, more slender, tapering; face fuscous yellowish. Mesonotum a bronzy gray, laterally and anteriorly variably margined by dark brown, the submedian lines thickly clothed with long, grayish setae. Scutellum dark brown with numerous gray setae apically, postscutellum a deep salmon. Abdomen dark brown, thickly clothed with long, whitish hairs, the incisures deep salmon; pleurae rather thickly clothed with silvery white hairs, ventral sclerites dark brown, rather thickly clothed with short, white hairs and margined posteriorly with longer, yellowish hairs. Ovipositor about as long as the body. Type Cecid. a1481.

### **Asphondylia helianthiflorae** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul., 124:376

The midge was reared during August and September 1907 from apparently unmodified flower heads of Helianthus strumosus taken at Highland, N. Y. It is much smaller than A. conspicua O. S. and distinctly smaller than A. globulus O. S.

*Larva.* Length 3 mm, slender, pale yellowish; head small. Antennae short, stout, conical; breastbone quadridentate; the inner teeth very small, separated by a round emargination, the outer teeth long, stout, conical. The heavy chitinized area extends to the anterior third, the shaft slender, irregularly chitinized and with an indistinct crescentic chitinized area posteriorly, the anterior two-thirds of the breastbone supported by irregular, faintly chitinized areas, similar though smaller areas occurring on the preceding segment; skin finely papillate. Posterior segment slender, slightly bilobed.

*Exuviae.* Length 5 mm, the cephalic horns stout, tapering, strongly serrate internally; the dorsum of the third or fourth abdominal segment with a uniform row of heavy, chitinous spines on the distal third, the basal half with an irregular double row of smaller spines. Terminal segment posteriorly with about 12 heavy, chitinous spines, the median ones slender and irregularly placed, the latero-ventral ones larger and apparently grouped, the basal half very scatteringly ornamented with shorter, stout spines, there being only three or four in the submedian areas.

*Male.* Length 4 mm. Antennae a little longer than the body, sparsely haired, yellowish brown, basal segments fuscous orange; 14 segments, the third with a length four times its diameter. Palpi; the first segment long, dilated apically, with a length about twice its diameter, the second slender, nearly three times the length of the preceding; face fuscous orange, eyes large, black. Mesonotum olive brown, the submedian lines rather thickly haired. Scutellum fuscous yellowish brown with numerous coarse setae apically, postscutellum fuscous yellowish. Abdomen rather thickly clothed with silvery hairs, dark brown, the venter thickly clothed with grayish hairs; genitalia fuscous yellowish. Wings hyaline, costa dark brown; halteres reddish brown. Coxae and base of femora fuscous yellowish, the distal portion of femora and tibiae darker, tarsi dark brown or black, except the second segment of the posterior legs, which is mostly fuscous yellowish; claws long, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, broad, deeply and roundly emarginate, the lobes broadly rounded.

*Female.* Length 4 mm. Antennae about as long as the body, sparsely haired, yellowish brown, the basal segments fuscous orange; 14 segments, the third with a length six times its diameter. Palpi; the first segment stout, broad, with a length about two and one-half times its diameter, the second slender, with a length more than twice the preceding. There is in some specimens of this sex a rudimentary third segment. Ovipositor nearly as long as the body. Other characters as in the male. Type Cecid. a1718.

### **Asphondylia eupatorii** Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:546–47

The midge was reared in September 1907 by Mr L. H. Weld of Illinois from a green, fleshy, stem gall on white snake root, Eupatorium urticaefolium collected at Medina, N. Y. This species is closely related to A. helianthiflorae Felt, though it may be readily separated therefrom by the coloration of the legs, the tapering apical segment of the palpi and the marked difference in the male genitalia.

It produces a green, fleshy stem gall very similar in general appearance to that of Asphondylia globulus O. S. on Helianthus but smaller and usually cracked.

### Asphondylia betheli Ckll.

1907 **Cockerell, T. D. A.** Can. Ent., 39:324
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:376

This species breeds in the swollen Opuntia fruit which collapses after the exit of the flies. The gall was taken at Boulder, Col., adults emerging in May 1907. The following description was drafted from type specimens kindly donated for study by Professor Cockerell.

*Gall.* Length 3 cm, diameter 1.3 cm, subcylindric, a variable greenish and yellowish green.

*Exuviae.* Length 6 mm, light brown, the anterior horns stout, conical, the dorsum of the second or third abdominal segment with a row of stout, evenly placed spines on the posterior third and on the basal half two irregular rows of similar weaker spines with minor ones on the anterior margin. Terminal segment with an irregular row of 12 stout spines on the distal third, they being irregularly arranged in submedian and sublateral groups of three, the basal half thickly clothed with smaller, stout spines.

*Male.* Length 3 to 3.5 mm. Antennae about as long as the body, thickly fine-haired, dark brown; 14 segments, the third with a length six times its diameter. Palpi; the first segment stout, with a length three times its diameter, the second twice the length of the first, broadly flattened, tapering to an acute apex. Mesonotum slaty brown, the submedian lines sparsely haired. Scutellum dark brown, postscutellum yellowish brown. Abdomen dark brown, sparsely fine, whitish-haired, the venter dark brown, rather thickly clothed with fine, whitish hairs; genitalia fuscous. Wings hyaline, costa light brown; halteres yellowish basally, slightly fuscous apically. Coxae and femora basally fuscous yellowish, the distal portion of femora and tibiae on the anterior legs a variable yellowish brown, the tarsi dark brown, the posterior legs mostly a light yellowish brown; claws rather short, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate long, broad, deeply and triangularly emarginate, the lobes narrowly rounded.

*Female.* Length 6 mm. Antennae presumably nearly as long as the body, rather thickly fine-haired, dark brown; 14 segments, the third with a length about six times its diameter. Palpi; the first segment long, stout, with a length twice its diameter, the second nearly twice the length of the first, dilated near the middle, tapering, acute. Ovipositor one-half longer than the body. Otherwise nearly as in the male. Type Cecid. a1776.

## **Asphondylia fulvopedalis** Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110:118 (separate, p. 22)
1908 ———— N. Y. State Mus. Bul. 124:376

Adults were swept from Solidago at Westfield, N. Y., July 11, 1906.

*Male.* Length 2 mm. Antennae as long as the body, sparsely haired, light brown, fuscous basally; 14 segments, the third with a length about five times its diameter. Palpi; first segment small, suboval, the second broadly oval, the third twice the length of the second, swollen basally, tapering. Face fuscous. Mesonotum dark brown, the submedian lines lighter, scutellum, postscutellum and abdomen dark brown, the segments of the latter narrowly margined posteriorly with yellowish brown. Wings hyaline, costa light brown. Halteres fuscous. Legs fuscous straw, tarsal segments dull yellowish; claws stout, strongly and uniformly curved. Genitalia; dorsal plate broad, narrowly and probably deeply emarginate, the lobes broadly rounded. Type Cecid. 546.

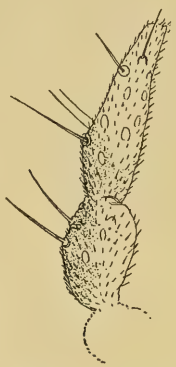


Fig. 14 Asphondylia fulvopedalis. Palpus of male, enlarged (original)

## **Asphondylia siccae** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:376

Unripe fruit of Phyllanthus distichus, the Otaheite gooseberry, is commonly badly injured by the stout, white larvae of this species, according to Dr N. Grabham of Jamaica, W. I.

*Larva.* Length 3 mm, stout, white, the head small. Antennae stout, biarticulate, conical; breastbone quadridentate, the inner teeth much shorter than the outer and deeply divided; the heavy chitinized area rounded and extending to the basal half of the irregular shaft, which latter has a slender irregularly chitinized crescentic area posteriorly. A slightly chitinized, roughly crescentic area occurs anterior of the breastbone; skin coarsely shagreened. Terminal segment slender posteriorly, bilobed.

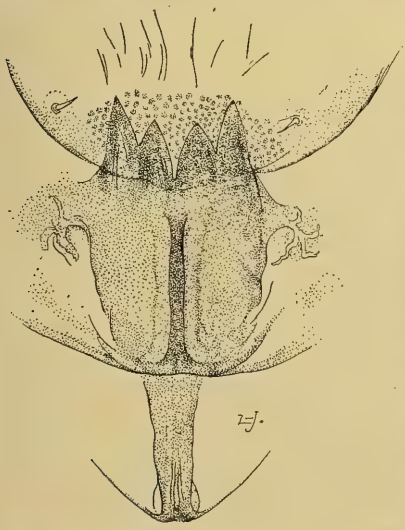


Fig. 15 Asphondylia siccae. Breastbone of larva, enlarged (original)

*Exuviae.* Length 5 mm, light brown, the anterior horns stout, conical, the dorsum of the second or third abdominal segment with an irregular row of stout spines on the distal third and on the basal half scattering weaker spines. Terminal segment with a transverse row of 10 spines on the distal third, the median four small, the others successively larger laterally and ventrally; the basal half with sparse smaller, stout spines.

*Male.* Length 2.5 mm. Antennae as long as the body, thickly short haired, light brown; 14 segments, the third with a length about five times its diameter. Palpi; the first segment with a length two and one-half times its diameter, rather stout, rounded at the extremities, the second one-fourth longer, tapering at the extremities. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum yellowish brown, postscutellum a little lighter. Abdomen reddish brown, sparsely clothed with fine hairs. Wings hyaline, costa pale yellowish brown. Halteres pale yellowish. Legs a variable yellowish brown; claws short, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, broad, the lobes apparently divided, orbicular.

*Female.* Length 3 mm. Antennae extending to the fourth abdominal segment, sparsely haired, light brown; 14 segments, the third with a length five times its diameter. Palpi; the first segment short, stout, subquadrate, the second more slender, one-half longer and tapering. Ovipositor nearly as long as the body. Other characters about as in the male. Type Cecid. 1213.

### **Asphondylia bumeliae** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 15
1908 ———— N. Y. State Mus. Bul. 124:296, 376

The galls on Bumelia lanuginosa were collected by Dr C. L. Marlatt at Nuecestown, Texas, in May 1896, the midges appearing shortly thereafter.

*Male.* Length 2 mm. Antennae shorter than the body, sparsely haired, light brown; 14 segments, the third with a length five times its diameter. Palpi; the first segment long, stout, swollen distally, the second oval, the third more than twice the length of the second. Face yellowish brown. Mesonotum light brown, indistinctly margined laterally and anteriorly with yellowish, submedian lines pale yellowish, sparsely setose. Scutellum light yellow, postscutellum light brown. Abdomen thickly clothed with fine, yellowish hairs, light brown. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Legs a variable brown, the extremities of tibiae and tarsi darker; claws long, stout, evenly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment stout; the rather large, roundly triangular lobe extends beyond the insertion of the terminal clasp segment, which latter is short, obliquely

truncate and bears a pair of heavy, asymmetrical teeth; dorsal plate stout, broadly and triangularly emarginate, the lobes narrowly rounded.

*Female.* Length 2.5 mm. Antennae yellowish brown; 14 segments, the third with a length six times its diameter. Palpi; the first segment short, subglobose, the second broad, quadrate, the third nearly thrice the length of the second, slender, tapering. Mesonotum dark brown, narrowly margined anteriorly and laterally with yellowish. Scutellum pale yellowish, postscutellum lighter. Abdomen sparsely yellow haired, light brown, the terminal segment pale orange. Legs yellowish. Ovipositor as long as the body, otherwise nearly as in the male. Type Cecid. 849.

### **Asphondylia florida** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:376

An unknown shrub bearing the bud galls of this species, collected by Mr E. A. Schwarz, was received from Cocoanut Grove, Fla., at the bureau of entomology, Washington, D. C., May 23, 1887, adults appearing the 25th.

*Gall.* The bud gall from which this specimen was reared is irregular, subglobular, about 6 mm in diameter and an empty pupal case protrudes therefrom.

*Exuviae.* About 3.5 mm long, rather stout, light brown, the anterior horns short, stout, conical; the dorsum of the third or fourth segment with a regular row of stout, chitinous spines on the distal third, the basal half with scattering smaller spines in two irregular rows.

*Male.* Length 2.5 mm. Antennae about as long as the body, sparsely clothed with fine hairs, reddish brown; 14 segments, the third with a length five times its diameter; the terminal segment subacute. Palpi; the first segment short, stout, subquadrate, the second stout, with a length two and one-half times its diameter, the third nearly twice the length of the second, somewhat swollen in the middle, slender at both extremities; face yellowish brown. Mesonotum dark brown, the submedian lines indistinct. Scutellum reddish brown, postscutellum yellowish brown. Abdomen light brown, the basal segments tinged with yellowish and sparsely haired. Wings hyaline, costa light brown; halteres yellowish basally, reddish brown apically. Legs a variable yellowish brown, the three distal tarsal segments darker; claws short, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, stout, slightly emarginate, the lobes widely separated, angulate. Type Cecid. 873.

### **Asphondylia integrifoliae** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:376

This species was reared April 15, 1886 from the flowers of Sumac, Rhus integrifolia, in Los Angeles county, Cal. It evidently came from a subglobular, apparently monothalamous flower bud gall some 3 mm in diameter.

*Exuviae.* Length 4.5 mm, light brown, the anterior horns short, stout, subconical, the dorsum of the third or fourth abdominal segment with a regular row of stout, chitinous spines at the distal third, the basal half sparsely clothed with smaller spines. Terminal segment invisible.

*Female.* Length 2.5 mm. Antennae nearly as long as the body, sparsely haired, rather dark brown; 14 segments, the third with a length five times its diameter. Palpi; the first segment short, stout, subquadrate, the second slender, with a length about four times its diameter, the third a little longer than the second, more dilated, acute distally. Mesonotum dark brown, the submedian lines sparsely fine haired. Scutellum reddish brown with a few apical setae; postscutellum a little darker. Abdomen reddish brown, sparsely and finely haired; ovipositor light reddish brown. Wings hyaline, costa pale brown; halteres yellowish basally, slightly fuscous apically. Legs a variable reddish brown, the tarsi slightly darker; claws long, stout, slightly curved, the pulvilli nearly as long as the claws. Ovipositor one-fourth longer than the body. Type Cecid. 868.

A number of specimens of this sex were reared by Mr P. H. Timberlake in early June 1914 from hypertrophied flower buds of Rhus trilobata, taken near Salt Lake City, Utah, and as the galls are very similar to those from which the above-described female was reared, and the two sexes present many similarities, we have provisionally referred them to the same species.

*Male.* Length 2.5 to 3.5 mm. Antennae extending to the fourth abdominal segment, sparsely haired, blackish brown; 14 segments, the fifth with a length about five times its diameter, the terminal segment with a length four times its diameter. Palpi triarticulate, the first segment small, subquadrate, the second broad, with a length three times its width, the third more slender and one-half longer than the second. Mesonotum dark reddish brown. Scutellum reddish brown apically, yellowish basally, postscutellum yellowish. Abdomen grayish brown. Halteres yellowish red, fuscous apically. Coxae slate colored, the legs yellowish brown, the tibiae and tarsi mostly pale straw; claws stout, strongly curved, the pulvilli as long as the claws. Genitalia; terminal clasp segment very short, bidentate apically; dorsal plate short, divided, the lobes narrowly oval; ventral plate short, narrowly and triangularly incised and densely setose. Cecid. 1644.

## **Asphondylia monacha** O. S.

*Nun midge*

1869 **Osten Sacken, R.** Amer. Ent. Soc. Trans., 2:299–301
1871 ———— Amer. Ent. Soc. Trans., 3:347
1875 ———— Can. Ent., 7:202 (A. recondita)
1886 ———— Biol. Cent. Amer. Dipt., 1:1
1907 **Beutenmueller, William.** Can. Ent., 39:305 (A. solidaginis)
1907 ———— Amer. Mus. Nat. Hist. Bul. 23:386 (A. patens)
1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 10
1908 ———— N. Y. State Mus. Bul. 124:291, 376
1908 **Jarvis, T. D.** Ent. Soc. Ont., 38th Rep't, p. 87
1909 **Felt, E. P.** Ottawa Nat., 22:246, 247, 248
1909 ———— Ent. Soc. Ont., 39th Rep't, p. 45
1909 **Jarvis, T. D.** Ent. Soc. Ont., 39th Rep't, p. 81
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2:49 (Cecidomyia bifolia)

This, one of the earliest known species, is easily recognized by the white tarsal bands, especially broad on the posterior legs. One of the commonest forms, it breeds in several species of Solidago and aster. The females are abroad in June and presumably may be found ovipositing during a considerable period, since they occur in greater or less numbers from then till September or even into October. This species occurs upon a variety of Solidago, namely S. graminifolia, S. sempervirens, S. serotina and S. canadensis. It has also been reared from aster.

Osten Sacken in 1875 proposed the name of A. recondita for an Asphondylid pupa protruding from an arrested budlike growth on aster taken at Lloyds Neck, N. Y., in September. Our rearings practically establish the identity of this pupa with the species under discussion. Professor Beutenmueller, basing specific characters largely upon the type of the gall, described this species as A. solidaginis and again as A. patens. An examination of the type of the latter shows that the peculiar tarsal banding given in the original characterization is evidently an error, since the specimen agrees in every particular with A. monacha.

*Gall.* This species produces a variety of deformations. The most typical one in the vicinity of Albany occurs on the narrow-leaved goldenrod, Solidago graminifolia, is apical, subglobular, rather firm and from 1 to 1.5 cm in diameter, tapering distally and with the apical third consisting of rather closely appressed leaves. It resembles very closely the gall produced by Oedaspis polita Loew. During midsummer the female may deposit eggs between the leaflets of a partly developed bud of Solidago serotina or S. canadensis and thus produce

the peculiar though widely distributed adherent type of gall which consists of a slight thickening and elevation of the apposed surfaces


Fig. 16 Asphondylia monacha. *a*, breastbone of larva; *b*, cephalic horns of pupa, enlarged (original)

of two leaves. The hypertrophid tissues adhere around an oval cell some 2 mm in diameter and hold the leaves together even after the normal development of the stalk has separated their bases by an inch or more. We have reared this species from apparently unmodified Solidago florets, the chaff of the flowers being wanting, and also from a purplish green gall in the leaf axil of an aster and from arrested aster buds.

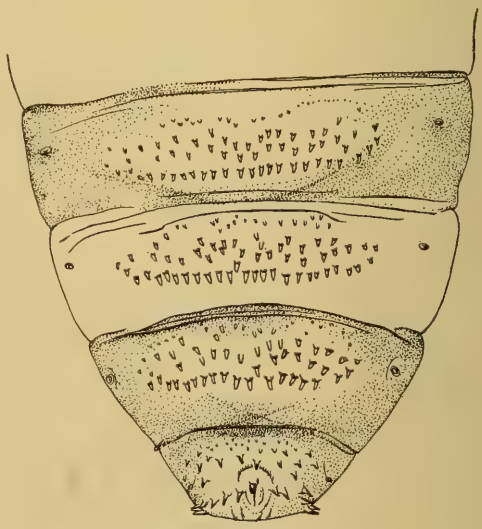


Fig. 17 Asphondylia monacha. Dorsal aspect of distal abdominal segments of exuvium, enlarged (original)

*Larva.* Length 3 mm, rather slender, pale yellowish; head small. Antennae small, obconic; breastbone quadridentate, the inner teeth divided and much smaller than the outer, the heavily chitinized area extending to the anterior third of the slender, irregular shaft, which dilates posteriorly into a narrow crescentic process. An irregular, slightly chitinized area supports the breastbone and a similar smaller one occurs on the preceding segment; skin minutely and sparsely papillate. Terminal segment slender, bilobed.

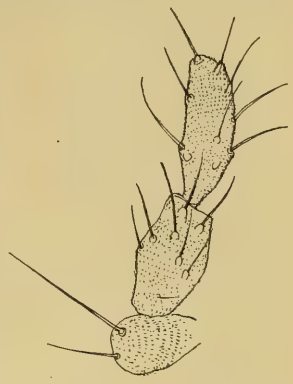


Fig. 18 Asphondylia monacha. Palpus of male, enlarged (original)

*Exuviae.* Length 3.5 mm, rather stout, pale yellowish, the anterior horns stout, broad, the internal curved margin serrate; dorsum of the third or fourth abdominal segment with a regular row of rather heavy, chitinous spines at the distal third, the basal half sparsely ornamented with an irregular double row of smaller spines. Terminal segment posteriorly with a row of about 10 spines, the median four small, the others laterally and ventrally successively larger, the basal half sparsely ornamented with smaller scattering spines.

*Male.* Length 3 mm. Antennae as long as the body, sparsely haired, dark brown; 14 segments, the fourth with a length four times its diameter. Palpi; the first segment short, stout, subquadrate, the second with a length over twice the first, swollen

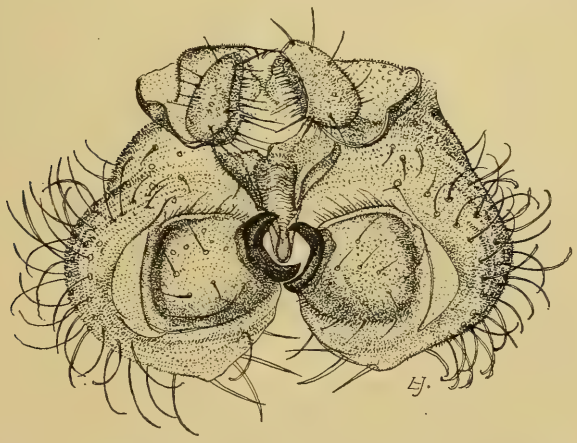


Fig. 19 Asphondylia monacha. Male genitalia, enlarged (original)

basally, tapering distally. Mesonotum slaty brown, the submedian lines lighter, thickly haired. Scutellum shining black, postscutellum yellowish brown. Abdomen thickly haired, light reddish brown.

Wings hyaline; halteres yellowish basally, fuscous apically. Coxae and base of femora fuscous yellowish, the distal portion of femora,

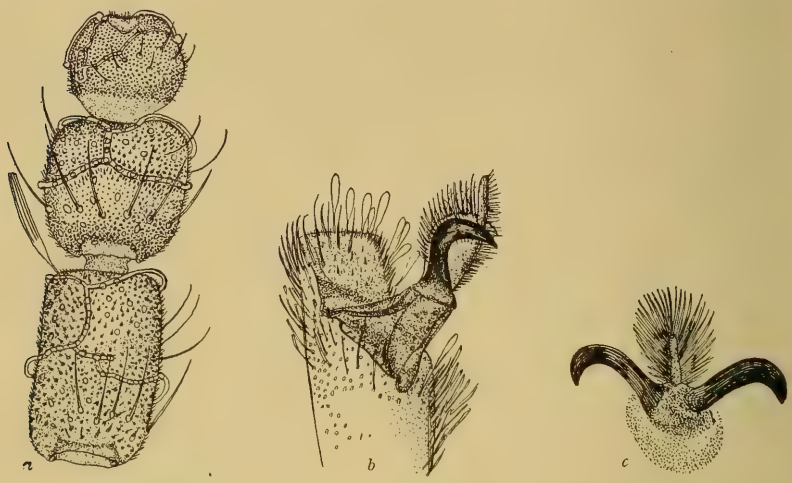



Fig. 20 Asphondylia monacha, female. *a*, distal three antennal segments; *b*, lateral view of distal portion of last tarsal segment showing claws; *c*, distal aspect of claws, enlarged (original)

tibiae and tarsi dark brown, except that femora apically is narrowly annulate with white, the first tarsal segment and the base of the second white, the markings broader on the posterior legs; claws

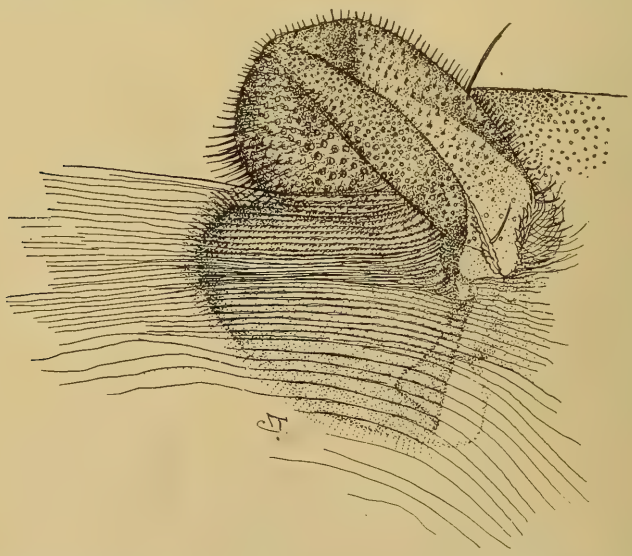


Fig. 21 Asphondylia monacha. Dorsal pouch at base of ovipositor, enlarged (original)

short, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, stout, deeply and triangularly incised, the lobes widely separated and narrowly rounded apically.

*Female.* Length 4.5 mm. Antennae three-fourths the length of the body, the third segment with a length five times its diameter. Palpi; the first segment rather long, the second one-half longer, slender. Scutellum dark reddish brown. Abdomen dark brown. Legs fuscous yellowish, the first tarsal segment and the base of the second dark yellowish or reddish white. Ovipositor long, otherwise nearly as in the male.

### **Asphondylia smilacinae** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 17
1908 ———— N. Y. State Mus. Bul. 124:298, 376

This species inhabits deformed berries of Smilacina racemosa and was taken, presumably at Washington, by Professor Barrows September 24, 1888, adults appearing September 26th to October 2d of the same year.

*Male.* Length 3 mm. Antennae as long as the body, rather thickly haired, light brown; 14 segments, the third with a length five times its diameter. Palpi; the first segment short, stout, subquadrate, the second stout with a length about two and one-half times its diameter, the third more slender, and nearly twice the length of the second. Mesonotum reddish brown, the sublateral areas darker and with a distinct irregular fuscous area at the anterior and posterior lateral angles, the submedian lines indistinct, dull orange, sparsely clothed with short setae. Scutellum pale yellowish, thickly clothed with short setae, postscutellum orange yellowish. Abdomen dull yellowish brown, basal segments sparsely clothed with long yellowish setae. Wings hyaline, costa light brown; halteres fuscous yellowish. Coxae and base of femora yellowish brown, the distal portion of femora, tibiae and tarsi a variable dark yellowish brown; claws long, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, broad, the lobes divided, roundly angulate.

*Female.* Length 3 mm. Antennae light brown; 14 segments, the third with a length five times its diameter. Palpi; the first segment short, stout, subglobose, the second stout, with a length nearly three times its diameter, the third long, slender, with a length fully twice that of the second; the pulvilli longer than the claws. Ovipositor hardly as long as the abdomen. Otherwise nearly as in the male. Type Cecid. 860.

### **Asphondylia globulus** O. S.

1869 **Osten Sacken, R.** Amer. Ent. Soc. Trans., 2:301
1871 ———— Amer. Ent. Soc. Trans., 3:52
1888 **Marten, John.** Psyche, 5:102–3
1907 **Beutenmueller, William.** Amer. Mus. Nat. Hist. Bul. 23:387
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

This species appears to have been first observed by Mr Walsh, who transmitted it to Osten Sacken under the manuscript name of Cecidomyia helianthi-globulus. It is easily distinguished from the larger A. conspicua, according to Osten Sacken, by the paler color of its hind tibiae and tarsi. The mesonotum is distinctly lighter in color and the submedian lines more thickly haired. Furthermore, the third antennal segment of the female in this form has a length only five or six times its diameter, while in A. conspicua the length is six or seven times its diameter. The ovipositor of this species is hardly as long as the body, though in A. conspicua it is about one-fourth longer. This species occurs about New York. The gall is found on the sunflower, Helianthus giganteus, and also on H. grosse-serratus, the adults emerging in September and October.

*Gall.* The galls of this form occur on the Helianthus stems from a few inches to three feet above the ground. They are globular, spherical or ovate in shape and range from three-eighths to 2 inches in diameter.

*Male.* Length 4.5 mm. Antennae nearly as long as the body, sparsely fine haired, dark brown; 14 segments, the third with a length five to six times its diameter. Palpi; the first segment apparently short, subglobular, the second irregularly subrectangular, with a length three times its width, the third strongly compressed, slender, acute distally and with a length more than twice the preceding; face reddish brown. Mesonotum dark reddish brown, submedian lines distinct, rather thickly clothed with fine, reddish hairs. Scutellum yellowish brown, postscutellum a little darker. Abdomen yellowish brown, rather sparsely clothed with fine, yellowish hairs; genitalia dark brown. Wings hyaline, costa yellowish brown; halteres yellowish basally, slightly fuscous apically. Legs a reddish brown, the distal tarsal segments distinctly darker; claws long, stout, strongly curved, the pulvilli distinctly shorter than the claws. Genitalia; dorsal plate broad, deeply and triangularly incised, the lobes acute.

*Female.* Length 4.5 mm. Antennae light brown; 14 segments, the third with a length fully six times its diameter. Palpi; the first segment short, stout, subglobose, the second broader, subrectangular, with a length more than twice its diameter, the third long, slender, slightly expanded distally, about three times the length of the second; face fuscous yellowish. Mesonotum purplish brown, the submedian lines distinct, sparsely clothed with yellowish hairs. Scutellum fuscous yellowish with a few yellowish setae, postscutellum yellowish brown. Abdomen yellowish brown, thickly clothed with dark brown scales, the segments sparsely margined posteriorly with rather long, yellowish white hairs. Legs mostly a yellowish brown, the tarsi slightly darker; the pulvilli as long as the claws. Ovipositor probably as long as the body. Type Cecid. 856.

### **Asphondylia baroni** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

A number of specimens were reared from galls collected by Mr O. T. Baron on some unknown plant April 8, 1888 in Arizona, adults appearing the 10th and 15th. Isorhombus arizonensis Ashm. MS and Polygnotus huachuacae Ashm. were probably reared from this gall (Insect Life, 4:125, 126)

*Female.* Length 3.5 mm. Antennae nearly as long as the body, sparsely fine haired, yellowish brown; 14 segments, the third with a length six times its diameter. Palpi; the first segment short, stout, subglobose, the second rather stout with a length about three times its diameter, the third slender, tapering slightly and with a length more than twice the preceding. Mesonotum grayish brown, the submedian lines dull orange, sparsely haired. Scutellum fuscous orange, postscutellum a little darker. Abdomen rather thickly clothed with short, gray hairs, light brown. Wings hyaline, costa light brown; halteres yellowish white basally, light brown apically. Legs a nearly uniform light brown, the tarsal segments narrowly annulate distally with dark brown; claws long, stout, strongly curved, the pulvilli a little shorter than the claws. Ovipositor nearly as long as the body. Type Cecid. 865.

### **Asphondylia artemisiae** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

Galls of this species were taken by Mr H. K. Morrison on Artemisia at Fort Grant, Ariz., July 5, 1882, the adults issuing before they were received at the bureau of entomology, Washington, D. C.

*Female.* Length 4 mm. Antennae nearly as long as the body, light brown, thickly fine haired; 14 segments, the third with a length six times its diameter. Palpi; the first segment short, irregularly subglobose, the second stout, with a length nearly three times its diameter, the third one-half longer and more slender than the second. Mesonotum dark reddish brown, the submedian lines rather indistinct, sparsely haired. Scutellum yellowish brown, postscutellum a little lighter. Abdomen dark yellowish brown, being somewhat darker laterally. Ovipositor pale yellowish. Wings hyaline, costa light brown; halteres pale yellowish. Legs a variable yellowish brown, the distal tarsal segments slightly darker; claws long, rather stout, strongly curved, the pulvilli shorter than the claws. Ovipositor nearly as long as the abdomen. Type Cecid. 861.

### **Asphondylia antennariae** Whlr.

1889 **Wheeler, W. M.** Wis. Nat. Hist. Soc. Proc., p. 209–12 (Asynapta)

1891 **Riley, C. V.** and **Howard, L. O.** Insect Life, 4:125 (Synopeas antennariae Ashm. reared)

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

Two gall midges produce bud galls on Antennaria plantaginifolia. Rhopalomyia antennariae inhabits a corm-shaped bud gall one-third to one-half of an inch in diameter. The sessile leaves surrounding this are somewhat succulent, broader and longer than normal, the tips being somewhat recurved and closely applied to one another like the leaves on onions. Both surfaces of the component leaves are covered with a woolly growth and there is more or less of a reddish discoloration. Frequently all the terminal buds of a plant, even a dozen or so, may become infested, the galls forming a cluster somewhat resembling a bunch of young hazelnuts.

The Asphondylia, according to Doctor Wheeler, produces a gall easily confused with that made by the Rhopalomyia. This gall is more elongate and the tips of the component leaves are scarcely recurved. The woolly growth on the under surface of the leaf is more regular, giving it a satiny appearance, while the upper surface is smooth. There is none of the reddish discoloration and but one insect occurs in a gall, occupying a smooth cavity with hard nutlike walls. The galls of Asphondylia may occur on the same plant with those of Rhopalomyia and even in the same cluster. The insect evidently hibernates in the gall, the adult emerging from its apex and appearing in the latitude of Wisconsin from about the 17th to the 20th of May. A parasite, Synopeas antennariae Ashm., was reared from this species May 31, 1888.

*Male.* Length 2.75 to 3 mm, the mesonotum and scutellum darker than in the female, the latter with numerous yellowish setae apically (markedly more than in the female), the abdomen dorsally with rather conspicuous lateral stripes rather thickly clothed with silvery white hairs, the terminal clasp segment of the genitalia apparently very broad, curved, the tip bidentate. Described from types in the American Museum of Natural History.

The description following is based on a specimen reared from material sent to Washington, D. C., by Doctor Wheeler in May 1888 and bearing the United States National Museum number 4288.

*Female.* Length 3.5 mm. Antennae about as long as the body, rather thickly fine haired, brown; 14 segments, the third with a length about five times its diameter. Palpi; the first segment short, stout, irregularly oval, the second stout, with a length about two and one-half times its diameter, the third slender, considerably swollen near the distal fourth, about twice the length of the preceding. Mesonotum dark brown, the submedian lines fuscous orange, rather thickly clothed with pale setae. Scutellum dark brown with numerous coarse setae apically, postscutellum yellowish. Abdomen brown, rather thickly clothed laterally with grayish setae, thickly so ventrally; basal pouch dark brown. Wings hyaline, costa

dark brown; halteres yellowish basally, fuscous apically. Coxae yellowish brown; femora, tibiae and tarsi dark brown, the tibiae slightly darker; claws long, somewhat slender, strongly curved, the pulvilli as long as the claws. Ovipositor about as long as the abdomen. Cecid. 870.

### **Asphondylia vernoniae** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

This insect was reared October 12, 1884 from galls collected in Virginia by Mr Theodore Pergande on Vernonia novebora-censis. Females associated with this male were taken by Mr Pergande on the same plant September 21, 1885, adults issuing the following May and June.

*Male.* Length 3 mm. Antennae about as long as the body, thickly short haired, yellowish brown; 14 segments, the third with a length about four times its diameter. Palpi; the first segment short, stout, subglobose, the second a little longer, broadly oval, the third more than twice the preceding and tapering at both extremities. Mesonotum dark reddish brown, the submedian lines yellowish brown, thickly haired. Scutellum fuscous orange, postscutellum fuscous yellowish. Abdomen rather thickly clothed with yellowish hairs, brown. Wings hyaline, costa light brown; halteres yellowish basally and apically, reddish brown subapically. Coxae reddish brown, the femora, tibiae and tarsi mostly dark brown, the two distal tarsal segments of the middle legs at least yellowish brown and on the posterior legs, the tibiae, the first, second and base of the third tarsal segments yellowish; claws long, slender, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate long, broad, deeply and narrowly incised, the lobes long and narrowly rounded.

*Female.* Length 3 mm. Antennae yellowish brown; 14 segments, the third with a length about five times its diameter; claws long, stout, strongly curved, the pulvilli nearly as long as the claws. Ovipositor a little longer than the body, otherwise nearly as in the male. Type Cecid. 867.

### **Asphondylia ceanothi** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

The gall of this species was taken on Ceanothus velutinus in May 1888 at Oakland, Cal., by A. Koebele, adults issuing in June. The species was evidently reared from a large, rather loose terminal bud gall some 2 cm in length and 1.5 cm in diameter. The deformity is thickly clothed with long, linear, haired leaflets.

*Female.* Length 4.5 mm. Antennae extending to the fourth abdominal segment, sparsely fine haired, dark brown; 14 segments, the third with a length about six times its diameter. Palpi; the

first segment short, stout, subquadrate, the second rather stout, somewhat swollen near the basal third and with a length about three times its diameter, the third about twice the length of the second, slender and tapering gradually to an acute apex. Mesonotum dark brown, sparsely and irregularly clothed with fine setae. Scutellum dark reddish brown, postscutellum a little lighter. Abdomen dark reddish brown, nearly naked. Ovipositor pale yellowish. Wings hyaline, costa yellowish brown; halteres yellowish basally, reddish brown apically. Legs a variable light reddish brown, the distal tarsal segments slightly darker; claws long, somewhat slender, strongly curved, the pulvilli as long as the claws. Ovipositor nearly as long as the abdomen. Type Cecid. 872.

### **Asphondylia hydrangeae** Felt

1907 **Felt, E. P.** New Species of Cecidomyia II, p. 15
1908 ———— N. Y. State Mus. Bul. 124:377

This midge was reared from bud galls on Hydrangea arborescens May 12, 1884. There appear to have been two lots referred to this number, since one bureau note records the collection of the gall by Pergande April 28, 1884, the larvae changing to pupae within the gall May 6th and adults appearing May 12th to 15th. Galls were received from Mr J. G. Barlow, Cadet, Mo., and referred to this species, all the material being in the National Museum.

*Gall.* An elongate, deformed bud about 1 cm in length, 3 cm in diameter, yellowish or brownish in color, the larvae living among the developing leaves.

*Male.* Length 4 mm. Antennae extending about to the fifth abdominal segment, thickly short yellowish haired, reddish brown; 14 segments, the third with a length six times its diameter. Palpi; the first segment short, subquadrate, the second nearly three times the length of the preceding, stout, the third one-half longer than the second, more slender; face and mouth-parts yellowish brown. Mesonotum an olive brown, the anterior lateral angles yellowish, the submedian lines rather distinct and rather thickly clothed with yellowish hairs. Scutellum yellowish brown with numerous long, yellowish apical setae, postscutellum yellowish brown. Abdomen dark brown; thickly short, yellowish or brown haired, the latter color more apparent along the median line, the hairs on the side and venter yellowish or silvery white. Wings hyaline, costa reddish brown; halteres yellowish basally, reddish brown apically. Pleurae reddish brown; coxae and femora basally yellowish brown; distal portion of the femora, tibiae and tarsi a nearly uniform dark brown; claws rather long, stout, strongly curved, the pulvilli a little longer. Genitalia; dorsal plate short, broad, deeply and triangularly incised, the lobes well separated, tapering to a narrowly rounded margin. Type Cecid. 852.

### **Asphondylia thalictri** Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:547

The midges were reared in some numbers August 8 to 18, 1911 from distorted seed capsules of Thalictrum collected by Miss Cora H. Clark at Magnolia, Mass. The work of this insect has also been noted at Nassau, N. Y. Specimens of presumably the same gall with exuviae were taken at Shelburne, N. H., and are in the Museum of Comparative Zoology, Cambridge, Mass. Trotteria solidaginis Felt was reared in some numbers from the same jar. The larvae of this latter species were probably preying upon the Asphondylia.

*Gall.* Seed capsule irregular, swollen. Length about 5 mm. The infestation is most frequently noted on account of the projecting exuviae.

*Exuvium.* Length about 3 mm, pale yellowish, cephalic horns long, stout, chitinous, the margins fuscous. Leg cases a variable fuscous, abdominal segments with a series of rather widely separated, chitinous teeth.

A reference to the description of the adult is given above.

### **Asphondylia autumnalis** Beutm.

1907 **Beutenmueller, William.** Amer. Mus. Nat. Hist. Bul. 23:386
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

This medium-sized Asphondylia was reared from a bud gall on Helenium autumnale by Prof. William Beutenmueller who took the species in the valley of the Black mountains, North Carolina, September 6, 1906. Mr J. G. Barlow found the galls of this insect at Cadet, Mo., August 18, 1891.

*Gall.* "Globular or irregularly rounded with a number of aborted leaves at the apex and elations of the stems of the plant at the sides. It is green outside and white inside. Interior rather soft, pithy and somewhat succulent. . . . The gall measures from 20 to 30 mm in length and from 15 to 30 mm in width. It occurs on Helenium autumnale (Beutm.)"

The following description has been drafted from a type specimen kindly placed at our disposal by Professor Beutenmueller.

*Male.* Length 2.5 mm. Antennae nearly as long as the body, thickly fine haired, light brown; 14 segments, the third with a length about five times its diameter. Palpi; the first segment short, stout, subquadrate, the second stout, rectangular, with a length about three times its diameter, the third flattened, tapering distally and with a length about one-half greater than the second; face light brown.

Mesonotum dark brown, the submedian lines sparsely haired. Scutellum yellowish brown with numerous coarse setae apically, postscutellum yellowish brown. Abdomen, somewhat thickly clothed with yellowish hairs, rather dark brown or dull orange as described by Beutenmueller. Wings hyaline, costa light brown; halteres fuscous yellowish basally, fuscous apically. Coxae yellowish brown; femora, tibiae and tarsi mostly dark brown, the posterior legs with the distal portion of tibiae and the basal part of the first and second tarsal segments obscurely yellowish, each tarsal segment narrowly annulate distally with dark brown; claws long, stout, strongly curved, the pulvilli a little shorter than the claws. Genitalia; dorsal plate very short, broad, apparently divided, the lobes diverging, broadly and irregularly rounded. Type Cecid. 1238.

### **Asphondylia atriplicis** Ckll.

1893 **Townsend, C. H. T.** Amer. Nat., 27:1021 (Cecidomyia)
1895 **Cockerell, T. D. A.** Amer. Nat., 29:766–67 (Cecidomyia)
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

This insect, according to Townsend, produces a fleshy, polythalamous, tumorlike, twig gall on Atriplex canescens. It was taken May 13, 1892 near Las Cruces, New Mexico.

*Gall.* The gall has been described as 12 mm long and 4.5 to 6 mm in diameter. It is smooth, pale greenish becoming more or less reddish when dry. The gall is rather oblong, more or less irregular in shape, fleshy green, tumorlike and occurs on one side of the twig which is more or less surrounded by the gall. The galls are normally bilocular, each cell being 2 by 3 mm in diameter.

*Exuviae.* Length 4.5 mm, light brown, the cephalic horns, long, stout, subapically and mesially rounded and finely serrate; dorsum of the third or fourth abdominal segment with a regular row of moderately stout, chitinous spines on the distal third, the basal half sparsely and irregularly clothed with smaller spines; terminal segment with a posterior row of about ten rather weak, chitinous spines, the latero-ventral ones stouter, the basal half with sparse, much weaker spines.

*Female.* Length 4.5 mm. Antennae as long as the body, sparsely fine haired, pale yellowish; 14 segments, the third with a length about five times its diameter. Palpi; the first segment short, stout, subquadrate, the second rather stout with a length nearly three times its diameter, the third nearly twice the length of the preceding, greatly dilated near the middle and tapering apically to an acute apex. Mesonotum slaty gray, the submedian lines dark gray and sparsely clothed with fine, whitish hairs. Scutellum a variable dark brown, postscutellum yellowish. Abdomen rather thickly clothed with grayish hairs, dark brown. Wings hyaline, costa light brown, subcosta uniting with the margin near the basal third; halteres pale yellowish, basally, yellowish white apically; coxae dark brown; femora, tibiae and tarsi yellowish white, the distal tarsal segments

light brown; claws long, stout, strongly curved, the pulvilli nearly as long as the claws. Ovipositor nearly as long as the abdomen. Cecid. 864.

### **Asphondylia neomexicana** Ckll.

1896 **Cockerell, T. D. A.** N. Y. Ent. Soc. Jour., 4:204 (Cecidomyia)

This species was taken by Professor Cockerell in the Organ mountains, New Mexico, at an elevation of 5100 feet and was also common on Tularosa creek. The adult, he states, resembled A. atriplicis Twns. though the gall is quite different. There is an excellent series of galls in the Museum of Comparative Zoology, Cambridge, Mass. It may prove identical with the preceding species.

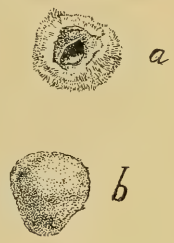



Fig. 22 Asphondylia neomexicana. Gall; *a*, section; *b*, external aspect (original)

### **Asphondylia sambuci** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377

This female was reared from a greenish white bud gall apparently on elder, Sambucus, sent to this office June 10, 1907 by Miss E. G. Mitchell of Washington, D. C.

*Gall.* This gall is irregularly subglobular, about 1.5 cm in diameter, green, hoary white with three thickened, projecting green bracts, each subtriangular in shape and about 1.5 cm long.

*Female.* Length 4.2 mm. Antennae nearly as long as the body, sparsely haired, dark brown, the basal segments yellowish; 14 segments, the third with a length fully five times its diameter. Palpi; the first segment short, stout, subquadrate, the second stout, with a length fully four times its diameter, the third one-half longer than the second, tapering at both extremities; face silvery between the antennae, whitish beneath, a tuft of black hairs at the middle. Mesonotum dark brown, cinereous, with the submedian lines sparsely clothed with pale hairs; laterally similar hairs margin the mesonotum. Scutellum dark reddish. Abdomen a uniform dark brown, the segments margined posteriorly with a thin row of fuscous hairs; laterally and ventrally hoary. Wings hyaline, costa dark brown; halteres


Fig. 23 Asphondylia sambuci. Gall nearly natural size (original)

dark brown, yellowish basally. Legs a uniform black with the exception of the basal third of the femora; coxae yellowish dusted with plumbeus, the first pair thickly clothed anteriorly with long, black hairs; pleurae a little darker than the coxae; claws long, stout, strongly curved, the pulvilli longer than the claws. Ovipositor about as long as the abdomen. Type Cecid. a1511.

### **Asphondylia diplaci** Felt

1912 **Felt, E. P.** N. Y. State Ent. Soc. Jour., 20:151–52

The midges were obtained by P. H. Timberlake from a cabbage-like, densely woolly apical gall on Diplacus longiflorus collected at Whittier, Cal.

### **Asphondylia diervillae** Felt

1897 **Felt, E. P.** N. Y. State Mus. Bul. 110:165
1908 ———— N. Y. State Mus. Bul. 124:377
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2:48 (Cecidomyia inaequalis Steb.)

This medium-sized, dark-brown species infests the unopened buds of bush honeysuckle, Diervilla trifida. The first galls were taken at Albany, N. Y., May 27, 1907 and adults continued to emerge from that time until June 15.

*Gall.* Length 9 mm, diameter 3 mm, green, the slender tips sometimes discolored.

*Larva.* Length 4 mm, stout, pale yellowish, the head small; antennae short, conical; breastbone quadridentate, inner teeth decidedly shorter than the outer and well divided (figure 24). The

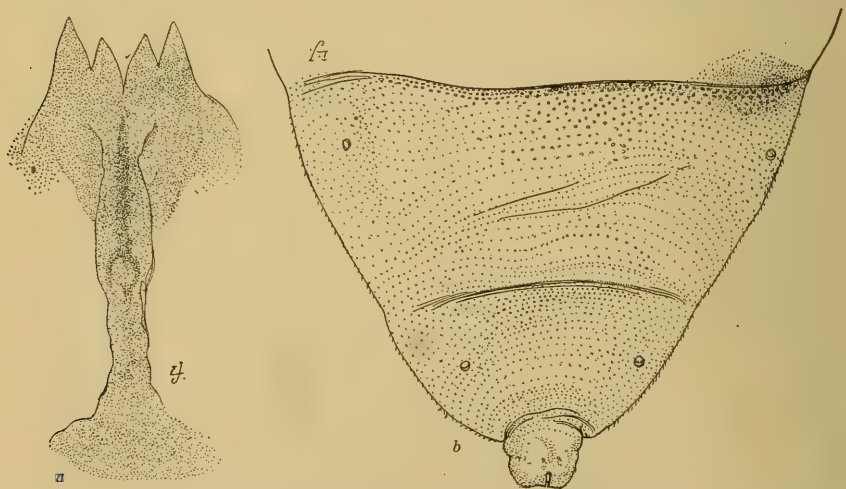



Fig. 24 Asphondylia diervillae. *a*, larval breastbone; *b*, posterior extremity of larva, enlarged (original)

heavy, chitinized area extends to the apical fourth, shaft irregular and with a weekly chitinized, crescentic area posteriorly; skin shagreened; terminal segment slender, bilobed.

*Male.* Length 4 mm. Antennae extending about to the fifth abdominal segment, thickly fine haired, light brown, the basal segments fuscous yellowish; 14 segments, the third with a length six times its diameter. Palpi; the first segment short, stout, subquad-

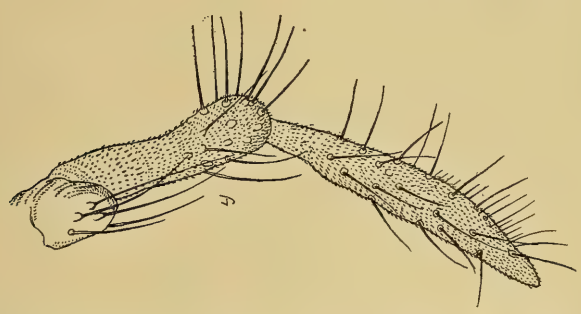


Fig. 25 Asphondylia diervillae. Palpus of female, enlarged (original)

rate, the second rather stout with a length about three times its diameter, the third twice the length of the second, tapering at both extremities; face fuscous yellowish. Mesonotum slaty brown, the submedian lines thickly clothed with long, grayish setae. Scutellum reddish brown with numerous apical setae, postscutellum a reddish salmon. Abdomen with the dorsal sclerites a nearly uniform dark brown, the incisures dull salmon; each of the segments sparsely clothed with fine hairs and margined posteriorly with long, yellowish setae. Genitalia fuscous; venter with the posterior segments rather thickly clothed with cinereous hairs. Wings hyaline, costa dark brown; halteres pale salmon basally, fuscous apically; coxae and base of femora a fuscous yellowish, the distal portion of femora, tibiae and tarsi a nearly uniform dark brown; claws long, stout, strongly curved, the pulvilli longer than the claws. Genitalia; dorsal plate apparently divided, the lobes roundly triangular.

*Female.* Length 3.5 mm. Antennae extending to the fourth abdominal segment, sparsely haired, grayish brown. Mesonotum dull slate color, irregularly margined laterally with long, grayish setae, the submedian lines thickly clothed with similar setae. Scutellum slaty gray with long setae apically, postscutellum fuscous yellowish. Abdomen a nearly uniform dark brown, the segments sparsely margined posteriorly with long, grayish setae; pleurae and abdomen rather thickly clothed with yellowish white setae; coxae a dull gray, the pulvilli as long as the claws. Ovipositor about as long as the body, otherwise nearly as in the male. Type Cecid. a1469.

### **Asphondylia enceliae** Felt

1912 **Felt, E. P.** N. Y. Ent. Soc. Jour., 20:152

Several midges were reared February 23 and 25, 1911 from leaf bud galls on Encelia californica collected by P. H. Timberlake in the Puente hills, Whittier, Cal. The species runs in our key to A. ilicoides Felt from which it is easily separated by the relatively much longer and narrower wings.

### **Asphondylia ilicoides** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 15–16
1908 ———— N. Y. State Mus. Bul. 124:296–97, 377

The small, oval, green bud galls on Ilicoides mucronata made by this form are about 5 mm long, 3 in diameter, each inhabited by several larvae and were taken at Old Forge, N. Y., June 20, 1907, several adults being obtained the latter part of the month. The species appears to be quite subject to attacks by parasites.

*Gall.* An oval, green bud gall 5 mm long.

*Male.* Length 3 mm. Antennae nearly as long as the body, sparsely short haired, dark brown, the basal segment pale at the base; 14 segments, the third with a length fully three times its diameter, slightly swollen at the base. Palpi pale yellowish, the first segment very short, stout, subquadrate, the second rather long, stout, with a length fully three times its diameter, the third a little longer than the second, somewhat constricted at the base, tapering, subacute. Mesonotum brown dusted with pruinose, the submedian lines sparsely clothed with gray setae and a lateral row of setae in front of the wing insertion; pleurae concolorous with the mesonotum. Scutellum concolorous with the mesonotum, thickly clothed with long, gray setae. Abdomen dark brown dorsally, sparsely clothed with gray setae which are apparently longer posteriorly; ventrally the abdomen is yellowish red, rather thickly clothed with short, shining, gray hairs. Wings hyaline, costa dark brown; halteres pale basally, fuscous subapically, slightly so apically; coxae and the basal two-thirds of the femora luteous, the latter shading to a very dark brown apically; tibiae and tarsi black, the anterior legs similarly colored; the midlegs have the femora quite a little darker at the base; claws stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, stout, deeply and narrowly incised, the lobes broadly rounded.

*Female.* Length a little less than 3 mm. Antennae nearly as long as the body, sparsely haired, dark brown; 14 segments, the third with a length fully five times its diameter. Colorational characters about as in the opposite sex, except that the abdomen is more thickly clothed with gray hairs, giving it a gray appearance. Ovipositor nearly as long as the body, otherwise nearly as in the male. Type Cecid. a1548.

### **Asphondylia salictaria** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 16–17
1908 ———— N. Y. State Mus. Bul. 124:297–98, 377

Willow twigs infested by this species were collected by Mr J. H. Jackson at Pleasantville, Ind., May 6, 1889, the adults appearing May 15th.

*Exuviae.* Length 5 mm, the cephalic horns absent in the preparation, the dorsum of the third or fourth abdominal segment with a regular row of small spines at the distal third, the basal half sparsely ornamented with smaller, widely scattered spines; the terminal segment with a posterior row of 11 or 12 spines, there being a median group of five small ones, the basal half sparsely ornamented with scattering, smaller spines. This species has the spines relatively much less developed than in many other forms.

*Female.* Length 3.5 mm. Antennae about as long as the body, thickly fine haired, yellowish brown; 14 segments, the third with a length fully six times its diameter. Palpi; the first segment short, stout, subquadrate, the second stout, with a length fully three times its diameter, the third a little longer than the second, curved and dilated apically. Mesonotum dark brown, the submedian lines fuscous yellowish, thickly clothed with long setae. Scutellum yellowish brown with numerous coarse setae apically, postscutellum dull yellowish white. Abdomen brown, rather thickly clothed with fine setae, the segments variably margined posteriorly with whitish setae, the basal segment margined anteriorly and posteriorly with silvery white; venter thickly clothed with silvery hairs. Wings hyaline, costa light brown; halteres yellowish basally, fuscous apically. Coxae and base of femora fuscous yellowish, distal portion of femora, tibiae and tarsi dark brown; claws long, stout, strongly curved, the pulvilli longer than the claws. Ovipositor hardly the length of the abdomen. Type Cecid. 859.

### **Asphondylia johnsoni** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377
1909 ———— Ottawa Nat., 22:246

This insect was reared from Solidago at Lansdown, Pa., July 28th by Prof. C. W. Johnson.

*Exuviae.* Length 5 mm, light brown, rather slender, the cephalic horns long, stout, conical, the dorsum of the third or fourth abdominal segment with a transverse row of uniform, heavy, chitinous teeth on the distal third, the basal half with a somewhat irregular transverse row of smaller, somewhat irregular teeth and a rudimentary scattering row just anteriorly; terminal segment posteriorly with a row of about eight heavy, chitinous teeth, the latero-ventral

ones larger, the basal half scatteringly and rather uniformly clothed with heavy, chitinous teeth.

*Male.* Length 4 mm. Antennae presumably as long as the body, sparsely haired, light brown; 14 segments. Palpi; the first segment short, stout, subquadrate, the second stout, with a length about three times its diameter, the third long, slender, tapering distally and with a length about twice the second; face reddish yellow. Mesonotum smooth, reddish brown. Scutellum fuscous yellowish, postscutellum a little lighter. Abdomen rather thickly clothed with long, yellowish hairs, reddish brown. Wings hyaline, costa yellowish brown. Halteres yellowish basally, fuscous apically. Legs fuscous yellowish, the distal tarsal segments darker; claws rather long, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, stout, deeply and triangularly emarginate, the lobes broadly rounded. Type Cecid. 809.

### **Asphondylia opuntiae** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377
1912 **Hunter, W. D., Pratt, F. C., Mitchell, J. D.** U. S. D. A. Bul. 113:34

This is a large, dark brown form occurring on Opuntia, and judging from the records, a relatively abundant species. The galls from

Fig. 26 Asphondylia opuntiae. Breastbone of larva, enlarged (original)

which this insect was reared were collected at Sinton, Texas, March 26, 1906 by J. D. Mitchell. Apparently the same form was taken

by Messrs Dyar and Caudell on Cactus in Colorado, flies appearing June 2d. Specimens reared from Opuntia at Los Angeles, Cal., April 11, 1908, at Beeville, Texas, March 7, 1908, at Ash Fork, Ariz., June 5, 1906 and in the Organ mountains May 17, 1905, were received from Mr W. D. Hunter of the bureau of entomology. Evidently this species has a wide distribution in the southwestern states.

*Larva.* Length 6 mm, rather stout, presumably yellowish white; breastbone bidentate, the teeth heavy, broad, triangular, the heavy, chitinized portion tapering from the base of the teeth to the anterior third, thence a rather stout, uniform process extending to the posterior extremity which is expanded as a weakly chitinized lunate piece. The anterior half of the breastbone is supported by a weakly chitinized irregularly oval area and by a similar weakly chitinized irregularly trapezoidal area on the anterior segment; skin slightly shagreened, the anal segment slender, bilobed.

*Exuviae.* Length 6 mm, cephalic horns long, stout, conical, the third or fourth abdominal segment with a very uniform row of heavy, stout spines on the distal third, the basal half with three irregular rows of stout spines; terminal segment with a posterior row of eight spines, the four median ones smaller, the others larger, the basal half with smaller, scattering spines.

*Male.* Length 4 mm. Antennae nearly as long as the body, sparsely fine haired, dark brown; 14 segments, the third with a length fully six times its diameter; terminal segment slightly prolonged and bearing a small apical knob. Palpi very small, indistinct; face yellowish white. Mesonotum a slaty brown, the sublateral areas distinctly lighter, submedian lines rather indistinct, sparsely clothed with fine hairs. Scutellum a slaty brown with a few yellowish setae apically, postscutellum fuscous yellowish. Abdomen dark brown, sparsely clothed with fine, silvery hairs, the incisures pale yellowish. Wings hyaline, costa dark brown; halteres yellowish basally and apically, brown subapically. Pleurae and coxae basally dark brown. Legs a variable light brown, tarsi slightly darker; claws stout, strongly curved, the pulvilli a little longer. Genitalia; dorsal plate short, broad, the lobes divided, irregularly subquadrate.

*Female.* Length 6 mm. Palpi; the first segment short, roundly subquadrate, the second stout, subrectangular, with a length over twice its diameter, the third longer, slender, irregularly fusiform; face yellowish. Mesonotum very dark brown, submedian lines indistinct, sparsely clothed with fine setae. Scutellum reddish brown, postscutellum a light fuscous yellowish with a dark brown, submedian area. Abdomen dark brown, very sparsely clothed with fine setae, the ovipositor dark reddish brown; halteres fuscous yellowish basally, light yellowish apically; the distal tarsal segments narrowly and rather indistinctly annulate with dark brown. Ovipositor longer than the body, otherwise nearly as in the male. Type Cecid. 848.

### Asphondylia conspicua O. S.

1871 **Osten Sacken, R.** Amer. Ent. Soc. Trans., 3:51–52
1907 **Beutenmueller, William.** Amer. Mus. Nat. Hist. Bul. 23:387
1907 **Cook, M. T.** Acad. Sci. Proc. Sep., p. 6
1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:377
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2:54

This large midge frequently attains a length of 5 or 6 mm and makes a very large gall on the flower heads of Rudbeckia triloba. It is closely related to A. globulus O. S. from which it is easily distinguished, according to Osten Sacken, by the darker color of the hind tibiae and tarsi, though in our own series we have failed to find this character of much service. A more striking feature is the much darker mesonotum. A comparison of type specimens in the Museum of Comparative Zoology at Cambridge, Mass., showed that these two species are probably distinct though closely related. There may be some difference in the pupal armature. Our studies of material reared from a typical gall show that in A. conspicua the male palpi are three-segmented, the third antennal segment has a length about six times its diameter and that of the female a length of seven times its diameter. There are also differences in the male genitalia. The gall was taken at Bath, Rensselaer county, N. Y., August 16, 1907 and was received from High-

Fig. 27 Asphondylia conspicua. Breastbone of larva, enlarged (original)

spire, Pa., August 17th; adults emerged from August 24th to 30th. Specimens doubtfully referred to this species were taken in a trap lantern at Newport, N. Y., July 2, 1906; captured by Prof. C.

W. Johnson at Philadelphia, Pa., August 14 and 20, 1891; taken at Westville, Conn., by Dr W. E. Britton, September 14, 1904 and reared August 8, 1882 from galls on Rudbeckia laciniata and collected by Mr Turner July 31, 1882 at Piney Branch, D. C. Torymus species was reared from this midge.

*Gall.* The gall is an irregular, subglobular swelling caused by an abnormal enlargement of the flower heads. It may be 5 cm in diameter and here and there with small leaflets on the surface (plate 15, figure 2). A number of larvae occur in a gall.

*Larva.* Length 4.5 mm, stout, yellowish; head small. Antennae very short, conical; breastbone (figure 27) quadridentate, the inner teeth rudimentary, widely separated, the other pair large, the anterior chitinous area extending to the cephalic fourth, the shaft irregular, slightly dilating distally and with inconspicuous lateral prolongations at its extremity; the skin minutely papillate and slightly shagreened; terminal segment with a relatively small, lobulate process posteriorly.

*Exuviae.* Length 6 mm, light brown; anterior horns stout; conical, the dorsum of the second or third abdominal segment with a row of stout, evenly placed, chitinous spines and on the distal third and on the basal half two irregular rows of rather heavy, chitinous spines with scatterings, smaller ones anteriorly. Terminal segment with an irregular row of stout spines on the distal third, the lateral and ventral ones stouter and more irregular, the basal half with smaller spines.

*Male.* Length 5 mm. Antennae nearly as long as the body, thickly fine haired, dark brown, the basal segment reddish yellow; 14 segments, the third with a length about six times its diameter. Palpi; the first segment short, stout, subquadrate, the second more than twice the length of the first, stout, the third about two and one-half times the length of the second, rather slender. Mesonotum slaty brown, the submedian lines broad, dull orange, rather thickly clothed with short setae. Scutellum brownish yellow with a few coarse setae apically, postscutellum yellowish. Abdomen yellowish brown, rather thickly clothed with short, yellowish brown hairs, the pleurae and venter thickly clothed with silvery hairs; genitalia dull orange. Wings hyaline, costa light brown; halteres yellowish basally, a variable fuscous apically. Coxae dull orange; femora and tibiae dark brown and yellowish, the tarsi usually somewhat darker, the posterior legs with the femora and tibiae decidedly lighter and the basal tarsal segments mostly a dull yellowish, the fifth segment a variable brown; claws long, rather stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate short, stout, broadly and roundly emarginate, the lobes broadly rounded.

*Female.* Length 6 mm. Antennae; 14 segments, the third with a length about seven times its diameter. Mesonotum grayish dark brown, the submedian lines rather indistinct, thickly clothed with fine hairs. Scutellum dark brown with a few coarse setae, postscutellum fuscous yellowish. Abdomen rather thickly clothed with

long, yellowish brown hairs, dark brown, the pleurae and venter thickly clothed with silvery gray hairs. Ovipositor about one-fourth longer than the abdomen. Cecid a1697.

### **Asphondylia arizonensis** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae II, p. 13
1908 ———— N. Y. State Mus. Bul. 124:294, 377

This large species breeds in fruitlike enlargements of the prickly pear or Cactus. The galls were taken by Mr H. K. Morrison at Fort Grant, Ariz., and were received at the bureau of entomology May 5; 1882 and figured in "Nature" for November 23, 1882, page 77. The figure referred to illustrates a somewhat pear-shaped gall about 16 cm long and 8 cm in diameter. Mr Morrison states that this gall appears to be rare, though the species of Cactus upon which it occurs is abundant. All the galls he observed were on one plant and contained hundreds of larvae May 5th. Pupae had forced their way out, some even penetrating the stout paper in which the galls were wrapped; the living adults were characterized as being dark gray with black eyes, the legs and halteres reddish. Koebele reared this species from seed pods of Cactus at Los Angeles, Cal., in March 1886. Another lot of supposedly the same species was received May 31, 1899 from Bayfield, Col., through C. F. Baker and adults, as in the previous case, issued during transit.

*Gall.* The galls are very large and resemble somewhat the fruit of the prickly pear. They are yellowish and in places somewhat rose colored, without thorns, except at the base, very fleshy and decay easily.

These data have been drafted from the notes of the bureau of entomology kindly placed at our disposal.

*Male.* Length 4.5 mm. Antennae a little longer than the body, sparsely haired, light brown; 14 segments, the third with a length five times its diameter. Palpi; the first segment with a length two and one-half times its diameter, the second as long as the first, more slender, the third one-half longer than the second. Mesonotum dark brown, nearly naked. Scutellum pale yellowish, postscutellum reddish brown. Abdomen rather thickly clothed with yellowish hairs, light brown, the eighth segment light yellowish. Genitalia fuscous. Wings hyaline, costa light brown. Halteres pale yellowish. Legs yellowish brown, the distal tarsal segments reddish brown; claws long, stout, strongly curved, the pulvilli as long as the claws. Genitalia; dorsal plate broad, broadly and triangularly incised, the lobes subtruncate.

*Female.* Length 5 mm. Antennae as long as the body, thickly haired, light yellowish brown; 14 segments, the third with a length six times its diameter. Palpi; the first segment short, stout, fusiform, the second a little longer, rectangular, the third about twice the

length of the second, more slender. Mesonotum grayish brown, the submedian lines thickly haired. Scutellum light fuscous yellowish, postscutellum lighter. Abdomen thickly clothed with fine, grayish

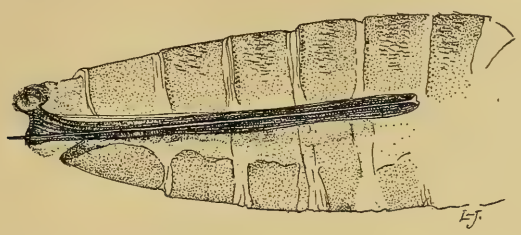


Fig. 28 Asphondylia arizonensis. Side view of abdomen showing ovipositor in retracted position, enlarged (original)

hairs, light yellowish brown, the eighth segment yellowish, the lobes dark brown. Ovipositor one-half longer than the body, otherwise nearly as in the male. Type Cecid. 857.

### **Asphondylia prosopidis** Ckll.

1898 **Cockerell, T. D. A.** Ann. Mag. Nat. Hist., 7th ser., 2:329–30

Galls of this insect were met with by Professor Cockerell at Mesilla Park, N. M., and consist of the aborted fruits of Prosopis juliflora var. glandulosa. "They hang on the stalk something like grapes and are subglobose with a pointed apical projection which represents the end of the pod. The globose portion is about 8 mm long and 7 broad, the pointed portion about as long or shorter. Color green, becoming yellowish and tinged with red." The pupal shell is a reddish brown, and adults emerged August 13, 1898.

Professor Cockerell states that this species differs from A. neomexicana in the dark, instead of pallid, second nervure and the impressed lines of the thorax being feebly or not pubescent. The life history is quite different.

### **Asphondylia mentzeliae** Ckll.

1900 **Cockerell, T. D. A.** Ent., 33:302

The larvae of this species occurred in the ovaries of Mentzelia multiflora at Raton, N. M., August 27, 1900, causing the flowers to wither. The pupal shells are red-brown and protrude over the sides of the flower.

### **Asphondylia attenuatata** Felt

1909 **Felt, E. P.** Ent. News, 20:300–1

This West Indian species was reared in some numbers by Prof. H. A. Ballou, government entomologist, from flower buds and flowers of privet or wild coffee, Clerodendron aculeatum. The male is peculiar on account of the slender, somewhat produced antennae, the flagellate segments being provided with unusually small and indistinct circumfili.

### **Asphondylia pattersoni** Felt

1911 **Felt, E. P.** Ent. News, 22:301

This reddish brown midge was reared February 3, 1911 by Mr W. H. Patterson, St Vincent, W. I., from the flowers of fiddlewood, Citharexylum quadrangulare.

### **Asphondylia vincenti** Felt

1911 **Felt, E. P.** Ent. News, 22:109–10

This species was reared by Mr W. H. Patterson from the fruits of Jussiaea linifolia and J. suffruticosa at St Vincent, W. I.

### CINCTICORNIA Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:379
1911 ———— N. Y. Ent. Soc. Jour., 19:48
1913 **Kieffer, J. J.** Gen. Insect., fasc. 152, p. 90
1915 **Felt, E. P.** U. S. Nat. Mus. Proc. 48:197

This genus comprises a group of very characteristic forms originally supposed by the writer to be cogeneric with Polystepha Kieff. Specimens of C. multifila Felt were submitted to this well-known European authority, who pronounced it a representative of a new genus and consequently this name was proposed. Asphondylia transversa Felt is the type.

Antennae consisting of 13 or 14 very rarely 15 sessile or subsessile, greatly produced, cylindric segments. There is a distinct tendency toward reduction and certain species have but 13 segments, while others may have the thirteenth and fourteenth greatly reduced. The flagellate segments of the male are provided with from 2 to 15 low, distinct, anastomosing circumfili which girdle the greater part of the segment from near the basal fourth to its apex. Normally, the number of circumfili vary from 6 to 15, while in the synthetic C. simpla and C. connecta we have but 2 circumfili, basal and apical, and a rather well-developed broad band of long

setae so characteristic of Lasioptera, Dasyneura and their allies. The flagellate segments of the female may have from 2 to 5 or 6 anastomosing circumfili, forming a more or less irregular network on the face of the segment, the more generalized species, C. simpla and C. connecta having, as in the male, a somewhat well-developed subapical band of long setae. Palpi composed of 4 segments; the wings are of the usual Asphondylid type; the claws are simple, the pulvilli usually being shorter than the claws. The genitalia are very characteristic, the terminal clasp segment being short, stout and curving to a broad, heavily chitinized, denticulate apex; the dorsal and ventral plate, as in Asphondylia are relatively small. The ovipositor is rather long, relatively stout, composed of a rather heavy, tapering basal segment and a more slender apical segment, peculiar on account of the thickened chitin along its ventral margin, and apically provided with a pair of small, setose lobes. This organ is distinctly more generalized than the highly developed ovipositor of Asphondylia and Schizomyia.

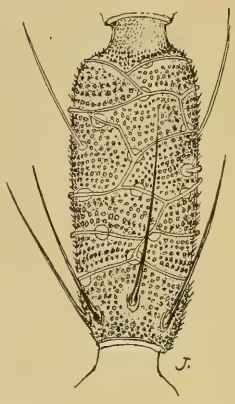


Fig. 29 Cincticornia species. Fourth antennal segment of female, enlarged (original)

This genus comprises, as our rearings show, mostly, if not entirely, oak insects. The rather stout, yellowish or orange larvae winter in the gall and prior to transformation escape therefrom, enter the soil and spin a loose cocoon with particles of leaves or sand adhering thereto. The adults in nature probably appear in early June at the time the young oak leaves are developing. The galls, so far as we know, are all confined to oak leaves, the more highly specialized forms producing more or less thick-walled, sometimes compound deformations of leaf tissues, while one at least of the generalized forms lives in a relatively inconspicuous cell lying between the slightly thickened epidermal layers. It is possible that further study will result in finding members of this genus inhabiting the leaves of some other plants.

**Key to species**

*a* Wings small (2.5 mm long or less)
  *b* Wings relatively long and narrow
    *c* Abdomen dark brown
      *d* Male; length 1.25 mm, scutellum reddish brown, fifth antennal segment with 10 to 12 circumfili..... transversa Felt, C. 53

*dd* Male; length 2 mm, scutellum fuscous yellowish, the fifth antennal segment with 8 circumfili. Reared from circular blister gall on scarlet oak.....serrata Felt, C. a1791

*cc* Abdomen reddish brown

*d* Male; length 3 mm, scutellum yellowish, antennae with 13 segments, the fifth with 10 circumfili. Recorded as reared from conic hickory leaf gall.....caryae Felt, C. 1114

*dd* Male; length 1.5 mm, scutellum yellowish, fifth antennal segment with 10 to 15 circumfili. Female; length 1.5 mm, the fifth antennal segment with a length three times its diameter and 4 coarsely anastomosing circumfili. Reared from flat, inconspicuous gall on red oak leaves..... quercifolia Felt, C. 1043

*ccc* Abdomen dark reddish orange

*d* Male; length 2 mm, scutellum fuscous yellowish, the fifth antennal segment with 8 to 9 circumfili. Female; abdomen mostly dark reddish orange, the fifth antennal segment with a length four times its diameter and with 4 coarsely anastomosing circumfili. Reared from circular, pustulate oak leaf gall..... pustulata Felt, C. a1789, 850

*bb* Wings relatively short and broad

*c* Abdomen dark brown

*d* Male; length 2 mm, scutellum reddish brown, the fifth antennal segment with a length two and one-half times its diameter; but 2 stout circumfili and a subapical band of long setae. Female; length 2 mm, the fifth antennal segment with a length three and one-half times its diameter. Reared from oval, pustulate red oak leaf gall..... simpla Felt, C. a1942, a1789d, a1903, a 1947

*dd* Male; length 2.75 mm, scutellum reddish brown, the fifth antennal segment with 11 circumfili. Female; abdomen reddish orange, scutellum dark red, fifth antennal segment with a length thrice its diameter and 4 coarsely anastomosing circumfili. Reared from subglobose, nippled, brown oak leaf gall.....globosa Felt, C. a1902

*ddd* Male; length 2 mm, scutellum dark brown, fifth antennal segment with 7 to 8 circumfili. Female; length 2.5 mm, fifth antennal segment with a length four times its diameter and 4 coarsely anastomosing circumfili. Reared from a midrib swelling on oak leaves.....podagrae Felt, C. a1788

*dddd* Male; length 2.5 mm, scutellum pale yellowish, fifth antennal segment with 9 circumfili. Female; length 2 mm, abdomen mostly deep orange, scutellum dark reddish, fifth antennal segment with a length three and one-half times its diameter and 4 coarsely anastomosing circumfili. Reared from a slight circular blister swelling on the lateral veins of red oak leaves .. americana Felt, C. a1792

*ddddd* Male; length 1.25 mm, scutellum reddish brown, 13 antennal segments, the fifth with 6 to 7 circumfili..... multifila Felt, C. 95, 99, 100

*cc* Abdomen yellowish orange

*d* Male; length .75 mm, scutellum light brown, 13 antennal segments, the fifth with a length of two and one-half times its diameter and 6 to 7 circumfili. Swept from sumac..... rhoina Felt, C. 94

*dd* Female; length 1.25 mm, scutellum yellowish red; 13 antennal segments, the fifth with a length two and one-half times its diameter; 2 to 3 circumfili. Swept from Cornus..... cornifolia Felt, C. 49c

*aa* Wings large (2.75 mm or more in length)

*b* Abdomen dark brown

*c* Male; length 3 mm, scutellum fuscous yellowish, the fifth antennal segment with 9 to 10 circumfili. Female; length 3.5 mm, the fifth antennal segment with a length two and one-half times its diameter and 4 coarsely anastomosing circumfili. Reared from warty, reddish brown oak leaf gall..... pilulae Walsh, C. 811, 814, 1046, 1105, a1888, a1939

*cc* Female; length 2 mm, scutellum purplish brown, the fifth antennal segment with a length two and one-half times its diameter and 5 coarsely anastomosing circumfili, the fourth palpal segment twice the length of the third.....canadensis Felt, C. 1042

*bb* Abdomen reddish brown

*c* Male; length 3 mm, scutellum reddish yellow, the fifth antennal segment with a length two and one-half times its diameter, 4 coarsely anastomosing circumfili. Female; length 3.5 mm, scutellum pale yellow, fifth antennal segment with a length three and one-half times its diameter and 5 coarsely anastomosing circumfili.....sobrina Felt, C. 1108

*bbb* Abdomen reddish yellow

*c* Female; length 2.5 mm, scutellum fuscous yellowish, the fifth antennal segment with a length two and one-half times its diameter and 2 irregularly anastomosing circumfili, the distal palpal segment one-fourth longer than the third..... connecta Felt, C. 822

## **Cincticornia transversa** Felt

1907 **Felt, E. P.** New Species of Cecidomyiidae, N. Y. State Mus. Bul. 110: 118 (separate p. 22) (Asphondylia)

1908 ———— N. Y. State Mus. Bul. 124:380

This species was first taken at Albany, N. Y., May 18, 1906. It probably occurs on oak.

*Male.* Length 1.25 mm. Antennae extending to the third abdominal segment, naked, dark brown; 14 segments, the fifth with a length two and one-half times its diameter, 12 to 15 circumfili on each segment; terminal segment a little shorter than the preceding, broadly rounded. Palpi; the first segment short, stout, the second subquadrate, slightly expanded distally, the third rather stout, twice the length of the second, the fourth one-half longer than the third, slightly fusiform; eyes black. Mesonotum very dark brown,

submedian lines ornamented with setae. Scutellum and postscutellum reddish brown, the former with apical setae. Abdomen dark brown, rather sparsely clothed with yellowish setae. Wings


Fig. 30 Cincticornia transversa, male. *a*, sixth antennal segment; *b*, genitalia, enlarged (original)

hyaline, costa reddish brown. Halteres yellowish transparent. Legs yellowish red, tibiae and basal tarsal segments slightly lighter apically, the distal tarsal segments darker; claws stout, strongly curved. Genitalia; basal clasp segment short, stout, obliquely truncate; at the basal angle a conspicuous chitinous process is continued anteriorly and ventrally, uniting basally with its fellow on the opposite side and forming a pair of heavy, curved beaks; terminal clasp segment very short, stout. Dorsal plate short, rather deeply emarginate, the lobes angularly rounded. Type Cecid. 53.

### **Cincticornia serrata** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:380

This species was reared in June 1908 from circular blister galls on scarlet oak, Quercus coccinea, taken near Boston, Mass., by Miss Cora H. Clarke.

*Gall.* The dark brown, broadly yellow-margined blister gall is circular and about 3 mm in diameter. The galls occur here and there upon the leaf.

*Larva.* Length 2 mm, yellowish orange, rather stout. Head very small; antennae short, stout. Breastbone slender, slightly expanded apically, bidentate. Skin coarsely shagreened, posterior extremity broadly rounded and with a pair of obtuse, semitransparent submedian tubercles.

*Male.* Length 2 mm. Antennae extending to the fourth abdominal segment, sparsely haired, dark brown; 14 segments, the fifth with a length about four times its diameter, about eight low circumfili. Palpi; the first segment short, stout, subquadrate, the second with a length about three times its diameter, narrowly oval, the third a little longer, more slender, irregular, the fourth a little longer and more slender than the third. Mesonotum dark reddish brown, the submedian lines sparsely haired. Scutellum and postscutellum fuscous yellowish. Abdomen sparsely haired, dark brown, the membrane and pleurae pale orange; genitalia fuscous. Wings hyaline, costa dark brown; halteres yellowish. Legs mostly dark brown; claws long, stout, strongly curved, simple, the pulvilli about two-thirds the length of the claws. Genitalia; dorsal plate short, broad, deeply and triangularly incised, the lobes short and roundly tapering. Type Cecid. a1791.

### **Cincticornia caryae** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:380
1909 ———— Ent. Soc. Ont., 39th Rep't, p. 45

This species was erected for a male which the late Dr M. T. Thompson supposed he had reared from a conic leaf gall on hickory, the latter being considered identical with that of Cecidomyia sanguinolenta O. S. It is very probable that this is an error, since all species of Cincticornia known to us have been obtained from oak galls.

*Male.* Length 3 mm. Antennae extending to the third abdominal segment, sparsely haired, pale yellowish; 13 segments, the fifth with a length twice its diameter; 10 low anastomosing circumfili; terminal segment produced, slightly expanded and with an apical knob. Palpi; the first segment with a length twice its diameter, the second broadly oval, the third a little longer than the second, slender, the fourth one-half longer than the third. Face fuscous yellowish. Mesonotum probably fuscous brown, the scutellum and postscutellum presumably yellowish or yellowish orange, the abdomen probably reddish brown. Genitalia fuscous. Wings hyaline, costa light brown. Halteres probably pale yellowish. Legs yellowish brown; claws long, stout, strongly curved, the pulvilli a little shorter than the claws. Genitalia; dorsal plate short, broad, broadly and triangularly emarginate. Type Cecid. 1114.

### **Cincticornia quercifolia** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:380

This was reared in the bureau of entomology from a flat gall on red oak, Quercus rubra, leaves collected in the District of Columbia, adults appearing April 1 to 27, 1896.

*Male.* Length 1.5 mm. Antennae probably extending to the third abdominal segment, sparsely haired, pale yellowish; 14 segments, the fifth with a length twice its diameter; 12 to 14 anastomosing circumfili; terminal segment produced, narrowly rounded. Palpi; the first segment short, subquadrate, the second about thrice the length of the first, the third one-half longer than the second, more slender, the fourth nearly twice the length of the third, dilated. Mesonotum reddish brown, the submedian lines thickly haired. Scutellum pale yellowish, postscutellum darker. Abdomen dark reddish brown, the segments rather thickly margined posteriorly with silvery hairs. Wings hyaline, costa light brown. Halteres pale yellowish. Legs light reddish brown; claws long, slender, strongly curved, the pulvilli shorter than the claws. Genitalia; dorsal plate short, deeply and narrowly emarginate, the lobes irregularly rounded.

*Female.* Length 1.5 mm. Antennae probably extending to the third abdominal segment, sparsely haired, light brown; 14 segments, the fifth with a length twice its diameter and 6 circumfili; terminal segment produced, narrowly rounded. Palpi; the first segment short, stout, subquadrate, the second more than twice the length of the first, more slender, the third one-half longer than the second, more slender, the fourth one-half longer than the third. Ovipositor about one-fourth the length of the abdomen, otherwise nearly as in the male. Type Cecid. 1043.

### **Cincticornia pustulata** Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:291

This species was reared in some numbers the latter part of April and early in May 1909 from oval, pustulate swellings on the leaves of the yellow barked or black oak, Quercus velutina, taken by Miss Cora H. Clarke at Magnolia, Mass., in October 1908. Apparently the same species was reared March 30, 1896 by Theodore Pergande from a similar leaf gall on red oak, Quercus rubra, taken at Washington, D. C.

*Gall.* This is a variable brown, irregularly oval, pustulate swelling 5 to 6 mm in diameter. It occurs here and there on the leaf surface.

*Larva.* Length 2 mm, semitransparent. Head small; antennae short, stout. Breastbone broadly bidentate, rather strongly chitinized anteriorly, weakly so posteriorly. Skin nearly smooth, strongly folded, posterior extremity broadly rounded and with a pair of short, broad tubercles.

*Male.* Length 2 mm. Antennae nearly as long as the body, sparsely haired, fuscous yellowish; 14 segments, the fifth with a length about three times its diameter; 8 or 9 circumfili; terminal segment slightly produced, with a length four times its diameter, apically a short, obtuse knob. Palpi; first segment short, rectangular, the second slender, with a length four times its diameter, the third as

long as the second, the fourth one-half longer than the third, all slender. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum fuscous reddish, postscutellum fuscous orange. Abdomen sparsely haired, deep reddish orange, the small dorsal sclerites dark brown; genitalia fuscous. Wings short, broad, hyaline, costa fuscous. Halteres yellowish basally, fuscous yellowish apically. Coxae slaty brown; femora, tibiae and tarsi fuscous yellowish, the distal tarsal segments darker; claws slender, strongly curved, the pulvilli shorter than the claws. Genitalia; dorsal plate short, narrowly and deeply emarginate, the lobes broadly rounded.

*Female.* Length 2 mm. Antennae extending to the fourth abdominal segment, sparsely haired, fuscous yellowish, yellowish basally; 14 segments, the fifth with a length four times its diameter; the circumfili four, coarsely and irregularly reticulate; terminal segment slightly produced, an obtuse knob. Palpi; first segment short, subquadrate, the second with a length four times its diameter, the third a little longer, more slender, the fourth one-third longer than the second, slightly dilated. Mesonotum dark brown, the submedian lines thickly haired. Scutellum reddish brown, postscutellum fuscous. Abdomen sparsely haired, the rather small dorsal sclerites dark brown, the incisures and pleurae deep reddish orange. Coxae fuscous yellowish; femora and tibiae a variable fuscous yellowish and dark brown, tarsi mostly dark brown or black. Ovipositor about half the length of the abdomen. Type Cecid. a1789.

### **Cincticornia simpla** Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:291

The oval blister galls on oak produced by this species are so insignificant as rarely to attract the attention of any but those specially interested in the study of insect galls. This species was reared in small numbers from several lots of galls taken by Miss Cora H. Clarke on yellow barked oak, Quercus velutina, at Magnolia, Mass., and also from blister swellings on the leaves of red oak, Quercus rubra, taken in the vicinity of Albany, N. Y.

*Gall.* An irregularly oval pustulate swelling 5 to 6 mm in diameter and showing equally on both surfaces but with no distinct nipple. The galls are a variable brown in the fall, darker than the normal tissue and occur here and there on the leaf. Apparently the same species produces a slightly green or variable yellowish and red elevation on both surfaces of the leaf some 5 by 7 mm in diameter. Several larvae occur in the cavity beneath.

*Larva.* Length 3 mm, whitish or yellowish, rather stout. Head small; antennae short, stout. Breastbone well developed, bidentate, the teeth rather long, stout; shaft well developed; segmentation

distinct. Skin finely shagreened, the posterior extremity narrowly rounded.

*Male.* Length 2 mm. Antennae extending to the fifth abdominal segment, sparsely haired, fuscous yellowish; 14 subsessile, cylindric

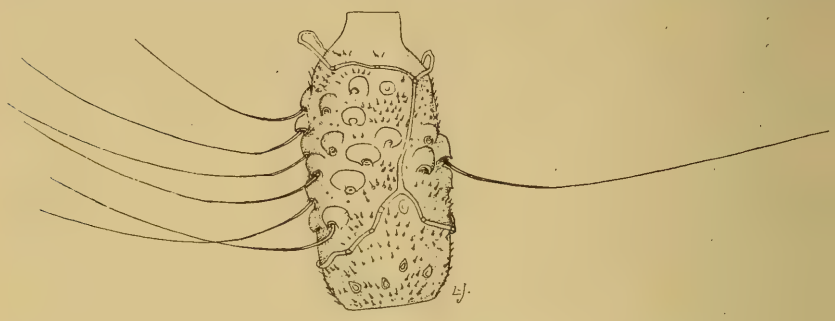


Fig. 31 Cincticornia simpla. Fifth antennal segment of male, enlarged (original)

segments, the fifth with a stem one-fourth the length of the cylindric basal enlargement, which latter has a length two and one-half times its diameter, the subapical whorl thick and long; low, irregular circumfili occur near the basal third and apically; terminal segment produced, with a length four times its diameter, tapering distally. Palpi; the first segment with a length three times its diameter, in-

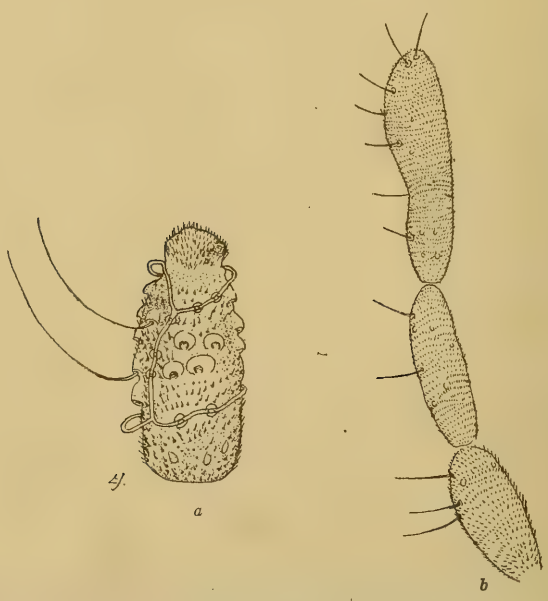



Fig. 32 Cincticornis simpla, male. *a*, terminal antennal segment; *b*, palpus, enlarged (original)

crassate, the second narrowly lanceolate, one-half longer; the third a little longer than the second, slender, the fourth a little longer than the third. Mesonotum dark brown, the submedian lines thickly haired. Scutellum reddish brown, postscutellum fuscous yellowish. Abdomen dark brown, the incisures and pleurae yellowish red, the segments sparsely haired posteriorly; genitalia fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, pale orange apically, fuscous subapically. Coxae fuscous yellowish; femora and tibiae mostly fuscous yellowish; tarsi dark brown; claws long, rather stout, strongly curved, the pulvilli shorter than the claws. Genitalia; dorsal plate short, broad, deeply and narrowly emarginate, the lobes broadly rounded.

*Female.* Length 2 mm. Antennae extending to the fourth abdominal segment, sparsely haired, fuscous yellowish, yellowish basally; 14 segments, the fifth with a length three and one-half times its diameter; subapically a few scattering setae; irregular, high, unusually thick, irregularly anastomosing circumfili near the basal third and apically (figure 33); terminal segment somewhat reduced,

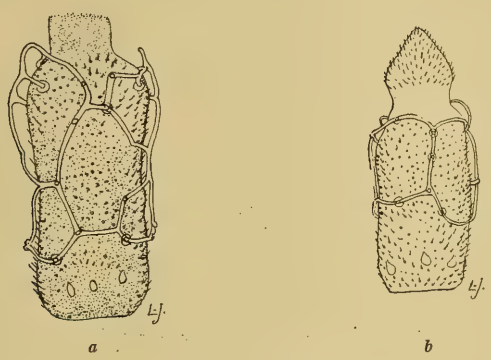



Fig. 33 Cincticornia simpla. Fifth (*a*) and distal (*b* antennal segments of female, enlarged (original)

with a length three times its diameter, the apical fourth constricted, narrowly rounded; claws stout, irregularly curved, the pulvilli shorter than the claws. Ovipositor about two-thirds the length of the abdomen. Otherwise nearly as in the male. Type Cecid. a1789d, a1942, a1947.

### **Cincticornia podagrae** Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:291

This species was reared in small numbers in April 1908 from a narrow, fusiform vein swelling on the leaves of the yellow-barked or black oak, Quercus velutina, collected by Miss Cora H. Clarke at Magnolia, Mass., in October 1908.

*Gall.* This is a narrow, dark purplish, fusiform, thin-walled swelling some 8 mm long on the under side of the mid or lateral veins and may contain two or more orange larvae.

*Larva.* Length 1.5 mm, rather slender, tapering at both extremities, orange color. Head rather small; antennae stout. Breastbone expanded apically and obtusely dentate. Skin coarsely shagreened, posterior extremity broadly rounded and with submedian obtuse tubercles.

*Male.* Length 2 mm. Antennae extending to the fourth abdominal segment, sparsely haired, dark brown, yellowish basally; 14 segments, the fifth with a length nearly four times its diameter; 7 or 8 anastomosing circumfili; terminal segment produced, with a length about five times its diameter and a rather long, obtuse knob. Palpi; first segment short, stout, second with a length fully three times its width, the third as long as the second, the fourth one-half longer, somewhat dilated. Mesonotum slaty brown, the submedian lines thickly haired. Scutellum dark brown, postscutellum fuscous. Abdomen a variable reddish or dark brown, the segments sparsely haired, the incisures and pleurae deep red. Wings short, broad, costa dark brown. Halteres pale orange, fuscous subapically. Coxae and legs mostly dark brown; claws rather slender, strongly curved, the pulvilli shorter than the claws. Genitalia; dorsal plate short, divided, the lobes broad, truncate.

*Female.* Length 2.5 mm. Antennae extending to the third abdominal segment, sparsely haired, dark brown; 14 segments, the fifth with a length four times its diameter; about four circumfili form coarse recticulations; terminal segment slightly reduced, with a length three and one-half times its diameter, tapering, subacute. Scutellum yellowish red, postscutellum darker. Abdomen sparsely haired, mostly dark brown, the incisures and pleurae deep orange; ovipositor pale yellowish. Coxae fuscous yellowish, the femora darker, the tibiae and tarsi mostly dark brown. Ovipositor about two-thirds the length of the abdomen. Otherwise nearly as in the male. Type Cecid. a1788.

### **Cincticornia globosa** Felt

1909 **Felt, E. P.** Econ. Ent. Jour., 2:291

This dark-brown species with short, relatively broad wings was reared in some numbers from a subhemispheric, brown, slightly nippled, oak leaf gall on black oak, probably Quercus velutina, in April and May 1909 from material collected by Miss Cora H. Clarke at Magnolia, Mass., in October 1908. Apparently the same gall was taken by Miss Clarke on the scarlet oak, Quercus coccinea. A very similar oak leaf gall may produce a Cynipid.

*Gall.* Subhemispheric, brown, slightly nippled, 1.75 mm in diameter. It is monothalamous, occurs on the under side of the leaf and causes on its upper surface a slight, brownish elevation encircled by yellowish orange.

*Larva.* Length 2.25 mm, rather stout, bright lemon yellow. Head small; antennae short, stout. Breastbone broadly and irregularly bidentate, the shaft narrow. Skin coarsely shagreened, posterior extremity broadly rounded with submedian obtuse tubercles and numerous short, stout, semitransparent spines.

*Male.* Length 2 mm. Antennae extending to the fifth abdominal segment, sparsely haired, fuscous yellowish; 14 segments, the fifth with a length about three times its diameter; about 11 low circumfili; terminal segment produced, with a length five times its diameter, tapering. Palpi; first segment presumably stout, the second with a length four times its diameter, the third a little longer, more slender, the fourth one-half longer than the third. Mesonotum dark brown, the submedian lines thickly haired. Scutellum reddish brown, postscutellum fuscous yellowish. Abdomen dark brown, the incisures and pleurae yellowish red, the segments sparsely haired posteriorly; genitalia fuscous. Wings hyaline, costa dark brown; halteres yellowish basally, pale orange apically, fuscous subapically. Coxae fuscous yellowish; femora and tibiae mostly fuscous yellowish; tarsi dark brown; claws long, slender, strongly curved, pulvilli shorter than the claws. Genitalia; dorsal plate short, deeply and roundly emarginate, the lobes broadly rounded.

*Female.* Length 2 mm. Antennae extending to the fourth abdominal segment, sparsely haired, fuscous yellowish; 14 segments, the fifth with a length fully four times its diameter, with four coarsely anastomosing circumfili; terminal segment slightly reduced, tapering, narrowly rounded. Palpi; first segment subquadrate, the second one-half longer, slender, the third a little longer, more slender than the second, the fourth one-half longer than the third. Scutellum deep red, postscutellum fuscous. Abdomen reddish orange, the rather small dorsal sclerites dark brown and sparsely margined with yellowish hairs. Halteres yellowish basally, fuscous apically. Coxae slaty brown. Ovipositor about two-thirds the length of the abdomen. Type Cecid. a1902.

### **Cincticornia americana** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:380, 381

This small, broad-winged form was reared in April 1908 from a slight blisterlike swelling on the lateral veins of red oak, Quercus rubra taken at Albany, N. Y., November 12, 1907.

*Gall.* The gall is a slight, circular, blisterlike swelling on the lateral veins beneath and of very nearly the same color as the leaf.

It is some 3 mm long and 1 mm wide, and may extend along the vein as well as into the leaf tissues beside.

*Larva.* Length 2.5 mm, orange, rather stout, the head rather broad, the antennae short, stout. Breastbone slightly expanded anteriorly, bidentate, obsolescent posteriorly. Skin nearly smooth, posterior extremity broadly rounded, with a pair of broad submedian tubercles.

*Male.* Length 2.5 mm. Antennae nearly as long as the body, sparsely haired, fuscous yellowish; 14 segments, the fifth with a length about three times its diameter; circumfili 7, forming fine reticulations; terminal segment produced, with a length four times its diameter, tapering, narrowly rounded. Palpi; first segment short, stout, the second with a length over three times its diameter, rather stout, the third a little longer, more slender, the fourth one-half longer than the third, somewhat dilated. Face pale yellowish. Mesonotum fuscous yellowish, the submedian lines thickly haired. Scutellum pale yellowish, postscutellum yellowish. Abdomen sparsely haired, mostly yellowish orange, the small dorsal and ventral sclerites fuscous; genitalia fuscous. Wings small, narrow, costa fuscous. Halteres light fuscous yellowish, fuscous subapically. Coxae and femora light fuscous yellowish, the tibiae slightly darker; tarsi mostly dark brown; claws rather stout, strongly curved, the pulvilli shorter than the claws. Genitalia; dorsal plate short, divided, the lobes narrowly rounded.

*Female.* Length 2 mm. Antennae extending to the third abdominal segment, sparsely haired, fuscous yellowish; 14 segments, the fifth with a length three and one-half times its diameter; four circumfili form coarse reticulations; terminal segment slightly reduced, with a length three times its diameter, narrowly rounded. Mesonotum shining dark brown, the submedian lines sparsely haired. Scutellum dark reddish, postscutellum fuscous yellowish. Abdomen sparsely haired, the sclerites shining dark brown, membrane and pleurae deep orange; ovipositor yellowish, when extended about two thirds the length of the abdomen. Otherwise nearly as in the male. Type Cecid. a1792.

### **Cincticornia multifila** Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110:118–19 (separate p. 22) (Asphondylia)

1908 ———— N. Y. State Mus. Bul. 124:380

This species appears to be a rather common form under certain conditions in the vicinity of Albany, N. Y., since it was taken June 1, 1906 while sweeping white oak Quercus alba.

*Male.* Length 1.25 mm. Antennae extending to the base of the abdomen, sparsely haired, light brown; 13 segments, the fifth with a length two and one-half times its diameter and six or seven circumfili; terminal segment produced and composed of two closely

fused segments. Palpi; the first segment suboval, the second one-fourth longer than the first, the third about one-third longer than the second, the fourth one-third longer than the third, each more slender than the preceding. Mesonotum dark brown. Scutellum reddish brown, postscutellum a little lighter. Abdomen nearly uniform dark brown. Wings hyaline, costa reddish. Halteres yellowish transparent. Legs pale yellowish brown, tarsi a little darker; claws stout, uniformly curved. Genitalia; dorsal plate broad, deeply and roundly emarginate, the lobes acutely rounded. Type Cecid. 95, 99, 100.

### **Cincticornia rhoina** Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110:123 (separate p. 26), (Oligotrophus)
1908 ———— N. Y. State Mus. Bul. 124:381

This species was taken at Albany, N. Y., June 1, 1906 while sweeping sumac, Rhus.

*Male.* Length .75 mm. Antennae a little longer than the body, sparsely haired, light brown; 13 segments, the fifth with a length two and one-half times its diameter and five or six circumfili; the thirteenth and fourteenth segments closely fused. Palpi; first segment subquadrate, the second one-half longer than the first, the third longer than the second and the fourth one-half longer than the third. Mesonotum dark brown. Scutellum light brown with sparse apical setae, postscutellum yellowish brown. Abdomen a somewhat variable yellowish brown, the anterior four segments irregularly marked near the median line with dark brown. Wings hyaline, costa reddish brown. Halteres yellowish transparent. Legs pale yellowish brown, tarsi darker; claws stout, rather strongly curved, the pulvilli shorter than the claws. Genitalia; dorsal plate broad, tapering, deeply and triangularly emarginate. Type Cecid. 94.

Fig. 34 Cincticornia rhoina, male, distal antennal segments, enlarged (original)

### **Cincticornia cornifolia** Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110:124 (separate p. 28), (Oligotrophus)

This yellowish species was taken on flowering dogwood, Cornus florida, at Albany, N. Y., May 18, 1906.

*Female.* Length 1.25 mm. Antennae extending to the third abdominal segment, reddish brown, sparsely haired; 13 segments,

the fifth with a length two and one-half times its diameter; subbasal whorl scattering, subapical whorl rudimentary; indistinct circumfili near the basal third and apically and with a variable anastomosis between; terminal segment with a length four times its diameter, evidently composed of two. Palpi; first segment short, stout, the second rectangular, with a length nearly four times its diameter, the third a little longer, more slender, the fourth longer and more slender than the third. Mesonotum dark brown, the submedian lines and the median posterior area yellowish. Scutellum yellowish red with numerous yellowish apical setae, postscutellum yellowish. Abdomen yellowish with the basal segments tinged with red, the first slightly darker. Wings hyaline, costa reddish brown. Halteres and coxae yellowish transparent; femora and tibiae yellowish tinged with red, tarsi somewhat darker; claws slender, evenly curved, the pulvilli shorter than the claws. Ovipositor about two-thirds the length of the abdomen. Type Cecid. 49c.

### **Cincticornia pilulae** Walsh

1864 **Walsh, B. D.** Ent. Soc. Phil. Proc., 2:481–82 (Cecidomyia q. pilulae)
1869 ———— Am. Ent., 2:29 (Cecidomyia)
1890 **Packard, A. S.** U. S. Ent. Com. 5th Rep't, p. 206–7 (Cecidomyia)
1892 **Beutenmueller, William.** Am. Mus. Nat. Hist. Bul. 4:269 (Cecidomyia)
1894 ———— Am. Mus. Nat. Hist., Guide Leaflet 16, p. 30 (Cecidomyia)
1902 **Cook, M. T.** Ohio State Univ. Bul. 15, ser. 6, p. 267 (Cecidomyia)
1905 ———— Dep't Geol. & Nat. Res. Ind., 29th Rep't, p. 841 (Cecidomyia)
1906 **Felt, E. P.** Ins. Affec. Pk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:619, 627 (Cecidomyia)
1908 ———— N. Y. State Mus. Bul. 124:380, 381
1909 ———— Ent. Soc. Ont., 39th Rep't, p. 45
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2, p. 18

This species appears to be one of the commonest representatives of the genus. The gall is by no means rare on various species of oak in the vicinity of Albany and in other parts of the country. It is presumable that all of the citations given above relate to this form, though we have reared Cynipids from galls supposed to be made by Cincticornia on several occasions. It would not be surprising if the work of two very dissimilar insects had been confounded occasionally. The late Dr M. T. Thompson of Clark University records the appearance of the young gall at Worcester, Mass., the second week in June, while Professor Beutenmueller states that in the vicinity of New York City it begins to develop in May and becomes full size by August or September. At first it is blister-like, yellow or pale brown and surrounded by a light-green ring. The full-grown gall varies greatly in size, ranging from about 3 to

6 or 7 mm in diameter and presents a characteristic reticulated appearance. The insect winters in the gall, the larvae escape and form silk-lined cells among leaves or in the soil prior to transformation. The late Doctor Thompson records having taken this gall on Quercus ilicifolia, Q. rubra, Q. coccinea, Q. stellata and Q. palustris. It also occurs on Q. falcata, Q. velutina and Q. nigra. Professor Beutenmueller states that it is found on various species belonging to the red oak group. Galls of this species were received from Riverdale, Md. through Dr W. L. McAtee accompanied by the statement that flocks of sparrows were observed opening the galls and eating the larvae.

There is in the Museum of Comparative Zoology at Cambridge, Mass., a gall labeled Cecidomyia palustris O. S. The deformity described by him (Ent. Soc. Phil. Proc., 1:252 and 4:359) is most probably the work of a Cincticornia and may be only a modified form of C. pilulae Walsh.

The adult of what may have been this species was briefly characterized by Dr A. S. Packard in the 5th Report of the U. S. Entomological Commission. The characters given are insufficient for the recognition of the species and it is possible that Doctor Packard was misled and characterized an inquiline or some form issuing from other material. We were fortunate in rearing a large series of adults in the spring of 1909. Midges of this species were obtained in numbers by the late Dr M. T. Thompson of Worcester, Mass., from material collected in that vicinity. It was taken by Prof. C. W. Johnson May 19, 1901 at Clementon, N. J., April 26, 1896 in Delaware county, Pa., and was reared from galls on Quercus nigra and Q. rubra taken at Washington, D. C., in March and April 1896 by the bureau of entomology. These specimens, while presenting some minor variations among themselves, are probably all referable to one species. This midge appears to be widely distributed, having been recorded, in addition to the localities given above, from Mississippi, Indiana, Illinois and Rhode Island.

*Gall.* Reddish brown, coarsely reticulate, thick walled, irregularly subglobose, 3 to 4 mm in diameter, somewhat depressed or fused to form lobulate masses 1 cm or more in length. The galls may occur scatteringly on the leaves or be present in large numbers, there being from 1 to 4 or 5 up to possibly 75 on a leaf. On badly infested leaves the galls may be confluent, and occasionally a considerable number adhere to form an almost continuous mass on

one or both sides of the midvein. The young galls are fleshy while the old ones are very hard and woody. Normally but one larva occurs in the typical gall, though three or four are frequently present in a confluent mass.

*Larva.* Length 3 mm, rather stout, reddish orange; head slightly rounded, triangular, the posterior angles with long, chitinous processes. Antennae rather long, stout, biarticulate, the terminal seg-


Fig. 35 Cincticornia pilulae. *a*, breastbone of larva; *b*, posterior extremity, enlarged (original)

ment minute. Breastbone expanded anteriorly, bidentate, the teeth widely separated, irregularly rounded, the shaft tapering and disappearing posteriorly; skin coarsely shagreened. Terminal segment small, rounded.

*Male.* Length 3 mm. Antennae extending to the fourth abdominal segment, sparsely haired, fuscous yellowish, yellowish basally; 14 segments, the fifth with a length a little over twice its diameter, 9 circumfili; terminal segment somewhat prolonged, narrowly rounded. Palpi; the first segment short, stout, subquadrate, the second more than twice the length of the first, more slender, the third a little stouter and hardly as long as the second, the fourth nearly twice the length of the third, strongly flattened and somewhat dilated. Mesonotum a dark brown, the submedian lines sparsely haired. Scutellum fuscous yellowish, postscutellum a little darker. Abdomen dark brown, the incisures and pleurae pale salmon, ventral sclerites dark brown. Wings hyaline, costa light brown; halteres whitish transparent. Legs with the coxae and femora a deep fuscous yellowish, the tarsi lighter; claws long, slender, evenly curved, the pulvilli shorter than the claws.

*Female.* Length 3.5 mm. Antennae extending to the fourth abdominal segment, sparsely haired, dark brown, the basal segments fuscous yellowish; 14 segments, the fifth with a length two and one-half times its diameter, with four circumfili; terminal segment with a length one-half greater than its diameter, irregularly rounded. Palpi; the first segment stout, with a length about twice its diameter, the second one-half longer, more slender, the third a little longer and more slender than the second and the fourth about one-half longer than the third, strongly flattened and dilated. Mesonotum dark brown, the submedian lines indistinct. Scutellum a reddish yellow, postscutellum yellowish anteriorly, fuscous posteriorly. Abdomen with the dorsal and ventral sclerites dark red, the incisures and pleurae dull red, the ovipositor pale yellowish. Wings hyaline, costa light brown; halteres pale yellowish basally, whitish apically, fuscous subapically. Legs fuscous yellowish; claws long, slender, strongly curved, simple, the pulvilli shorter than the claws. Ovipositor short. Cecid. 1105.

### **Cincticornia symmetrica** O. S.

1862 **Osten Sacken R.** Mon. Dipt. N. A., 1:200–1 (Cecidomyia)
1869 **Walsh, B. D.** & **Riley, C. V.** Am. Ent., 2:29 (Cecidomyia)
1891 **Riley, C. V.** & **Howard, L. O.** Ins. Life, 4:126 (Polygnotus tumidus Ashm. reared, Cecidomyia)
1892 **Beutenmueller, William.** Am. Mus. Nat. Hist. Bul. 4:270 (Cecidomyia)
1906 **Felt, E. P.** Ins. Affec. Pk. & Wdld. Trees, N. Y. State Mus. Mem. 8, 2:710 (Cecidomyia)
1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2, p. 18 (Cecidomyia)

This deformity has been described by Osten Sacken as a hard, red gall on the leaves of different kinds of oak. It is small and round, between one-twentieth and one-tenth of an inch in diameter, though more commonly assuming an irregular shape by the coalescence of several galls. He states that this gall occurs in large numbers on the leaves of Quercus falcata in autumn, sometimes occupying almost the entire leaf and having exactly the same size and shape on both surfaces. A study of the types of this gall in the Museum of Comparative Zoology at Cambridge, showed that it was very close to, if not identical with, that of Cincticornia pilulae. Beutenmueller states that it differs from the more common C. pilulae by protruding equally on both surfaces of the leaf, and adds that it has not been found in the vicinity of New York City. The larvae in the collections of the United States National Museum and labeled as having come from this gall, belong to the genus Cincticornia and possibly may be different from those of C. pilulae. It is provisionally placed next this common species.

### **Cincticornia canadensis** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:380

This species, taken at Toronto, Ont., bears the date label 3–5–91 and occurs in the National Museum collection.

*Female.* Length 2 mm. Antennae extending to the fourth abdominal segment, sparsely haired, dark brown; 14 segments, the fifth with a length two and one-half times its diameter, and with 6 circumfili; terminal segment slightly reduced, tapering to a narrowly rounded apex. Palpi; the first segment short, stout, rounded distally, the second about twice the length of the first, rather stout, the third a little shorter than the second and the fourth about twice the length of the third. Mesonotum dark brown. Scutellum purplish brown, postscutellum reddish brown. Abdomen dark reddish brown. Wings hyaline, costa light brown. Halteres fuscous yellowish basally, pale salmon apically. Legs mostly pale yellowish brown; claws rather long, moderately stout, strongly curved, the pulvilli shorter than the claws. Ovipositor about one-half the length of the abdomen. Type Cecid. 1042.

### **Cincticornia sobrina** Felt

1907 **Felt, E. P.** N. Y. State Mus. Bul. 110:158 (Asphondylia)
1908 ———— N. Y. State Mus. Bul. 124:381

Adults of this form were first reared by the late Dr M. T. Thompson of Clark University, Worcester, Mass., from a vial containing earth brought into the laboratory for the purpose of rearing Tineids. It was then thought that they might have come from some seed, possibly elm keys. Subsequent rearings in April 1911 resulted in obtaining numerous flies, referable with little question to this species, from the leaves of the black oak, Quercus velutina, and probably those of other species, thickly infested with an inconspicuous, circular, blister gall. This species may be most easily distinguished from allied forms by the coarse reticulations formed by the circumfili on the antennal segments of both male and female, there being four or five transverse fili on each.

*Gall.* An inconspicuous, circular, blister enlargement showing mostly on the under surface of the leaf and varying in diameter from 3 to 5 mm.

*Larva.* Length 3.5 mm, stout, probably yellowish orange. Head rather long, narrow, tapering. Antennae short, subconic, biarticulate; breastbone long; the shaft rather stout, with a uniform diameter, pale basally, expanded apically and minutely bidentate; skin coarsely shagreened; posterior extremity broadly rounded and apically with submedian short, conical, chitinous processes.

*Exuviae. Male.* Length 4 mm, stout, pale yellowish white, the wing cases extending to the third, the leg cases to the fourth, and the antennal sheaths to the fifth abdominal segment. The dorsum of each of the abdominal segments is rather thickly covered with long,

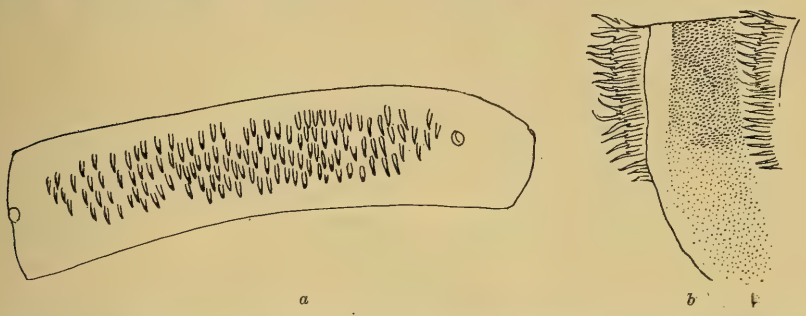



Fig. 36 Cincticornia sobrina. *a*, dorsal aspect of the third abdominal segment of the pupa; *b*, lateral view of the same, enlarged (original)

heavily chitinized triangular spines (figure 36), the entire surface being uniformly dotted with the same. Terminal segment broadly rounded, with a roundly triangular area bounded by an irregular chitinous thickening, the posterior lateral angles marked by conspicuous rounded chitinous processes.

*Female.* Length 3 mm, stout, pale yellowish, the thoracic horns long, slender, curved, the wing cases extending to the third abdominal segment, the leg cases to the fourth, the dorsum of the abdominal segments with a treble row of short, stout, heavily chitinized spines on the basal third, the row on the last segment being double, the posterior two-thirds of the abdominal segment with the surface thickly dotted with minute triangular points.

The exuviae differs markedly from those of Asphondylia in the peculiar ornamentation on the dorsum of the abdominal segments. There is also a marked sexual difference, the antennal sheath of the male having about sixty distinct annulations, approximately one to each circumfilum. The dorsum of the abdominal segments in the male is entirely covered with the stout, chitinous spines observed in the opposite sex only on the basal third of the segments.

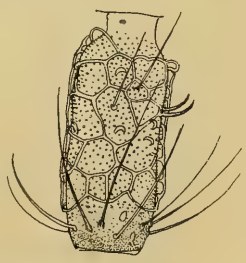


Fig. 37 Cincticornia sobrina. Fifth antennal segment of male, enlarged (original)

*Male.* Length 3 mm. Antennae extending to the second abdominal segment, sparsely haired, light yellowish; 14 segments, the fifth with a length two and one-half times the diameter, and 4 circumfili; terminal segment slightly reduced, tapering to an obtusely rounded apex. Palpi; the first segment irregularly subquadrate, swollen distally, the second one-half longer, subrectangular, the third

one-half longer than the second, tapering slightly at each extremity, the fourth nearly twice the length of the preceding, more compressed; face fuscous yellowish. Mesonotum dark brown, the submedian lines rather thickly clothed with yellowish hairs. Scutellum reddish yellow, postscutellum yellowish. Abdomen a reddish brown, the genitalia yellowish, fuscous distally. Wings hyaline, costa light brown; halteres semitransparent basally and apically, fuscous yellowish subapically. Legs a variable light fuscous yellowish, the tarsi somewhat darker; claws long, slender, strongly curved, the pulvilli a little shorter than the claws.

*Female.* Length 3.5 mm. Antennae extending to the second abdominal segment, sparsely haired, pale yellowish; 14 segments, the fifth with a length about two and one-half times its diameter and with four circumfili. Palpi; the first segment short, subquadrate, the second more than twice the length of the preceding, the third a little longer and more slender than the second, the fourth one-half longer than the third, strongly flattened and somewhat dilated apically; face yellowish. Mesonotum a light fuscous orange, the submedian lines lighter. Scutellum a pale yellow, postscutellum yellowish. Abdomen a pale orange, the distal segments lighter. Wings hyaline, costa light brown; halteres whitish transparent basally and apically, somewhat fuscous subapically. Legs a variable fuscous yellowish, the tarsi darker; claws long, slender, strongly curved, simple, the pulvilli a little shorter than the claws. Ovipositor short, less than one-half the length of the abdomen. Type Cecid. 1108.

### **Cincticornia connecta** Felt

1908 **Felt, E. P.** N. Y. State Mus. Bul. 124:381

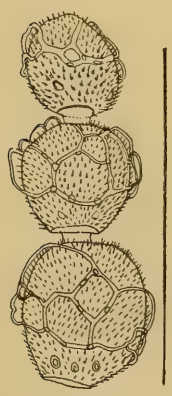


Fig. 38 Cincticornia connecta. Distal three antennal segments of female, enlarged (original)

This species was taken at Westville, Conn., May 8, 1903, by Dr W. E. Britton, state entomologist. A supplementary label on the pin bears the statement: "Color of a red mite."

*Female.* Length 3.5 mm. Antennae extending to the second abdominal segment, sparsely haired, fuscous yellowish; 14 segments, the fifth with a short stem and a length three and one-half times its diameter, two circumfili; terminal segment distinctly reduced, the twelfth with a length about one-half greater than its diameter, the thirteenth and fourteenth each irregularly subglobose. One antenna is peculiar in having 15 segments. Palpi; the first segment short, stout, narrowly oval, the second one-half longer, more slender, the third about as long as the second, more slender, the fourth one-half longer than the third, slightly dilated; face reddish yellow, eyes rather large, black. Mesonotum reddish brown, the submedian lines

rather broad, fuscous yellowish, slightly expanded at the anterior margin and continued along the lateral margin. Scutellum fuscous yellowish, postscutellum reddish brown. Abdomen rather thickly clothed with fuscous hairs, reddish yellow and in life probably deep red. Wings hyaline, costa light brown; halteres pale yellowish basally, fuscous apically. Coxae and femora fuscous yellowish,

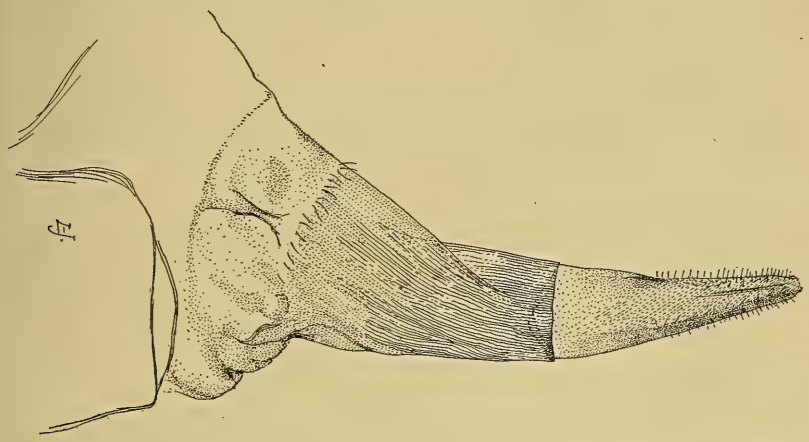


Fig. 39 Cincticornia connecta. Posterior extremity of female showing ovipositor extended, enlarged (original)

tibiae and tarsi mostly a very dark fuscous yellowish, owing to the presence of numerous long, black hairs; claws long, moderately stout, strongly curved, the pulvilli as long as the claws. Ovipositor about one-half the length of the abdomen. Type Cecid. 822.

### **Cincticornia pustuloides** Beutm.

1907 **Beutenmueller, William.** Amer. Mus. Nat. Hist. Bul. 23:390 (Cecidomyia)

1910 **Stebbins, F. A.** Springf. Mus. Nat. Hist. Bul. 2:22, 24

This species is with very little question referable to Cincticornia.

The gall is circular, blisterlike and protrudes slightly on each side of the leaf. It measures 4 to 7 mm in diameter and occurs in September in clusters on the leaves of various kinds of oaks.

### FELTOMYIA Kieffer

1911 **Felt, E. P.** N. Y. Ent. Soc. Jour., 19:48–49 (Uleella)

1912 ———— Ent. News, 23:353–54 (Uleella)

1913 **Kieffer, J. J.** Gen. Insect., fasc. 152, p. 100

1915 **Felt, E. P.** U. S. Nat. Mus. Proc. 48:198

This tropical American genus was erected for a remarkably synthetic form, the generic type being F. pisonifolia Felt.

Antennal segments 14, cylindric, sessile, the distal one in the female reduced; the circumfili in the male are large and very irregular, the palpi triarticulate; the third vein unites with the margin at the apex of the wing; the terminal clasp segment of the male is subapical and serrate distally, while the ovipositor is short with feebly chitinized plates and a moderately stout, variably chitinized terminal portion.

The slight reduction of the terminal antennal segments in the female and the palps indicates relationship with Asphondylia, the terminal clasp segment of the male shows affinity with Cincticornia, while the circumfili are nearly identical with those of Schizomyia. Detailed description of adults, erroneously referred to Bruggmanniella, have been given by the writer in 1911 in the Journal of Economic Entomology, 4:547, and in 1912 in Entomological News, 23:174–75.

### **Feltomyia pisonifolia** Felt

1912 **Felt, E. P.** Ent. News, 23:353–54 (Uleella)

This species was reared in June 1911 from oval leaf galls on Pisonia nigricans collected by Mr W. H. Patterson, St Vincent, W. I.

### **Feltomyia mexicana** Felt

1911 **Felt, E. P.** Econ. Ent. Jour., 4:547 (Bruggmanniella)

This species was reared from an irregular stem gall on a plant provisionally identified as Pisonia aculeata Linn. and collected by E. A. Schwarz at Tampico, Mexico, December 1909.

### **Feltomyia pisoniae** Felt

1912 **Felt, E. P.** Ent. News., 23:174–75 (Bruggmanniella)

This midge was reared May 5, 1911 from irregular stem galls on Pisonia nigricans collected by Mr W. H. Patterson, St Vincent, W. I.

# EXPLANATION OF PLATES

**PLATE I**

**Codling moth,** Carpocapsa pomonella Linn.
Three apples showing typical side injury

Plate I

Side injury or "sting"

PLATE 2

**Codling moth,** Carpocapsa pomonella Linn.
Three apples showing one type of hail injury, simulating in appearance the side injury illustrated on plate 1

Plate 2

A type of hail injury resembling codling moth side injury

PLATE 3

**Codling moth,** Carpocapsa pomonella Linn.
Typical side-wormy apples showing the work of nearly full-grown larvae

Plate 3

Side-wormy apples

PLATE 4

**Codling moth,** Carpocapsa pomonella Linn.
Typical side-wormy apples showing fresh borings extruding from the galleries

Plate 4

Side-wormy apples showing fresh castings

PLATE 5

**Codling moth,** Carpocapsa pomonella Linn.
Three apples in section showing typical side-worm injury

Plate 5

Side-wormy apples in section

PLATE 6

**Bud moth,** Tmetocera ocellana Schiff.
Apples showing work of young larvae

Plate 6

Bud moth injury

PLATE 7

**Fruit tree leaf roller,** Archips argyrospila Walk. Apples showing early injury by the larvae

Plate 7

Leaf roller work, slight injury

PLATE 8

**Fruit tree leaf roller,** Archips argyrospila Walk. Apples showing early and serious injury

Plate 8

Leaf roller injury

PLATE 9

**Fruit tree leaf roller,** Archips argyrospila Walk.
Apples showing late injury by the larvae and possibly also the work of the lesser apple worm, Enarmonia prunivora Walsh

Plate 9

Late leaf roller injury

PLATE 10

**Rosy aphis,** *Aphis sorbi* Kalb.
Group of apples showing characteristic stunting and deformation

Plate 10

Aphis apples

PLATE II

Work of a sawfly larva

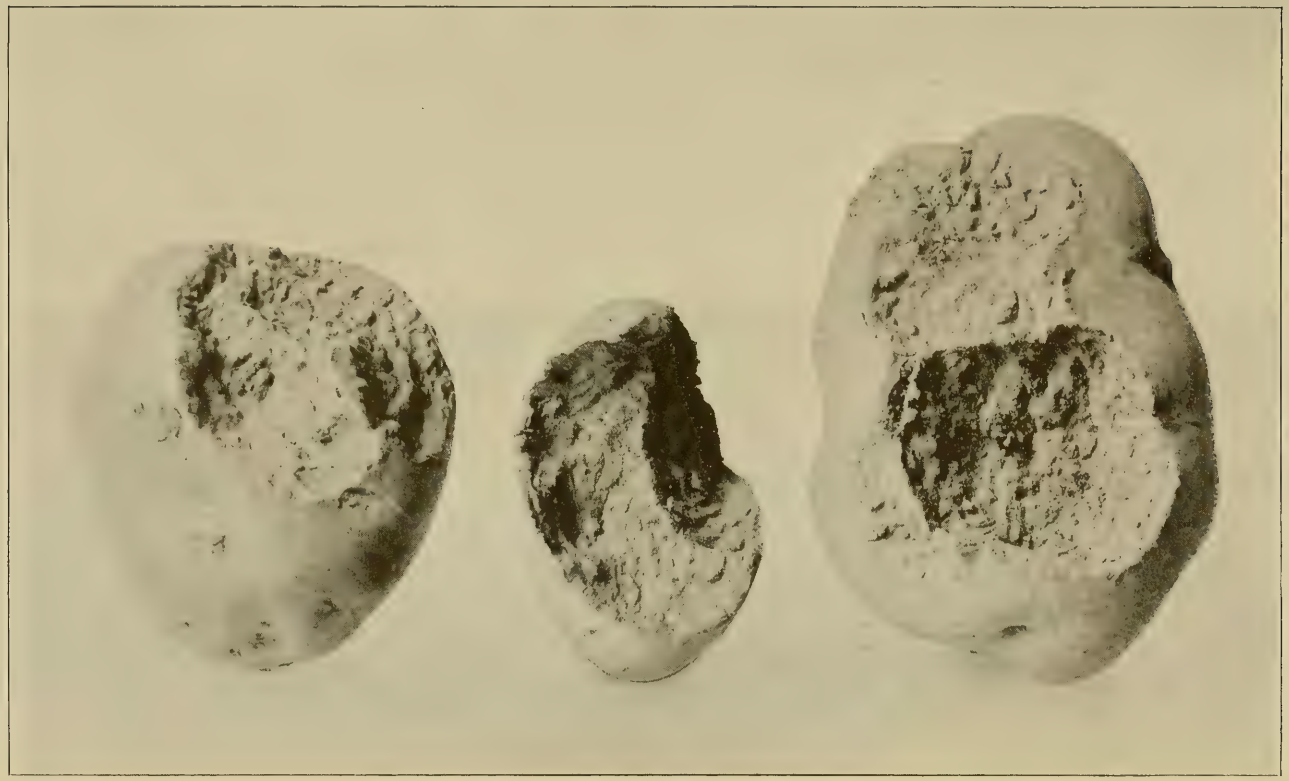
Plate 11

Hole made by greenish sawfly larva

PLATE 12

**White grub,** L a c h n o s t e r n a f u s c a Frohl.
Work of larvae in potatoes

Plate 12



Potatoes eaten by white grubs

PLATE 13

**Chrysanthemum midge,** Diarthronomyia hypogaea H. Lw.

Chrysanthemum leaves showing the characteristic oval galls

Plate 13

Chrysanthemum midge galls

PLATE 14

**Nun midge,** Asphondylia monacha O. S.

1 A few galls on the narrow-leaved goldenrod, Solidago graminifolia

2 Bunch of narrow-leaved goldenrod showing numerous galls

Plate 14

1

2

Nun midge galls

PLATE 15

1 Gall of Asphondylia globulus O. S. on Rudbeckia stem
2 Deformed flower head on Rudbeckia produced by the larvae of Asphondylia conspicua O. S. Both from photographs by L. H. Weld

Plate 15

1

2

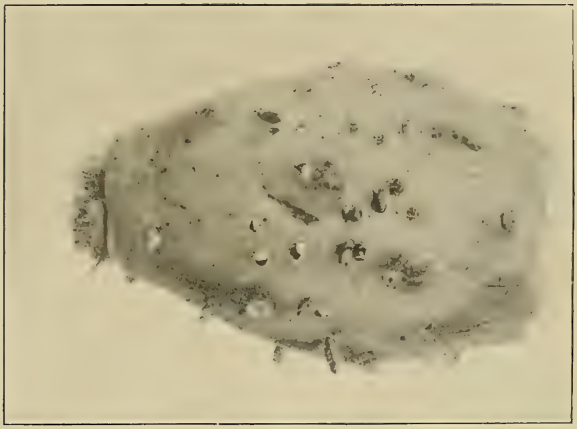
Midge galls

PLATE 16

1 A Cactus lobe showing exuviae of Asphondylia opuntiae Felt, photographed by E. O. Essig

2 Section of lobe of Cactus showing cavities inhabited by Asphondylia opuntiae Felt, photographed by E. O. Essig

Plate 16



1

2

Galls of Asphondylia opuntiae

PLATE 17

1 Clustered bud gall of Schizomyia coryloides Walsh & Riley on grape. From photograph by L. H. Weld

2 Pustulate galls of Cincticornia pustulata Felt on oak From photograph by Miss Cora H. Clarke

1

2

PLATE 18

1 Wing of Asphondylia monacha O. S., female, x 20
2 Wing of Asphondylia monacha O. S., male, x 20
3 Wing of Schizomyia viburni Felt, x 20
4 Wing of Cincticornia transversa Felt, x 20
5 Male genitalia of Asphondylia fulvopedalis Felt, x 260

Plate 18

1

2

3

4

5

Gall midge structures

# INDEX