REPORT

OF THE

STATE ENTOMOLOGIST

1895.

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REPORT.

OFFICE OF THE STATE ENTOMOLOGIST,
ALBANY, *December* 10, 1895.

To the Regents of the University of the State of New York:

GENTLEMEN. — I have the honor of transmitting herewith my Eleventh Report on the Injurious and Other Insects of the State of New York, for the current year, 1895. The Ninth Report, for the year 1892, was published in 1893. The report for the year 1893 was necessarily brief, embracing but 25 pages, and was therefore designated merely as a report for that year and not numbered in the regular series. The Tenth Report of the series for the year 1894 has not been printed at the time that this is submitted.

The work of the department continues to be successfully prosecuted. The insect attacks requiring special investigation have not been as numerous as in some former years, consequently a larger share of attention has been given to a few of our more destructive pests. Among these which have received special study was the "San José Scale" — one of the most injurious scale-insects known to science and which for several years has been exceedingly harmful to the fruit interests on the Pacific Coast. It has recently made its appearance in the Atlantic States, and there was reason to believe that from infested nurseries in New Jersey and New York large distribution had been made of it, through the sale of nursery stock, into other States. The importance of arresting its spread and exterminating it where it had obtained a foothold, was recognized. As it was learned that stock from known infested nurseries had been sent to nearly every county in the State of New York, it was proposed that

with the aid of an appropriation by the State Legislature, examination should be made of every locality, so far as ascertained, which may have received infested stock. The bill introduced in the Senate providing for this work, failed to become a law. Such examinations as have been made during the year, have not brought to light many localities where the scale was found. There is, therefore, reason to hope that this serious fruit-pest will not spread over the entire State, but that it will prove subject to a law which appears to be controlling several of our more injurious insects, whereby their distribution and successful planting is limited to certain life-zones which are based on the aggregate amount of temperature during the year. If it shall prove that the San José Scale can not be permanently established outside of the northern limit of the "Upper Austral life-zone," then its operations in New York will be largely confined to Long Island, the valley of the Hudson River, and portions of Western New York lying upon Lakes Erie and Ontario. An extended Bulletin upon this Scale, giving description and illustration sufficient for its recognition, and the best methods for its destruction, was prepared and published, and copies of it sent to each person known to have made purchases during the past five years from infested nurseries. The Bulletin also contains information upon other pernicious New York scales, important to fruit growers, and it is therefore reproduced in the present Report.

The elm-leaf beetle, *Galerucella luteola* (formerly *Galeruca xanthomelæna)*, was given considerable attention during the months of its presence in Albany, in consideration of its destructiveness in a limited portion of the city, its gradual spread during the past three years, and its unlooked for development of a second brood in midsummer. The operations of this insect wherever it has made its appearance, resulting in the defoliation and, often, death of our most highly prized shade trees — the elms — have excited such a widespread interest in it and a desire to learn of means for its control, that notwithstanding its exceeding destructiveness, a leading State Entomologist has ventured to call

it "a blessing in disguise." In his eyes it has proved a powerful auxiliary in securing attention to the necessity of the study of insect pests and to what is being done for their control; and thus to have advanced the science of economic entomology to an extent that the labors of entomologists, unaided by its presence, could not have attained in years.

At the meeting of the Association of Economic Entomologists held at Springfield, Mass., in August, a half-day was devoted to the consideration of this insect. One of the papers there presented — "On the Elm-leaf Beetle in Albany" — was read in advance of its publication in this report, as was also another, entitled "The Cottonwood Beetle, Lina scripta, in Western New York."

As much time as could be spared from more imperative labors, has been given to the arrangement and classification of the Collection. Its reference to families has been about completed, and progress made in generic and specific determinations. When the additional cases that have been ordered, are secured, it will then be possible to carry on the classification more thoroughly and satisfactorily. So far as record has been kept, 1006 specimens have been mounted from former collections and contributions, 560 labeled with locality and date, and 305 with scientific name.

In my report for 1894, mention is made of work done upon the *Andrenidæ* (the short-tongued bees). The collection now embraces 98 species, 12 of which are unnamed. They have all been submitted to Mr. Charles Robertson, of Carlinville, Ill., who has been making special study of the family. So far as could be done, they have been identified by him, and a number of additional species not in the collection submitted, have been procured from him. The family is numerous in species, 144 species having been listed by Cresson in 1887, and 70 species have since been described by Mr. Robertson.

The other family of the Bees, viz., the *Apidæ*, contains an immense number of species, no less than 517 being named in the Cresson

List. Beyond the studies of Mr. Cresson, to whom we owe the description of more than three-fourths of the above number, very little has been done in our country upon this interesting family. The social members of it (*Bombus*) have not proved attractive subjects for systematic study, owing to difficulty of identifying the three forms under which each species occurs, unless they are collected in their nests, which, from the danger incurred, few care to undertake. The State Collection has but feeble representation in this family, only 76 species being contained in it. A study of the genera of *Bombus* and *Psithyrus*, made by Mr. W. L. Bemis, of the Massachusetts Agricultural College, under the supervision of Professor C. H. Fernald, afforded the opportunity of submitting the examples in those genera for critical study and determination. Nearly all of the about 700 examples in the Collection had been taken in the Adirondack Mountains. Nine species of *Bombus* and three of *Psithyrus* (formerly *Apathus*) were identified among them — six species in their three forms, three in male and female, and three in one form only, viz., *Bombus Ridingsii* in the female and *Psithyrus celatus* and *P. citrinus* in the male. The species occurring the most abundantly were *Bombus vagans* in 262 examples, *B. terricola* in 147 examples, and *B. ternarius* in 101 examples. The rarest apparently was *B. Ridingsii* Cress. in only two examples. *Psithyrus* — generally believed to live parasitically in nests of *Bombus* — while regarded by some as the male of species of *Bombus* — as compared in number with that genus, was as one to thirty-seven. Species of *Bombus* not occurring in the collection but which might have been exepcted in it, were *affinis*, *bimaculatus*, *borealis*, and *consimilis*. Examples of these would be acceptable contributions to the Collection.

Some work has been done in determination of and cataloguing the *Odonata* (Dragon-flies) of the State. A list published by P. P. Calvert, of the Philadelphia Academy of Natural Sciences, an authority in the Odonata, in March, 1895, gave 85 species as known to occur

in the State of New York. In a considerable collection subsequently submitted by me to Mr. Calvert for his examination, four additional species were found. Besides these, there are twelve other species known to me to belong to the State Fauna, making the entire number at present as 101. No special effort for the collection of these insects, so far as known to me, beyond that of Mr. Nathan Banks, upon Long Island and the vicinity, has been made within our State. Whenever done, the present list will undoubtedly be largely increased. The entire number of species credited to Temperate North America, in the Banks Catalogue of 1892 is 254.

The assistant employed by me at the time of my last report, Miss R. L. Davis, resigned her position on July 1st, that, as Mrs. C. P. Lounsbury, she might accompany her husband to the Cape Colony, South Africa, where he had been called to serve as State Entomologist. It was a gratification to our Entomologists that one of their number should be selected for so honorable a position in a British Colony, but it is simply a recognition of the advance that has been made in economic entomology in the United States beyond that of any of the older countries of the world.

Mr. E. P. Felt having been selected to succeed Miss Davis, entered upon his labors as my assistant in September. His previous studies in entomology under Professor Fernald at the Massachusetts Agricultural College and in several of the departments of Zoölogy in a post-graduate course at Cornell University, together with other special qualifications, have, it is believed, eminently fitted him for his work, and valuable aid is expected from his services.

The principal publication of the Entomologist during the year was the "Bulletin of the New York State Museum, (vol. 3, No. 13, April, 1895) — The San José Scale — Insects of the State of New York," (50 pages and seven plates,) which has been previously referred to. The usual list of publications of the Entomologist for the year, together with abstracts of the same, comprising 50 titles is given in the Appendix.

The collections, as in several preceding years, were made mainly in the Adirondack Mountains. Although the season was not favorable for a varied insect life, the collections were quite satisfactory, particularly as a portion of them was made in the month of June—at an earlier date than the region had hitherto been visited by me. About 1,800 specimens were obtained, mounted and labeled with locality and date, and 400 unmounted. Of the former were 212 aquatic insects in Coleoptera, Hemiptera, and Pseudoneuroptera, which were taken from a single small pond which was frequently visited and its bottom explored. A number of these were quite desirable as new to the Collection.

The occurrence during the year of several species of insect pests in unusual abundance gave the opportunity of securing them with very little difficulty. The number gathered and placed in alcohol was, from partial count and estimate, between nine and ten thousand.

A marked feature for the year was the very small number of Lepidoptera that were attracted to light. No one species was common at Keene Valley except the beautiful bombycid, *Arctia virgo* (Linn.). Not one of the orders was represented in its ordinary abundance. Comparatively few of the *Cicindelidæ* were to be found in the localities where they were commonly met with, although the openings to the burrows of their larvæ — "doodle-bugs," as known in Southern States, were not at all uncommon in foot-paths traversed along roadways and in meadows. *Coccinellidæ* were almost entirely wanting. The Diptera were remarkably few. It was seldom that a Bombylid was seen hovering over moist spots in roads, and the search for the *Syrphidæ* on golden rods and other attractive flowers was almost fruitless. It is strange that conditions preventing the usual abundance of insects, particularly in the Diptera, have been so general that even black-flies, the "midge" or "punky" (gray gnat), and mosquitoes, were not, so far as came under my observation, even an approach to their ordinary annoyance.

Contributions have been made to the Department by 86 persons of about 560 specimens. In the record given in the Appendix, whenever it may aid in the knowledge of the life-history and habits of the insect, the date of the sending of the living specimens and their food-plant is stated.

With grateful acknowledgment of the interest taken by your Board in the work of the Department during the year, and the aid extended to it,

Respectfully submitted,

J. A. LINTNER.

INJURIOUS INSECTS.

Monomorium Pharaonis (Linn.).

The Little Red Ant.

(Ord. Hymenoptera: Fam. Myrmicidæ.)

Linnæus: Syst. Nat , Tom. i, pars ii, 1767, p. 963 (described as *Formica Pharaonis*).

Say: in Boston Journ. Nat. Hist., i, 1835, pp. 293-294 (*Myrmica molesta*, description, habits): Comp. Writ., Lec. Edit., ii, 1883, p. 737.

Fitch: in Trans. N. Y. State Agr. Soc. for 1854, 1855, p. 833, 834; same in 1st Rept. Nox.-Ben. Ins. N. Y., 1856, pp. 129–130 (habits in houses, fields); in Trans. N. Y. State Agr. Soc. for 1865, 1866, p. 133, (*Myrmica molesta* on corn, attacking cut-worms).

Packard: Guide Study Ins., 1869, p. 185 (*Myrmica molesta* in houses all over the world); Entomol. for Beginn., 1888, p. 171 (mention).

Riley: 2nd. Mo. Rept., 1870, p. 11 (*Myrmica molesta* troublesome in England, widely distributed); 9th do., 1877, p. 43 (in England); in Scientific Amer., lii, 1885, p. 183 (as small red ant, remedies); in Insect Life, ii, 1889, pp. 106–108, fig. 18 (*Myrmica molesta* a synonym, life-history, remedies).

Bethune: in 11th Ann. Rept. Ent. Soc. Ont. for 1880, 1881, p. 88 (remedies for ants in houses).

Lintner: 1st Rept. Ins. N. Y., 1882, p. 62 (remedies, synonymy), p. 321 (injuring corn); 10th do., 1895, p. 366 (*Monomorium molestum* in walks); in Gardening, iv, 1895, p. 12 (remedies for red ants in houses).

Comstock: in Kingsley's Stand. Nat. Hist., ii, Crust. and Ins., 1884, p. 520 (mention as *Myrmica molesta*).

Bowles: in 15th Ann. Rept. Ent. Soc. Ont., 1885, p. 63 (*Myrmica molesta*, mention).

Hunt: in Miss. Ess. Econom. Ent., 1886, p. 58 (as *Solenopsis molesta*, on corn, etc.).

Cresson: Synopsis Hymenop. Amer., 1887, p. 262.

Bellevoye: in Ann. Soc. Entomol. France, viii, 1888, pp. clxxvii–clxxxi (observation on in France); the same translated and condensed in Insect Life, ii, 1890, pp. 230–233.

Schwarz: in Insect Life, i, 1888, p. 40 (in Florida).

Fernald: Bull. 5 Hatch Expt. Station, Mass., 1889, p. 10 (remedies for ants in houses).

Provancher: Add.–Corr. Faun. Ent. du Canada, ii, 1889, p. 240 (distribution and injuries).

RILEY-HOWARD: in Insect Life, ii, 1890, p. 200 (note on habits); id., v, 1893, p. 268 (edible qualities of); id., vi, 1894, pp. 340–341 (red ants destroying bed-bugs).
WEED, C. M.: Insects and Insecticides, 1891, pp. 275–276, fig. 143 (brief account, with remedies).
COMSTOCKS: Man. Study Ins., 1895, p. 643 (habits, remedies).
MARLATT: in Bull. 4 New Ser., U. S. Dept. Agr., Div. Ent., 1896, p. 38 (destroying bed-bugs), pp. 95–97, fig. 43 (general account).
SMITH: Economic Entomol., 1896, pp. 396–398, fig. 452 (habits, remedies).

This widely distributed insect is known to many a housekeeper as a most persistent inmate of the dwelling. Its presence in all kinds of foods, in dishes, and many other places where it is not wanted, often gives rise to the question: Is there anything that will exterminate red ants in a house?

The Earlier History of the Insect.

This pest is an European insect which was introduced very early in the history of this country, or it is a native form agreeing so closely with the European species that they cannot be separated. In 1767, Linnæus described the European insect under the name of *Formica Pharaonis* and gave as its habitat, Egypt. According to Dr. Packard, this insect is known in houses all over the world. At times it has become so great a pest in London, Liverpool, and Brighton, as to cause the occupants in some instances to vacate their houses.

Say described it in 1835 as *Myrmica molesta*, stating that this is the insect that is frequently found in great numbers in houses. The insect had been known in this country for a long time under the name given by Say: later it was referred to the genus *Monomorium*, and finally the identity of the insect described by Say with the European was established.

Description of the Insect.

The ant is so well known to many housekeepers that a description is not necessary for them: it is the pale reddish-yellow or honey-yellow species commonly found in pantries and similar localities. But for the sake of completeness the description of Say is herewith given:

☿ Body pale honey-yellow, immaculate: antennæ with the two ultimate joints much larger than the others; the terminal one as large again as the penultimate one: wings whitish; smaller cubital cellule none; discoidal cellule very small, less than half as large as the first cubital; first cubital receiving the recurrent nervure near its base; nervure of the radial cellule terminating abruptly before the tip; the two other apical nervures feebly traced towards the tip and not reaching the tip: metathorax unarmed.

Length less than three-twentieths of an inch.

The female is very rarely met with by the ordinary observer and the same is true of the males which are also winged and resemble them in a general way.

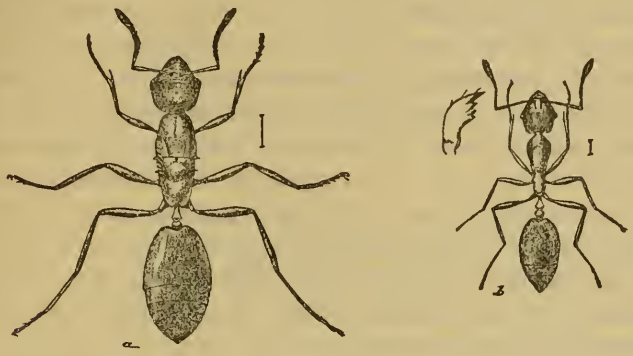

FIG. 1.—The little red ant, MONOMORIUM PHARAONIS; *a*, female; *b*, neuter or worker—enlarged. (After Riley, Insect Life, iii, Divis. Entomol., U. S. Dept. Agr.)

The neuters or workers are by far the most numerous and are the ones commonly seen infesting victuals of all kinds. They are wingless and of a honey-yellow color. The female after she has lost her wings and a neuter are represented in Figure 1.

Habits of the Pest.

It is not so much the loss caused by their devouring food that troubles the housekeeper, as their getting into everything. Few people like to pick them out of food or to eat from plates over which they have been running, or to see them upon the table linen; yet, when abundant it is almost impossible to keep them away. Though not generally known, a large number of these insects in food can impart to it an agreeable acid flavor: such was the experience of a man eating in the dark a section of railroad pie that swarmed with them (*Insect Life*, v, p. 268). The sting of this ant is like a puncture made by a fine needle.

These pests are attracted to almost everything in the house; sweets greases, dead insects, even shoe polish and bath sponges have been reported as attractive to them. They will also damage collections of insects and are pests in breeding cages for insects. They are very persistent in the search for food even when closely covered, and their small size makes it difficult to exclude them. In badly infested houses it has even been found necessary to place the legs of the dining tables in water to keep them out of the food after it had been served. They form their nests in almost any secluded spot either in or just outside of the house,

and from these retreats sally forth. M. Bellevoye failed to observe in France that the ants carry off any food to their nests, but they will do so in this country according to the observations of Dr. Riley. Very little food will maintain a large host of them. According to some interesting observations by M. Bellevoye, a small piece of liver after having two or three thousand ants working at it for a few days did not look damaged, and it was only after a score of days of such treatment that its interior was entirely hollowed out. Freshly killed insects, as cockroaches, also greasy bones and masses of sweets appear to be particularly attractive.

This species is also common in fields and gardens where it sometimes does much injury to corn by gnawing the blades when but a few inches high for the purpose of drinking the sweet exuding juice. Dr. Fitch reports this species so abundant in 1850 in some fields as to threaten the cutting off of every blade of corn.

Although this little ant is such a nuisance in the house, it has at least one redeeming habit; it is an active and efficient enemy of that disgusting household pest, the bed-bug. This habit is so well known in the Southern States that a writer in the *Farmer and Fruit Grower* (Florida) has recommended the introduction of the ants in houses for the purpose of exterminating the bed-bugs. Mr. Marlatt (*loc. cit.*, p. 38) records the following interesting case where the ants proved themselves benefactors to humanity during the late war: Mr. Theo. Pergande, when he was with the Union army, occupied at one time barracks at Meridian, Miss., vacated some time before by the Southern troops and which proved to be swarming with bed-bugs. The little red ants discovered the bugs, invaded the building in large numbers, and in a single day dismembered or carried away bodily every bug.

Life-History.

Each nest of these insects contains several females laying hundreds of eggs each and well attended by workers whose duty it is to care for the eggs and larvæ and also to provide the females with food. It would appear that neuters are produced during most of the summer, as in the case of many ants, and that the winged females and males are not produced until in the autumn. M. Bellevoye failed to obtain any sexed individuals until the last of September and in October, during which time he took 239 males and 577 females (but 14 winged); in November and till December 6th he took 203 wingless females; no other sexed individuals were found, although there were thousands of neuters before that time. The sexed individuals appeared successively and not sim-

ultaneously as in many species, and from his observations he concludes that the males and females continue to live in the same formicary, which increases indefinitely unless broken up. Pairing apparently takes place subterraneously and not in the air, as in many species. As indicating the prolificacy of the insect, it is worthy of note that M. Bellevoye estimates that he killed 359,500 neuters in his apartments within about six weeks' time without apparently diminishing their number; but after continuing this destruction for over five weeks longer, they were observed to be a little less numerous.

Other Species Occurring in Houses.

There is a much larger brownish or black ant sometimes found in houses. It is known as *Camponotus herculaneus* var. *pennsylvanicus*. This species usually comes into dwellings from nests built outside near the house. It overruns the rooms and even gets into clothing and otherwise makes itself disagreeably prominent. It is a very active species, and in one instance related by Riley, it was so annoying that a fine old homestead was on the point of being sold because of the presence of this pest, when the source of the infestation was discovered in a large nest of several feet in diameter in the back yard, and the colony destroyed by treating it with bisulphide of carbon, as given below.

The little black ant (*Monomorium minutum* Mayr) may be found in houses, and at times is as troublesome as the little red ant, though it is not, like the latter, strictly a house species. Another, known as the pavement ant, *Tetramorium cæspitum* (Linn.), is common in Eastern towns under pavements or beneath stones or flagging in yards. In Washington it is often as pestilent a nuisance as the true house ant. Some species of *Lasius* form large colonies in yards and may get into neighboring houses.

Remedies.

If the ants can be traced to their nests, and they are accessible, they can all be killed by making several holes with a stick in the nests and pouring in an ounce or two of bisulphide of carbon. This is the best remedy known, and is a simple one, when the colony is located in the yard or garden. It may be made even more effective if, after pouring in the liquid, the nest is covered with a damp blanket and after a few moments the poisonous vapor is exploded The explosion drives the fumes deeper into the nest and more quickly reaches the inmates. Care should be taken in exploding the dangerous vapor. The torch may be

applied on the end of a pole. This remedy is of special value against the large black ant.

If the nest is located in a wall or other place where the carbon bisulphide cannot be employed, and there is no objection to the odor of kerosene for a time, the location of the nest might be soaked with a strong kerosene emulsion. If thoroughly done it would in all probability kill all the insects — egg, larva, pupa and imago. It surely would drive them away after several applications if not at the very first. Hot water has also been recommended for these pests.

The little red ants often establish their nests in the walls or the foundations of buildings, and then the preceding remedies cannot be employed. Various baits may be effectively used. It is stated, on good authority, that maple syrup with some London purple that was mixed in a low dish and exposed in a frequented closet, not only killed large numbers but prevented the recurrence of the pest for a long time thereafter. In a newspaper article before me the following is recommended: One spoonful of tartar emetic and one spoonful of sugar mixed into a thin syrup; it relieved the house at once from their presence. An old and popular remedy is dipping a sponge in sweetened water and placing it in their haunts; when they collect therein the sponge may be dropped into hot water. A greasy bone may be used in a similar manner. A few repetitions of any of these baitings is usually all that is necessary; the intelligence of danger or disaster seems to be rapidly communicated from one to another, and safer quarters are sought by the colony.

If their entrance to the house can be discovered, kerosene, or other repellants as carbolic acid or napthaline, placed in their path will keep them out. Ants are quite susceptible to pyrethrum powder and that could be used where the presence of food did not prohibit. A mixture of borax and sugar, well stirred with boiling water and left here and there on bits of crockery, has been recommended.

A broad chalk-line is an effectual barrier for many species of ants, especially if frequently renewed, by the aid of which preserve jars or special shelves in closets may be protected. This means would be of value for keeping ants from tables and other places where they must climb vertical walls in order to reach the desired position. Placing the legs of tables in shallow vessels of water is also another protection from these pests — the more effective if a thin film of kerosene is floated on the water.

Ants in a Lawn.*

(Ord. HYMENOPTERA: Fam. FORMICIDÆ.)

In the preceding Report of the Series (Tenth), "Ants on Fruit Trees," have been treated of. Relief is now asked from the operations of ants which infest a lawn in Queens county, Long Island, as stated in the following communication:

A friend of mine on the south side of Long Island has a beautiful lawn of several acres which a few years ago was a dense woods. This lawn during the summer is alive with ants, which in a measure destroy its beauty and are very annoying to the owner. What can be done to get rid of them? He does not want to plow it up unless absolutely necessary. Would fertilizer, plaster or lime of any kind used now or in the early spring be of any use? F. F. East Williston, N. Y.

About 200 species of ants are known in the United States, and in this large number, as might well be supposed, there is great diversity in habits. Nearly all of them live in the ground, and comparatively few are to be classed as injurious. But even without being positively injurious, they may, when numerous, become annoying from their biting—in some species stinging, when they get upon the person, or in throwing up unsightly heaps of the soil that they infest.

The best method, or even an effectual one, for ridding the lawn of the ants with which it "is alive during the summer," cannot be given without a knowledge of the species of ant of which complaint is made. It is not improbable that the dense woods that a few years ago occupied the place of the present lawn, may have contained a few colonies of the mound-building ant, *Formica rufa*, sometimes known as "the fallow ant," which throws up from the soil beneath, through the labors of its immense colonies, mounds of a foot or two in height and several feet in diameter. These mounds are abundant in some portions of the Alleghanies in Pennsylvania. We have seen them in the Catskills and in the Shawangunk range at Lake Mohonk, but while the species is common over a large portion of our country (also in Europe), we do not know that its habit of constructing these large mounds, is co-extensive with its distribution.

In the transformation of a wood into a lawn, the large colonies would naturally be broken up, and the subsequent care of the ground would tend to their distribution into smaller colonies, in which the original feet dimensions might be reduced to inches.

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* Published in the *Country Gentleman* for January 3, 1895.

If such "nests" are to be found upon the lawn, easily to be detected by the scant herbage mingled with the excavated pellets of the soil, or if more obscure, to be discovered by following the traveling ants to their homes, then it will be but a simple matter to break up the nests and destroy their inmates. With a cane or broom-handle or other round stick make a hole (if a large nest, two or three holes) to the depth of a few inches, and pour in a tablespoonful of bisulphide of carbon, filling up the hole thereafter with earth. The volatile vapor will permeate the nest and quickly kill all of its occupants.

If no such nests of large colonies can be found, and the distribution of the ants seems to be general over the lawn, without, so far as can be seen, any special biding places, then we would advise that on some bright sunny day in spring, when the lawn is seen to be "alive" with the ants, the entire surface be sprayed with a strong kerosene emulsion. This should kill all with which it comes in contact. A repetition of this a few times ought certainly to free the lawn of its hosts of unwelcome guests.

As to the merits of lime or fertilizers in destroying ants: It is probable that freshly slacked lime liberally applied to the ground in the early spring before it could injure the young grass by its causticity, would reach and kill such of the eggs and larvæ and perhaps some of the workers, as are not too deeply buried in the ground. Perhaps kainit would prove, in this connection, a still more efficient insecticide, as the experiments of the New Jersey State Entomologist, Prof. J. B. Smith, have shown it to be effective in killing wire-worms which we are accustomed to regard as unusually tenacious of life.

As the reported abundance of ants upon this Long Island lawn appears to be an extraordinary one, it would be of interest and perhaps of service if specimens of the ants were sent to us for identification. They would be found in three (or four) forms, viz., winged males and females, and wingless workers. These last (in two sizes?) should occur at any time after the month of March and until severe cold weather sets in, while the males and females would rarely be seen except when, with common impulse, they leave their nests simultaneously, some time about the first of September, for their nuptial flight and final abandonment of their home, the females to found new colonies and the males soon to die.

On Arsenical Spraying of Fruit Trees while in Blossom.

(Read before the Association of Economic Entomologists at its Fifth Annual meeting, at Madison, Wis., August 16, 1893.)*

Are Honey-Bees Killed by Arsenical Spraying?

The long-mooted question, are honey-bees poisoned by arsenical spraying, is still an unsettled one. There are those who claim that a great mortality among bees is the result of their visiting blossoms that have been sprayed with Paris green, while others hold that the mortality so frequently observed at this time is ascribable to other causes, and that the arsenic would not reach the nectar of blossoms, and, being an insoluble substance, could not affect the bees or be communicated to the honey. This latter view has been entertained by some of our best botanists. The pollen, however, might contain arsenic and thus become poisonous, not only to the bees visiting the blossoms, but also to the nearly-matured, chyme-fed larvæ to whom it might be conveyed.

Experiments by Professor Webster.

In behalf of a committee appointed by the Association of Economic Entomologists to investigate the matter, Prof. F. M. Webster, of the Agricultural Experiment Station of Ohio, chairman of the committee, has recently reported progress in the investigations undertaken, to the following effect: He had experimented with a hive of bees placed underneath a sprayed plum tree wholly inclosed with a fine netting. Within two days thereafter a large number of dead bees were taken up from the cloth with which the ground had been covered. Without much doubt, most of these had been killed in their efforts to escape from their confinement. Examination of the bodies of the dead insects before washing and after they had been washed to remove any arsenic that had been attached to their surface from contact with the sprayed blossoms, gave the examining chemist the presence of arsenic. In another experiment made, hives of bees were placed under sprayed trees, but without any inclosing net. These also gave dead bees with arsenic upon them, but in much smaller number.†

*Published in *Insect Life*, December, vi, 1893, pp. 181-185.

† It is possible that these bees may have been caught and killed by some of the predaceous insects which are known to lie in wait among or near blossoms, whence they suddenly seize the bees and suck out their juices, such as the bee-slayer, *Phymata erosa* and several of the "robber flies" or Asilidæ, of which Prof. A. J. Cook records six species having this habit.

The Experiments not Conclusive.

The experiments were not deemed conclusive by Prof. Webster, and it is intended to continue them another year.

That the bodies of crushed bees that had visited blossoms sprayed with arsenic should disclose to chemical tests the presence of arsenic is not at all strange. Even an ammoniacal bath could not have removed every trace of arsenic from the surface of their bodies.

Experiments of Professor Cook.

Prof. A. J. Cook, the distinguished apiarist of the Michigan State Agricultural College, makes the positive assertion that honey bees are killed in large numbers through the arsenical spraying of fruit trees in blossom, but he has not proven the assertion. Experiments instituted by him in which bees fed on sweetened water poisoned by arsenic — 1 pound to 200 gallons — were killed, are claimed by him as decisive upon the question under consideration. How entirely unwarranted the conclusion. The experiment had no bearing upon the question at issue. No one could have doubted that imbibing strongly poisoned syrup would be fatal to honey bees. Furthermore, in his experiment (see *Report of the Michigan Board of Agriculture* for 1891) the bees were fed in his laboratory, within a small cage. Bees are known to die very soon in confinement, even without an arsenical diet (Howard, in *Insect Life*, vol. v, 1892, p. 123).

Examinations that would be Satisfactory.

A simple method can be resorted to by which the question could be definitely and effectually settled. It is this: Confine a hive of healthy bees to blossoms sprayed with Paris green, and when death speedily follows, have examination of their stomachs made by experts testing for arsenic. If it is found therein, then it may be accepted as the cause of their death. Examination of stomachs of bees collected promiscuously would not be satisfactory, for a statement was made at a recent bee-keepers' convention in Albany that honey bees had been seen eagerly feeding on the liquid resting on the leaves of a potato patch soon after it had been arsenically sprayed, and it was thought to have caused the death of many bees.

Up to the present, so far as I know, no examination such as above suggested has been made. I hope that Prof. Webster will undertake it, in the progress of his experiments the coming season.

Legislation Against Arsenical Spraying.

Prof. Cook desires that "everyone of the United States should pass a law making it a misdemeanor to spray fruit trees while in blossom." I do not know that this, although urged in some of the States, has been done in any. Such a law was passed by the Ontario legislature, in April, 1890. It provides:

SEC. 1. No person in spraying or sprinkling fruit trees during the period within which such trees are in full bloom shall use or cause to be used any mixture containing Paris green or any other poisonous substance injurious to bees.

§ 2. Any person contravening the provisions of this Act, shall on summary conviction thereof before a justice of the peace, be subject to a penalty of not less than $1.00 or more than $5.00, with or without costs of prosecution, * * * * * .

That the above law is calculated to protect the interests of both the fruit grower and honey producer, is the opinion of Prof. J. H. Panton, of the Ontario Agricultural College, as given in Bulletin LXXXI, of the college, issued in November, 1892. He remarks:

"Although there has been no analysis of the bodies of the dead bees for the purpose of ascertaining the presence of arsenic, still the death of the bees is so intimately associated with spraying that there seems but little reason to believe otherwise than that the bees have been poisoned by Paris green used in spraying. However, this will likely soon be settled by analysis of the bodies of bees suspected to have been poisoned, and I have no doubt arsenic will be detected."

May Blossoms be Blighted by Arsenical Spraying?

There is another important question connected with the arsenical spraying of blossoms, viz., this: May not the arsenic blight the blossom and prevent fruit development? "The portion of the pistil," says Prof. Panton, "upon which the pollen falls is exceedingly tender and sensitive, so much so that the application of such substances as Paris green injures it to so great an extent that the process of fertilization is affected and the development of fruit checked." No experiments known to me have been made upon the effect of arsenical spraying on fruit blossoms. That its effect would be to destroy the blossoms is quite probable. Thus, Mr. James Fletcher has suggested the spraying of the blossoms of pear trees infested with the Pear Midge (*Diplosis pyrivora* Riley) as a remedy for annual attacks of the insect by depriving it of the food (within the young fruit) needed for its development.

There are, then, before the economic entomologist and the fruit-grower at the present time these two questions relating to spraying with the arsenites during the blossoming of fruit trees: First, will the poison kill the bees, destroy the young brood and affect the honey? Second, will it blight the blossoms? It would not be a difficult task for an experiment station, and it is specially within the province of the stations, to set these questions at rest and no longer leave them subject to crude observations or individual opinions. Until this shall be done, there should be an entire cessation from arsenical spraying of fruit trees while in blossom, without the enactment of laws which now seem premature and may prove to be not needed; and even if seeming to be needed, are still fraught with evil, from the general disregard with which such laws are treated.

Spraying Indispensible to the Fruit-Grower.

It is unnecessary to say that there should be no restriction of the kind, either optional or compulsory, unless it is shown to be absolutely required. The arsenical spraying of fruit trees has already come to be regarded as almost indispensable to the successful fruit-grower, and day by day its importance is being more fully and widely realized. No longer limited to the control of Codling Moth injury, it is being rapidly extended to other insect attacks. For each week of early spring, I have no doubt but that a calendar could be made wherein each day would stand for the incipiency of attack by some insect pest or fungus disease, to be combatted in no better way than by arsenical or copper solutions sprayings. What opportunities may therefore be lost for arresting and defeating attack at the most favorable time, and possibly at its only vulnerable stage, if two or three weeks' armistice is accorded to our enemies, during which time the army is recruited a hundred-fold, the infant becomes a veteran, mines are run, pits are dug, tents are built, covered ways are constructed, insidious mycelium threads are permeating leaf and twig, and in many other of the arts of warfare our wily foes, with their rich inheritance of surprising means for self-protection, have planted themselves in strongholds where an entire park of spraying pumps with their baneful poisons will utterly fail of reaching and destroying them. Far better a cessation of hostilities for any six weeks later in the season than for three in early spring.

Apple Pests to be Combated during the Blossoming Period.

It has been stated and reiterated many times that the Codling Moth is the only insect against which we need to employ the arsenites in early spring, but this is far from the truth. It is conceded that we can not

destroy the Apple worm until after the fruit is set and the eggs deposited thereon, but of the two hundred and eighty known species of insect depredators on the Apple* (not referring to those infesting other fruits) it would be strange indeed if there were no others which are specially vulnerable before the setting of the fruit. Let me name a few of those that could be reached at this time.

The well-known Apple-tree Tent-caterpillar of *Clisiocampa Americana* Harris, attacks the bursting buds and the young leaves.

The caterpillars of the White-marked Tussock-moth (*Orgyia leucostigma*, Sm.-Abb.) hatch from the eggs about the middle of May and commence their destructive work.

Among the cut-worms there are a number of climbing species, four of which have been identified, viz., *Agrotis clandestina* Harris, *A. scandens* Riley, *A. messoria* Harris, and *A. saucia* (Hübn.), which are known to ascend apple and other fruit trees to feed upon the blossom and leaf-buds and the tender leaves. The odd-looking caterpillar of *Catocala grynea* (Cramer), feeds on the foliage of the apple in May, and those of *Catocala ultronia* (Hübner) are often shaken from plum trees when jarring them for the curculio.

The Canker Worm (*Anisopteryx vernata*, Peck) usually appears as the young leaves are pushing from the bud.

The White Eugonia (*Ennomos subsignaria*, Hübn.), one of the family of measuring worms, occasionally appears in injurious numbers about the 1st of May.

The Oblique-banded Leaf-roller of *Cacœcia rosaceana* (Harris), spins together the young leaves for its shelter.

The Lesser Apple-leaf Folder (*Teras minuta*, Rob.) attacks the opening foliage and folds the leaves for its retreat.

The Leaf-crumpler (*Mineola indiginella*, Zeller), awakening from its winter's sleep and drawing some of the unfolding leaves together, resumes its feeding.

The destructive Eye-spotted Bud-moth (*Tmetocera ocellana*, Schiff.), so injurious in western New York,—after its larval hibernation in its half-grown state, makes its formidable attack, first on the buds and afterward on the leaves.

The Apple Bud-worm (*Eccopsis malana* Fernald) creeps at night from its retreat and after having consumed the terminal buds feeds upon the leaves.

*Three hundred and fifty-six species are named in the present Report.

The Apple-tree Case-bearer (*Coleophora malivorella*, Riley) emerges from its peculiar pistol-shaped case in which it has passed the winter, to eat the buds as soon as they begin to swell, and afterward to skeletonize the leaves.

The Plum Curculio (*Conotrachelus nenuphar*, Herbst) enters upon the scene at least two weeks before its first crescent cuts are made in the fruit, ready and free to devote all its energies to obtaining the supply of food needed for the development of its eggs and for the labors attending its complicated and painstaking method of oviposition.

Seventeen species of insects are named above, each one of which is feeding voraciously during the blossoming of our fruit trees. Possibly as many more could be added to the list, all of which could best be destroyed by arsenical spraying.

Respective Interests of the Apiarist and Fruit-Grower.

It is therefore respectfully submitted whether there should be the intermission of spraying as proposed, urged, and sought to be made compulsory through legislation, until it shall appear beyond all controversy that the interests of the apiarist and the fruit-grower, each carefully considered and perhaps weighed one against the other, really demand it.

NOTE. — Since the preparation of the above paper, Prof. Webster, as the result of later and carefully conducted experiments,* has been able to adduce positive proof that honey bees are injured by feeding on blossoms that have been sprayed with the arsenites. In the first experiment, a Lombard plum tree in full bloom was sprayed April 29, 1892, with Paris green and water (four ounces to fifty gallons) until wet thoroughly without dripping. The tree was covered down to the lower branches with thin brown sheeting, the lower portion being inclosed with mosquito netting, and the ground covered with the same material. The hive of bees, which had been kept for the preceding two weeks, was placed under the tree within the coverings in the evening after the spraying. The following afternoon there was a large number of dead and dying bees on the cloth when the cover was removed, and several hundred bees were gathered from the cloth on the ground. These dead bees were tested for arsenic in several lots: First, as they were; second, after a thorough washing to remove arsenic which might have become attached to their bodies; third, after washing as before, the abdomens only; fourth, the remainder of the bodies less the wings; fifth, the rest of the dead bees were thrown out, exposed to a severe thunder shower, again col-

* Spraying with Arsenites vs. Bees. Bull. 68 *Ohio Agr. Expt. Stat.*, 1896, pp. 48–53.

lected, then washed with water and with a weak solution of ammonia. In each case the presence of arsenic was detected.

In the next experiment, six apple trees were sprayed May 4th with the same solution as in the preceding experiment, and sheets twenty-four feet square were placed under them, and on the sheets two hives of bees. In the next week fifty-six dead bees were found under the trees and in the vicinity of the hives. Analysis of some of these showed traces of arsenic. During this experiment the climatic conditions were, as a rule, unfavorable to the full activity of the bees. It thus appears that when the weather is unfavorable for honey-gathering the bees do not suffer much, even though there be not enough rain to wash all the poison off the leaves.

In the next successful experiment, two apple trees in full bloom were thoroughly sprayed with Paris green — one ounce to twelve gallons of water. The application was made in the morning of a clear, warm day, and in the afternoon a number of bees were caught while visiting the bloom and marked with carmine ink. The hives were but a few yards from the trees. None of the marked bees were afterward found dead about the hives. On the following day bees were caught in an ordinary cyanide bottle, dissected at once and analyzed. No arsenic was found associated with the posterior legs or the pollen with which they were loaded, but it was found present in the contents of the abdomens, including the honey sacs. Entire bodies, after repeated external washings, gave the test for arsenic. The experiment was repeated upon a crab apple tree, and in this case the contents of the abdomen showed the presence of arsenic. The other parts of the body were not tested.

About May 10th a small apple orchard on the Experiment Station farm was sprayed with the Bordeaux mixture, to which had been added Paris green, — four ounces to fifty gallons of the mixture. Three apparently healthy colonies of bees had recently been brought on the premises, and, although the bloom had nearly all fallen from the trees, one colony suddenly became extinct and a second greatly reduced in numbers, dead bees being abundant about both hives. Arsenic was found in the abdomens of the dead bees and in the dead brood of the extinct hive; none was found in the honey from uncapped cells, which might and probably did contain last year's honey that was being used for a partial food-supply by the bees.

"Briefly recapitulated, arsenic was found in the contents of the abdomens of bees frequenting recently sprayed blossoms, and we are at least free to assume that more or less of it was contained in the honey sacs.

The dead bees, three times washed in ammonia water, the latter not revealing the presence of the arsenic externally, when tested showed its presence internally. Brood from uncapped cells (larvæ) of a colony suddenly dying without other apparent cause gave evidence of having died from the effect of arsenic which could have been introduced only from without.

"In summing up the matter, then, I can see no other conclusion that can be drawn from the results of my experiments than that bees are liable to be poisoned by spraying the bloom of fruit trees, the liability increasing in proportion as the weather is favorable for the activity of the bees, and that all bloom must have fallen from the trees before the danger will have ceased."

On the Girdling of Elm Twigs by the Larvæ of Orgyia leucostigma, and its Results.

(Read before the American Association for the Advancement of Science at its Springfield meeting, September 3, 1895.)*

The white-marked tussock moth, *Orgyia leucostigma*, has for a long term of years been exceedingly destructive to the foliage of the elms, horse-chestnut and fruit trees in Albany. Fruit trees of considerable size have been killed by their defoliation in a few days, toward the maturity of the caterpillar. Large elms and horse-chestnuts have had the foliage entirely consumed, only the ribs and principal veins remaining.

In the summer of 1883, a new form of attack by this insect was observed by me in Albany. About the middle of June of that year, the sidewalks, streets and public parks where the white elm, *Ulmus Americana*, was growing, were seen to be thickly strewn with the tips of elms two to three inches in length, bearing from four to ten fresh leaves, and comprising nearly all of the new growth of the season. On examination it was found that above the point where the tips had been broken off, the bark had been removed for an extent averaging about one-tenth of an inch, apparently by an insect.

As the Orgyia larvæ were then occurring in abundance on the trees they were suspected of being the authors of this injury, and the suspicion was verified by ascending to a house-top, where the roof was found to be heaped in the corners with the severed tips, and the caterpillars engaged upon the branches in the girdling. The explanation of the breaking-off

* Published in the *American Naturalist*, xxx, January, 1896, pp. 74, 75.

was simple. With the removal of the bark, the decorticated portion — not exceeding in many instances in thickness the diameter of a large pin — dried, and becoming brittle, was readily broken off by a moderate swaying of the wind.

The girdling of the twigs in this manner could serve the Orgyia no such purpose as attends the girdling of several other insects, as the *Elaphidion* pruners of oaks and maples, where it enables the insect to attain greater security for its transformations through this method of reaching the ground, or the *Oncideres* twig-girdler, where the dead wood affords suitable food for the larvæ. Probably the conditions of growth during the spring of this year were such as to render the young bark, at the point attacked, particularly attractive to the larvæ; but why, after feeding upon it to so limited an extent, it should cease and resume its feeding on the leaves, cannot be explained. In a few instances where the twigs had become detached quite near the node marking the commencement of the year's growth, the bark had been irregularly eaten for an inch or more in extent.

While the Orgyia is a serious pest in Albany, it has its years of remarkable abundance, and of comparative scarcity. Girdled tips, as above described, have been seen each year since 1883, but by no means corresponding in number to the degree of abundance of the caterpillar. My attention had not been drawn to them the present year, until much later than the usual time — toward the end of August. At this time (21st of August) many tips of unusual length and with perfectly fresh leaves were collected from beneath a large American elm. Each one had broken at the base of the girdling, which had probably been quite near the node of the year's growth. They were of especial interest from their great length, varying from 10 to 18 inches. From the growth they had attained, it was evident that the girdling had not been done in the spring or early summer, but in the late summer after the usual brood had completed its transformations. It was clearly the work of a second brood of the insect, and this was confirmed by my having seen a few days previously from a house-top, while making observations on the elm-leaf beetle, the Orgyia larva about one-half grown.

A distinct second brood of the Orgyia has not been recorded in Albany, although it is known to be double-brooded in Washington and Philadelphia and probably in Brooklyn, and has also been observed in Boston. The present year, however, has been an exceptional one in the remarkable abundance, the rapid development and the injuriousness of several of our more common insect pests.

Another interesting feature connected with these tips was the illustration they gave of the manner in which woody structure is built up—the sap ascending through the sap wood, and after its assimilation in the leaves, returning through the inner bark and depositing its organized material. The bark above the girdling in healing in a rough and irregular manner, had swollen out at this point in a bulbous-like enlargement, showing very clearly the arrest and deposit of the returning sap consequent on the absence of its natural channels, and the drying and the death of the decorticated wood below it. In a specimen gathered in which the node of the preceding year remained attached to the fallen twig, the diameter of the new growth above the bulb was at least twice that of the starved node below.*

This peculiar form of Orgyia attack has not been seen upon the horse-chestnut, maple, apple or plum, or on any of its other food-plants.

Eudioptis nitidalis (Cramer).

The Pickle Caterpillar.

(Order LEPIDOPTERA: Family PYRAUSTIDÆ.)

Phalæna nitidalis. CRAMER: Pap. Exot. trois part. du monde, iv, 1782, "371 F."

Phalæna nitidalis. FABRICIUS: Ent. Syst., Tom. iii, pars II, 1794, p. 228 (habitat Austria).

Phakellura nitidalis. GUENÉE: Hist. Nat. Ins.—Lepidop., 1854, viii, p. 299 (descr., food-plants, and distribution).

Phakellura nitidalis. WALSH-RILEY: in Amer. Ent., ii, 1869, p. 31 (injuring cucumbers at Alton, Ill., and Peverly, Mo.), do. p. 61 (at St. Joseph, Mich.).

Phacellura nitidalis. RILEY: 2nd. Rept. Ins. Mo., 1870, pp. 64–70, fig. 43 (larva described, natural history, distribution).

Phakellura nitidalis. GLOVER: in Rept. U. S. Comm. Agr. for 1870, p. 84, fig. 47 (injuring squash in Fla., and cucumbers in Mo.).

Phacellura nitidalis. SNOW: in Trans. Kans. Acad. Sci., iv, 1875, p. 56 (injures cucumbers); in Observer of Nature, iii, no. 5, 1876, p. 4 (not common in Kans.).

Phacellura nitidalis. PACKARD: in Hayden's 9th Rept. G.-G. Surv. Terr., 1877, p. 772, fig. 41 (brief account after Riley).

Phacellura nitidalis. FRENCH: in Trans. Ill. State Hort. Soc. for 1877, 1878, pp. 199–200; in 7th Rept. Ins. Ill., 1878, pp. 251–252 (brief notice).

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*This bulbous enlargement is illustrated in figure 15 of the *Second Report on the Insects of New York*, 1885.

Phakellura nitidalis. COMSTOCK: in Rept. U. S. Comm. Agr. for 1879, p. 219 (reference).
Eudioptis nitidalis. GROTE: New Check List of N. Amer. Moths, 1882, p. 54, no. 160.
Phacellura nitidalis. COOKE: Ins. Inj. Orch.-Vin., 1883, pp. 304–305, fig. 301 (general account).
Eudioptis nitidalis. SAUNDERS: Ins. Inj. Fruits, 1883, 1889, pp. 367–368, figs. 378, 379 (habits, remedies, brief).
Phacellura nitidalis. EDGE: in Rept. Penn. State Bd. Agr. for 1883, 1884, pp. 65–66, figs. 3, 4 on pl. (brief notice).
Eudioptis nitidalis. FERNALD: in Kingsley's Stand. Nat. Hist., ii, Crust. and Ins., 1884, p. 444, fig. 564 (reference).
Phakellura nitidalis. LINTNER: in Country Gent., l, 1885, p. 607 (from Tenn.; general notice); in do. li, 1886, p. 733 (from Va.); 3rd Rep. Ins. N. Y., 1886, pp. 140, 141 (reference); 5th do., 1889, p. 320 (reference); in Country Gent., lix, 1894, p. 721 (from North and South Carolina); 10th Rept. Ins. N. Y. for 1894, 1895, p. 503 (reference).
Eudioptis nitidalis. ASHMEAD: in Bull. 14 U. S. Dept. Agr., Div. Ent., 1887, p. 24 (lists, food-plants, etc.).
Eudioptis nitidalis. EDWARDS: Bull. 35 U. S. Nat. Mus., 1889, pp. 111–112 (bibliography of transformations).
Eudioptis nitidalis. CAMPBELL: in Bull. 3 Ga. Agr. Expt. Stat., 1889, pp. 46–47 (habits, remedies).
Margaronia nitidalis. SMITH: List Lepidop. Bor. Amer., 1891, p. 75, no. 3975 (listed); Econom. Entomol., 1896, p. 311, fig. 354 (mention).
Eudioptis nitidalis. MOFFAT: in Canad. Entomol., xxiv, 1892, p. 132 (taken in Can. by Mr. Hill).
Eudioptis nitidalis. HOPKINS-RUMSEY: Bull. 44 W. Va. Agr. Expt. Stat., 1896, pp. 300, 317 (brief notice and remedies).
Margaronia nitidalis. QUAINTANCE: Bull. 34 Fla. Agr. Expt. Stat., 1896, pp. 292–293 (brief notice as squash borer).

Specimens of a caterpillar were communicated in September, 1894, by a correspondent of the *Country Gentleman* from Pendleton, S. C., which had been very injurious to his crop of muskmelons. One of the two examples gave out soon after its reception the beautiful moth, *Eudioptis nitidalis*, a well known pest of cucumbers and melons in the Western States where the larva is commonly known as "the pickle worm." This name was given it by Prof. Riley, from its having been found quite frequently in pickled cucumbers, as related in the extended account of the insect contained in his *Second Report on the Insects of Missouri.* In the Southern States it is more commonly found attacking melons.

The Pendleton, S. C., correspondent writes as follows of the insect, its boring operations and losses caused by it:

Enclosed find a smaller and a larger worm or borer that has upon an average destroyed eight-tenths of our cantaloupe crop for the last three

years. Early in the first crop I have found a small white worm about as large as a small hair-pin and perhaps half an inch long boring in from the underside of the melon which destroys the melon, to the extent of nine-tenths of the crop, but this small white worm disappears during the first dry hot weather and the small semi-transparent spotted worm [*E. nitidalis*] attacks the melons on the shaded sides, tops or bottom. This spotted worm grows rapidly into a much larger one of a light green color with scarcely a trace of the spots on the smaller one. Whether the very small worm is the same as the one that bores later on and grows to a larger green worm, 1½ inch or more in length, I do not know. Can you suggest a remedy? I have applied salt under the early crop that kills this small white worm but does not appear to hinder the larger green one. To give an idea of the destruction this little pest causes, the two worms sent were cut out of a cantaloupe that weighs 34½ lbs. that would bring in our market 50 cts. each. But for these destructive worms we could reap large crops of this melon, and it pays even now to grow them.

Pendleton, S. C. J. C. S.

Resemblance of the Larva to Another Species.

As the moth was obtained from only one of the two caterpillars submitted for examination, it is not possible to say if they were both of the same species, or if one may not have been of the closely allied species, *Eudioptis hyalinata*, to be noticed in subsequent pages. Judging from the published descriptions, and in consideration of the different features, especially colorational, that they present at different stages of growth, it seems hardly possible to distinguish between them, except with examples of the two in hand, from the same food-plant, and at the same degree of development. Several writers have remarked upon their liability to variation in color, dependent upon their food-plant. This uncertainty is unfortunate, for they are both quite destructive to several of the Cucurbitaceæ — cucumbers, melons, and occasionally to pumpkins and squashes — and reliable recommendations of methods for arresting their ravages must of necessity be based upon a knowledge of the entire life-history of the insect, or at least that of the larval stage. For example, it is important to know definitely if there is but one brood of each or more. If the latter, are the habits different in the successive broods? Does the first brood attack the foliage and the second the fruit? When and where are the eggs deposited? Do the species occur simultaneously in the same field?

A careful study of the larvæ and carrying them to their winged stage is a present desideratum. While a child could readily distinguish between the moths of the two, so markedly distinct are they in their appearance, it is doubtful if any entomologist could from his knowledge identify, beyond question, a collection of South Carolina Eudioptis caterpillars, in different ages, submitted to him.

Description of E. nitidalis Larva.

Professor Riley has given in his 2nd Mo. Report (*loc. cit.*) a careful description and drawing of the pickle-worm, which for convenient reference we quote, together with the appended description of an earlier stage by Walsh. His figure, in which the moth is also represented, is herewith reproduced:

One of the worms is represented in the figure 2 in natural size. They vary much in appearance, some being of a yellowish-white, and very much resembling the inside of an unripe melon, while others are tinged more or less with green. They are all quite soft and translucent, and there is a transverse row of eight shiny, slightly elevated spots on each segment, and an additional two behind the others on the back. (See Fig. 2, *c*.) Along the back and toward the head, these spots are larger than at the sides, and each spot gives rise to a fine hair. The specimen from which I obtained my first moth last summer was very light colored, and these spots were so nearly the color of the body as to be scarcely visible. The head was honey-yellow bordered with a brown line and with three black confluent spots at the palpi.

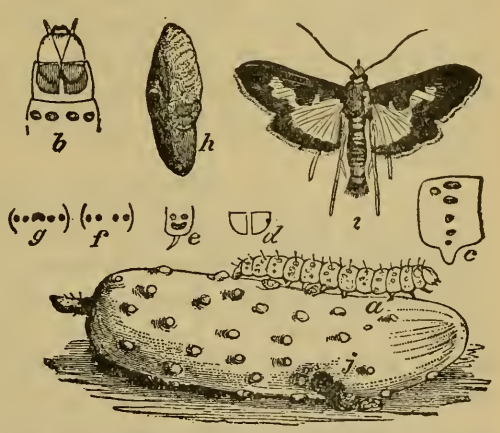

FIG. 2. The pickle-caterpillar and cucumber moth, EUDIOPTIS NITIDALIS. (From Riley.)

The cervical shield or horny plate on the first segment was of the same color as the body, and so transparent that the brown border of the head when retracted shone distinctly through it as at Figure 2, *b*. The breathing-holes or stigmata are small, oval, and of the same color as the body, with a fulvous ring around them. In some of the young worms the shiny spots are quite black and conspicuous. My late associate, Mr. Walsh, communicated to me the following description of such a marked specimen, from which he bred the very same species of moth as from the paler individuals. The description was taken when the worm was but half-grown.

Length ½ inch. Color pale greenish-yellow; 16 legs. Head pale rufous, the Y-shaped sutures and the mouth black. Cervical shield as in Figure 2 , *d*, each half edged with black, center rufous. Marked under shield as at *e*, and the same lateral markings on joints 2 and 3. Above on joints 2 and 3 as at *f*. On joints 4–11, eight (including 2 lateral) spots transversely arranged, and behind these, two dorsal spots. Of the eight spots the two lateral ones on each side are substigmatal. Stigmata edged with dusky. Anal joint with five spots as in *g*, the middle one

large and transverse. Body with some sparse long dusky hairs, 6–8 times as long as wide, a little tapered toward the head. Spins a thread. Legs and prolegs nearly immaculate.

It is probably the same larva that has been described by a correspondent as of "a light yellowish-green color, nearly translucent, with a few scattered hairs, and when mature, about an inch and a quarter long." Another, writing of the same insect, characterizes it as follows: "When from one-fourth to one-half an inch long, they are of a whitish color, dotted transversely with blackish spots, and the head of a dull brownish, color. When grown to a little less than an inch, their color changes — in white-meated melons to a light green, in yellow-fleshed varieties to a darker green, and spots giving way to lines of more or less intense green color. The head is armed with stout jaws, and becomes more or less dark brown.

Description of the Moth.

Where the insect is prevalent it is important that the appearance of the moth should be known, so that when they are frequenting the melon and cucumber fields for the purpose of depositing their eggs, they may be captured in nets and destroyed. It is probable, that after the habit of most of the family (*Pyraustidæ*) to which it belongs, that its flight commences at about sunset, but that it is readily driven up from repose on the lower surface of leaves at any hour of the day. The figure above given, in connection with the following description by Riley will render it easily recognizable:

It is of a yellowish-brown color, with an iris-purple reflection, the front wings having an irregular, semi-transparent, dull golden-yellow spot, not reaching their front edge, and constricted at their lower edge; and the hind wings having the inner two-thirds of this same semi-transparent yellow. The under surfaces have a more decided pearly lustre. The thighs, the breast, and the abdomen below, are all of a beautiful silvery-white, and the other joints of the long legs are of the same tawny or golden-yellow as the semi-transparent parts of the wings. The abdomen of the female terminates in a small flattened black brush, squarely trimmed, and the segment directly preceding this brush is of a rust-brown color above. The corresponding segment in the male is, on the contrary, whitish anteriorly and of the same color as the rest of the body posteriorly, and he is, moreover, at once distinguished from the female by the immense brush at his tail, which is generally much larger than represented in the above figure, and is composed of narrow, lengthened (*ligulate*) scales, which remind one of the petals of the common English daisy, some of these scales being whitish, some orange, and others brown.

Life-History and Habits.

Prof. Riley found that the worms commenced to appear on cucumbers in the latitude of St. Louis about the middle of July, boring cylindrical holes usually from below, and feeding upon its fleshy portion, and that they continued their destructive work till into September. As many as four had been found in a medium sized cucumber. Mr. Ashmead has reported the insect as commonly feeding on squashes in Florida, where it not only bores into the fruit but also feeds upon the leaves.* The larvæ are gross feeders, producing a large amount of soft excrement and developing rapidly. They complete their growth in from three to four weeks according to the observations of Prof. Riley. When about to transform they usually leave the fruit and spin a slight cocoon of white silk within portions of a convenient leaf or beneath such loose rubbish as may be found in the vicinity. In a few days they change to light brown pupæ, and the moths emerge in warm weather eight to ten days after spinning up. The later ones do not give out the moths in the autumn, but remain all winter in the cocoon, probably in the pupa state. Some imagoes probably winter, in Florida, according to Quaintance. In warm weather the insect can complete its round of life in four or five weeks; thus there might be two or three broods after the middle of July. There appears to be no record of observation of the moth during the summer months, yet it is by no means improbable. The latest individuals in Missouri came out as late as November. The earliest appearance of the adults and their egg-laying habits are of great importance in controlling this pest.

Its Injuries and Spread.

The injuries from this insect have been quite severe in Illinois, Missouri, Tennessee, North and South Carolina, Virginia, and Florida, and in all probability in all places where it has established itself. In 1869, the insect was very destructive around Alton, Ill., and also in the vicinity of Springfield. The cucumbers and melons in the vicinity of St. Joseph, Mich., were greatly injured by the worms the same year, and in Missouri it was abundant and destructive in several counties, — cucumbers suffering the most. A correspondent from Asheville, N. C., reported three-fourths of the crop of cantaloupes in that section destroyed by this insect — possibly aided by its close ally, *E. hyalinata*. It is apparently gradually ex-

*Prof. Riley states that "it neither bores into the root nor devours the foliage [of the cucumber], but seems to confine itself to the fruit. Mr. Ashmead states: "as a borer it is found [in Florida] in squash, cucumbers, and melons, but it will also feed on the leaves of all these vines."

tending its range through the United States. It would seem that several of the Western States in former years, offered favorable conditions for its rapid increase. Since then, comparatively little has been recorded of the insect in that region. Lately, 1894, North and South Carolina have suffered from its great abundance, Its multiplication is probably largely controlled by the varying climatic conditions in different years. Apparently the insect is rapidly becoming a greater pest of the muskmelon than it was originally of the cucumber in the Western States, and has largely transferred its depredations to the Southern States, to dispute with its congener, *Eudioptis hyalinata*, its appellation of "melon caterpillar."

Food-Plants.

From the frequent occurrence in Missouri of the larva in cucumbers after pickling, it was given the name of the "pickle-worm," as before stated, although in the same State it was nearly as abundant in melons. Mr. Ashmead has written of it in his "Report on Insects Injurious to Garden Crops in Florida" (*loc. cit.*), as the "squash borer." Of the melons, it appears to have a preference for cantaloupes—a variety of the muskmelon, but also burrows into watermelons according to Walsh. Guenée states—"la chenille vit sur les patates." Patate is defined by Spiers and Surenne, as "batatas; Spanish potato; skirret of Peru."

Distribution.

So far as known *E. nitidalis* is an American species, having an extended distribution in both North and South America. It is reported from Hamilton, Ontario, Canada, about 70 miles northwest of Buffalo, N. Y. It has not been recorded from New York or from the Eastern States. The following are the recorded United States localities: Michigan, at Potoskey and St. Joseph; Illinois, Alton, Rock Island and Springfield; Delaware, Felton and Newark; District of Columbia, Washington; Virginia, Crozet; Kentucky, Bowling Green; Missouri, Kirkwood and "in various parts of St. Louis and Jefferson counties;" Kansas; Tennessee, Carp; North Carolina, Asheville; South Carolina, Pendleton; Florida, Lake City and Cresent City.

Guenée lists it from Brazil, Cayenne in French Guiana, and Columbia. It occurs in the West Indies, according to Ashmead. It should also be found in Central America and Mexico.

Its Natural Enemies.

But a single parasite has been recorded (by Mr. Ashmead) as preying upon *E. nitidalis*, viz., *Chalcis fulvipes* (Fabr.)—an important parasite,

as it is known to destroy at least seven other species of Lepidoptera, both moths and butterflies (Howard, in *Bull.* 5, *Bureau of Entomology, U. S. Dept. Agricul.*, 1885, p. 31).

A correspondent from Virginia, whose attention had been drawn to an article on the margined soldier-beetle, *Chauliognathus marginatus* (Fabr.), in my Fourth Report (pp. 84–88), in which its valuable service in destroying the apple-worm in its burrows is shown, reports that he had seen a number of these beetles in his infested melon patches, and that there was good reason to believe that they had entered many of the *nitidalis* burrows which he found tenantless, and destroyed the borer. It would be an interesting fact if, by watching, with this purpose, the Chauliognathus beetle could be detected entering the melon in search of its prey, or still better, if found within, engaged in its repast.

Remedies and Preventives.

As the insect feeds upon the leaves at times, and most probably in the earlier part of the season, Paris green or London purple could be used to great advantage. If it can only be shown that the caterpillar feeds in its first stages upon the foliage, then an early spraying by all growers would be a most effectual check for the pest. If this fails, then resort must be had to other methods.

Sprinkling the melons, cucumbers, etc., occasionally with London purple or Paris green and water, during the time that the moths are abroad for the deposit of their eggs, would probably be the most effectual method to prevent the attack of the insect. The young larva, upon hatching from the egg, would be killed by the poison, in its attempt to enter the fruit, as is the apple-worm of the codling-moth.

The increase of the insect may be prevented by frequent examination of the cucurbits and the destruction of all such as are seen to have been penetrated by the borer. Several of the borers are frequently found within a single melon or cucumber.

If the eggs are placed on the fruit, and only there (not on the leaves), it would seem that the injuries of the borer may be prevented by destroying the eggs. This could be done by going over the fields, if not too large, and, lifting each melon, rub the surfaces where the eggs are deposited (if on the under side only, the operation would be simplified) with a gloved hand, crushing the eggs. Preparatory to resorting to this method, the time of the earliest appearance of the moth should be noted, and the length of time that the egg-laying continues. Going over the melons once a week should suffice to reach all of the eggs.

Eudioptis hyalinata (Linn.),

The Melon Caterpillar.

(Ord. Lepidoptera: Fam. Pyraustidæ.)

Phalæna hyalinata. Linnæus: Syst. Nat., i, pars ii, 1767, p. 874, no. 279 (description).

Phalæna hyalinata. Fabricius: Ent. Syst., iii, pars ii, 1794, p. 213, no. 311 (habitat, America, Asia).

Pyralis hyalinata. Poey: Cent. Lepidopt. Cubana, 1832 (larvæ, pupa, pl. 19, colored fig.).

Pyralis hyalinata. Westwood: Introduc. Class. Ins., ii, 1840, pp. 400–401 (characters, type of Phakellura MS.).

Phakellura hyalinatalis. Guenée: Hist. Nat. Ins., Lepidopt., viii, 1854, p. 296 (descr., distrib., vars., food-plants).

Phakellura hyalinitalis. Dodge: in Field and Forest, i, 1875, p. 9 (injurious to cucumbers in Fla.).

Phacellura hyalinatalis. Snow: in Trans. Kans. Acad. Sci., iv, 1875, p. 56 (habits same as *P. nitidalis*); in Observ. of Nature, iii, no. 5, 1876, p. 4 (common in Kans.).

Phakellura hyalinitalis. Mann: in Psyche, ii, 1878, p. 129 (reference).

Phakellura hyalinatalis. Willet: in Rept. U. S. Comm. Agr. for 1879, p. 219 (life-history).

Phakellura hyalinatalis. Comstock: in Rept. U. S. Comm. Agr. for 1879, 1880, pp. 218–220, pl. iii, figs. 5, 6 (distrib., life-history, parasites, remedies).

Eudioptis hyalinata. Grote: New Check List of N. Amer. Moths, 1882, p. 54, no. 159.

Phacellura hyalinitalis. Cooke: Ins. Inj. Orch.-Vin., 1883, pp. 301–302 (general notice, life-history, remedies).

Eudioptis hyalinata. Saunders: in Canad. Entomol., xv, 1883, p. 56, fig. 3 (taken at Hamilton, Ont., larvæ, pupa); the same in 14th Rept. Ent. Soc. Ont. for 1883, pp. 23–24, fig. 4; Ins. Inj. Fruits, 1883, pp. 365–366, fig. 377 (distrib., habits, etc., brief).

Phacellura hyalinitalis. Edge: in Rept. Penn. State Bd. Agr. for 1883, 1884, pp. 66–67 fig. 6 on plate (general notice).

Eudioptis hyalinata. Fernald: in Kingsley's Stand. Nat. Hist., ii, 1884, p. 444, (brief notice).

Phakellura hyalinatalis. Lintner: in Country Gent., l, 1885, p. 607; in do., li, 1886, p. 733; 5th Rept. Ins. N. Y., 1889, p. 320; in Country Gent., lix, 1894, p. 721 (as *Eudioptis*); 10th Rept. Ins. N. Y. for 1894, 1895. p. 503 (reference as *E. hyalinata*).

Eudioptis hyalinata. Ashmead: in Bull. 14 U. S. Dept. Agr., Div. Ent., 1887, pp 26–27 (distribution, food-plants, description of stages, etc.).

Phacellura hyalinitalis. Riley-Howard: in Ins. Life, i, 1888, p. 161 (*Pimpla conquisitor* parasitic on); in do., ii, 1890, p. 376 (*Phakellura hyalinatalis* injuring cantaloupes in So. Carolina); in do., iv, 1891, p. 157 (*Eudioptis hyalinata* from Jamaica).

Eudioptis hyalinata. Edwards: Bull. 35 U. S. Nat. Mus., 1889, p. 111 (bibliography of transformations).

Eudioptis hyalinata. CAMPBELL: in Bull. 3 Ga. Agr. Expt. Stat., 1889, pp. 45–46 (life-history, ravages, remedies).

Eudioptis hyalinata. SMITH: Cat. Ins. N. J., 1890, p. 343 (common in Ocean Co.); List Lepidop. Bor. Amer., 1891, p. 75, no. 3973 (listed as *Margaronia hyalinata*).

Eudioptis hyalinata. VAN DUZEE: Lists Macro-Lep. Buff.-Vic., in Bull. Buff. Soc. Nat. Sci., v, 1891, p. 157 (taken at Buffalo).

Phakellura hyalinatalis. KENT: in Insect Life, iii, 1891, p. 337 (habits, destructiveness).

Eudioptis hyalinata. MOFFAT: in Canad. Entomol., xxiv, 1892, p. 132 (in Canada 10 years).

Margaronia hyalinata. COMSTOCKS: Manual Study Ins., 1895, pp. 231–232, fig. 276 (brief notice).

Eudioptis hyalinata. HOPKINS-RUMSEY: Bull. 44 W. Va. Agr. Expt. Stat., 1896, pp. 300, 317 (brief notice with remedies).

Margaronia hyalinata. QUAINTANCE: Bull. 31 Fla. Agr. Expt. Stat., 1896, pp. 298–300 (brief notice).

This insect is commonly termed the melon-worm, and it is the species that is most frequently recorded as injuring the melons in the southern and western States. In New York and the eastern States it does not appear to be known, being replaced by another Lepidopter, still more destructive to the *Cucurbitaceæ*, viz., the squash-vine borer, *Melittia Ceto.* It is closely allied to the insect treated in the preceding pages and in habit it is very similar. It is possible that this species was also associated with the preceding in the destruction of melons in North and South Carolina, and Virginia. It may be this insect which a correspondent of the *Country Gentleman* from Tennessee reported as boring in the heart of melons, causing them to decay.

Characteristic of Attack.

Professor Willet gives an excellent account of the ravages of the caterpillar in Georgia as follows:

At the annual meeting of the Georgia Horticultural Society, July, 1879, earnest inquiry about the melon-worm was made by many of the members. It was stated that the August crop of musk-melons was very subject to the attack of worms, which were very numerous and destructive, and against which no remedies had been successful.

The only worm destructive to melons, described in the books at my command, was the pickle-worm, *Phakellura nitidalis.* The figures and description of this by Prof. C. V. Riley are copied by Prof. Packard in his Report on Noxious Insects in Hayden's Report for 1875. This worm is here represented as very injurious to melons, cucumbers, etc., in the western states. A moth of this species was caught in my house the last week in August, and was the only one seen during the season.

On the same day on which this moth was caught, Mr. S. I. Gustin brought me two nutmeg-melons, saying they were the best of a load which he had just gathered. Each melon had about a half dozen caterpillars

which had excavated shallow cavities in the melons, or had penetrated bodily into the same. The melons were too much injured to be eatable. These worms, I naturally supposed, might be the pickle-worms, a moth of which species I had just caught.

In the course of two or three weeks I visited three melon patches, where musk-melons had been planted for market. All presented the same scene of total destruction. Most of the vines had been more or less denuded of leaves, and the remains of the leaves contained brown chrysalids or pupæ "webbed up" in them. The melons, of various sizes, were occupied in great measure by the worms. The younger worms were generally confined to the surface, but the older had penetrated to different depths. Some had excavated shallow cavities half an inch in diameter and one-eighth of an inch in depth; each cavity occupied by one or more worms. Others had penetrated perpendicularly into the melons, frequently beyond sight. None had reached the hollow of the melon so far as I saw. The melon crops of these three market-gardens were a total loss.

It appears that this species feeds more generally on the leaves in the earlier part of the season than does the pickle-caterpillar. Mr. Dodge reported in 1875 that it attacks first the bud, then works into the plant and eventually kills it root and branch. Later Mr. Ashmead observed that the food of the first brood of worms must be largely phyllophagous.

Life-History and Ravages.

It is probable that the round of life is completed in about the same time as that of its congener, *E. nitidalis*, though there appears to be no record to that effect. The larvæ are most destructive the latter part of the summer. The number of broods has not been definitely ascertained. The larvæ are said, as a rule, to migrate a short distance to some neighboring tree or plant before spinning up for pupation. The duration of the pupa state has not been recorded, but it is probably no longer than that of the *nitidalis*. It passes the winter in the chrysalis.

In 1875 the insect was very destructive to cucumbers at Indian River, Fla., where it was reported as ruining the crop. In 1887 Mr. Ashmead reported the crop of cantaloupes and muskmelons as totally destroyed by this insect in the same State, and in 1889 it was again reported as quite injurious for the past few years. Its injuries in Georgia in 1879 have been given in detail in a preceding paragraph. In 1891 it was reported as very destructive in Mississippi to melons, cucumbers and cashaws the previous season. It is also injurious at times to pumpkins.

Description of the Insect.

The larva is smaller than that of the pickle-caterpillar, being but eight-tenths of an inch in length. The color is translucent green or pale

greenish-yellow, which is quite similar to that of *E. nitidalis*. The jaws and surrounding mouth-parts are black; from both sides of the head issue some fine hairs; the stigmata are yellowish; the warty tubercles on the segments are arranged as in *E. nitidalis*, only they are not so prominent or black but green, and the hairs issuing therefrom are very fine and almost invisible to the naked eye; the legs are the same in both species (Ashmead, *loc. cit.*).

The pupa is about seven-twelfths of an inch long, yellow-brown, darker and tapering to a point at the tail. It is generally inclosed in a loosely woven web in the folds of a leaf, though it has been found in the soft pulp of the melon.

The moths into which they develop have wings of a pearly iridescent whiteness, except a narrow black border, and measure, when extended, an inch across. Their legs and bodies present the same glistening whiteness, and the abdomen terminates in a curious moveable tuft of white appendages like feathers of a pretty buff color, tipped with black and white (Fig. 3).

FIG. 3.—The melon-caterpillar and moth, EUDIOPTIS HYALINATA. (From Comstock.)

Guenée describes the moth as follows: "Wings of a beautiful pearly white color; the superiors with a broad costal band and a border equally broad, the inferiors with a border gradually diminishing toward the anal angle which it does not reach, of a shining brown color. The costal band has two small teeth at the place of the cellular spots. Anterior half of the thorax and nearly the whole of the shoulder-cover, brown. Abdomen white, more or less tinged with yellowish-brown in the female, with a large shining-brown dorsal spot on the last segment: the anal brush formed of shining scales, of a leaden-brown color, with some other scales of a yellow-fawn at their base, arranged especially on each side."

It would appear from the limited literature accessible, that *Eudioptis hyalinata* is more especially a southern insect. I have examples in my collection from Texas. It has also been taken in Michigan, is not uncommon in New Jersey, and has been taken in Canada. I have no knowledge of its occurrence in the State of New York.

Natural Enemies and Remedies.

Pimpla conquistor, an Ichneumon-fly, has been bred from the larva. This insect is abundant in the Southern States, being an efficient parasite of the cotton-worm, and it should aid materially in keeping this pest in check. A Tachina fly was also reared from the larvæ. Mr. Ashmead observed that the majority of the pupæ in his breeding boxes were destroyed by a small red ant, which may also be useful in destroying them elsewhere. There is no reason why *Chauliognathus marginatus* should not destroy the larvæ of this species, if it attacks those of *E. nitidalis*, as appears probable.

Remedies of service against the "pickle worm" should also prove of value in checking the melon caterpillar. The habit of the larvæ of the first brood feeding upon the leaves renders their control comparatively easy. One or two thorough sprayings of the vines in the early part of the season with Paris green or London purple in water ought to keep the insect from multiplying to such an extent as to cause much damage later. After the worms begin boring into the fruit they are beyond the reach of insecticides, and they can only be destroyed with the fruit.

Pyrausta futilalis (Lederer).*

A Dogbane Caterpillar.

(Ord. Lepidoptera: Fam. Pyraustidæ.)

Lederer: in Wien. Entomol. Monatschr., iii, 1859, p. 467, pl. 10, fig. 1 (described as *Botys futilalis*).

Grote: in Canad. Entomol., viii, 1876, p. 99 (described as *Botis erectalis*; Albany, N. Y.); in Bull. iv U. S. Geolog.-Geograph. Surv. Terr., 1878, p. 679 (from Mass.); Check List N. Amer. Moths, 1882, p. 53, nos. 78, 92.

Beutenmuller: in Canad. Entomol., xx, 1888, pp. 15–16 (description of full-grown larvæ; habits, brief, as *Botis erectalis*).

Edwards: Bull. 35 U. S. Nat. Mus., 1889, p. 110 (reference, as *Botis erectalis*).

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* By E. P. Felt, from observations made at the Cornell University Agricultural Experiment Station.

SMITH: List of Lepidop. Bor. Amer., 1891, p. 77, no. 4053 (as *Pyrausta futilalis*).
MOFFAT: in Canad. Entomol., xxvi, 1894, p. 126 (collected at London, Ont.).

In the early part of July one may find here and there a leaf of the common spreading dogbane, *Apocynum androsæmifolium*, more or less inclosed with a slight web, and underneath a number of naked caterpillars with greenish-yellow bodies marked with sooty-yellow spots and with a head of a similar color to that of the tubercles. Later the web includes more and more of the plant, until whole branches and even entire plants are included. In the meantime the larvæ have changed to a coppery red with black tubercles, and the head has become heavily mottled with black. Upon bringing larvæ thus obtained to maturity, the moth of the above-named insect was disclosed.

The Eggs.

None of the eggs of the insect were discovered before they had hatched, but on the under surface of some of the leaves upon which the young larvæ were found, there were a few very delicate fragments of transparent egg shells which were in all probability those of this insect. They were deposited in a small mass, each nearly touching its neighbor; the number in a group being about ten to fifteen.

Habits of the Caterpillars.

The young larvæ confine themselves to the under surface of the leaf, where they eat the lower epidermis and the soft parenchyma. Before attaining full size, the caterpillars moult four times at intervals of four to nine days. They are gregarious and, as they eat and move about, a web is spun which incloses their food and at the same time affords protection to its inmates. The leaves thus skeletonized, quickly turn brown, become dry, and the nest is soon a conspicuous object among the unharmed foliage. As the caterpillars increase in size, they eat some holes through the leaves, though most of the time they prefer the soft parenchyma and remove the epidermis from but one surface. Larvæ which were confined singly in cages and each given a spray of the dogbane to feed on, were observed to spin a slight web to serve as a retreat and usually one or more leaves were drawn together to make this retreat more secure. The caterpillars complete their growth in about four weeks during which time they eat most voraciously; leaf after leaf is inclosed in the web until not only branches but almost entire plants are devoured. At Ithaca, N. Y., on August 10, 1895, whole masses of their food-plant

were composed of dried, half-eaten foliage inclosed with web. This destruction was not local but was apparent in several diverse localities in the vicinity of Ithaca. The injury to this plant occasions no regret; the above facts are simply put on record as evidence of the nature of the insect and also as of value in determining the habits of allied species which may not destroy a plant of so little economic value.

Description of the Larval Stages.

First stage.— Head diameter, 0.475 mm.; body diameter, 0.625 mm.; length, 4. mm. Head, thoracic shield, tubercles and true feet a sooty yellow; eyes dark brown; sutures of the head nearly black; clypeus well defined, triangular; thoracic shield mottled with brown spots; body greenish-yellow. The thoracic shield bears three nearly equidistant setæ along its anterior margin; two along its posterior margin, and one smaller near the center of each half. Below the thoracic shield two large tubercles, each with two setæ. On thoracic segments two and three, five large tubercles above the legs, all but the posterior in the stigmatal line and the substigmatal tubercle with two setæ. Abdominal tubercles in six rows; subdorsal and subventral on posterior portions of segments; substigmatal with two, the one at base of prolegs with three setæ, corresponding one on legless segments the same. See figure of larva of *Mecyna reversalis* (Fig. 4) for general arrangement of these setæ. Paired ventral tubercles occur on the thoracic and all but the last abdominal segment; on segments bearing prolegs they are well down on the leg, each with one seta. Described July 16th, several days after hatching.

Second stage.— Head diameter 0.75 mm.; length about 7. mm. Head and thoracic shield mottled with brown; tubercles a little larger than in preceding stage and a greenish black. Described July 18th.

Third stage.— Head diameter 1.122 mm.; length 10. mm. The larvæ are a little darker than in the preceding stage. Described July 22d.

Fourth and last stage.— Head diameter 1.63 mm.; body diameter 4. mm.; length 18. mm. Head, thoracic and anal shields heavily mottled with black on a yellowish-white ground; small, black tubercles occur on the head. General color of the body ochreous; tubercles, spiracles, and thoracic legs jet black. Described July 31st.

The Pupa State.

The caterpillars do not pupate at once after they have ceased feeding. They usually wander around for six or seven days before spinning up; it appears to make no difference whether there are abundant places to pupate in or not; the larvæ will not spin up until the lapse of a certain period. At the end of this time they spin a reddish-brown, tenestrated cocoon, within which they remain without undergoing marked changes for some time; some examples remained in the larval state at least two weeks and probably longer. Beutenmuller states that the insect passes the winter in the larval state, but pupæ were found by me in the field during August. Most of the eggs were laid before the middle of July and

the majority of the larvæ had spun up about August 10th. Several pupæ were found in the field at this latter date; in nature they are found under stones and other protective materials above ground.

Number of Generations.

The insect remained in the pupa state during the winter, and moths emerged on March 14th, 20th, and May 6th. Though the emergence of the adults was most likely hastened by the warmth of the greenhouse where they were kept all the winter, yet it would hardly seem as though their appearance would be earlier by nearly three months. As previously recorded, young larvæ were found in the early part of July; some were so young that they could not have hatched long before being found. The eggs from which they emerged were in all probability deposited only about ten days previously, or the last of June — a week to ten days is often found to be the time between oviposition and hatching in Lepidoptera, especially in warm weather. The irregular appearance of the few moths bred does not permit of a very accurate opinion as to the normal time of their appearance. Still it is possible that there is an earlier brood than the one observed, especially as pupæ were seen in the autumn, and Beutenmuller records the occurrence of the larvæ in September. It is not unlikely that the insect hibernates either as a larva or pupa with nearly equal facility.

The Moth.

The imago is a plain appearing brownish-gray moth with a wing expanse of 1. 1 inch. The palpi above, head, and thorax are ornamented with rich brown scales and the fore wings are thickly mottled with the same on a background of light gray; at the base of the fore wings along the costa the brown scales are thicker; outer edge of the wing with a rich brown line; fringe of medium length, purplish-brown in color. Hind wings a light gray with a brown median line and sparse brown mottling on the outer third, outer border of the wing brown; apical portion of the fringe concolorous with that of the fore wing, the remainder of the fringe nearly white. Beneath, the fore wings are nearly as above but with a more pronounced discal spot; hind wings beneath with a distinct reniform discal spot; palpi beneath and legs clothed with white scales.

Its Enemies.

It was not possible to find anywhere the number of larvæ and pupæ one might expect in the vicinity of the food-plant after the caterpillars had begun to leave their nests; it is quite likely that many of them

fell as prey to birds and other enemies which were only too glad to partake of such food without the labor of parting a troublesome web. The insect is also preyed upon by a true parasite; several of its cocoons were found filled with the whitish ones of an *Apanteles*, probably *A. congregatus;* though as none of the parasites were reared their identity can not be certainly known.

Mecyna reversalis (Guen).

The Genista Caterpillar.

(Ord. LEPIDOPTERA: Fam. PYRALIDÆ.)

GUENÉE: Hist. Nat. Ins., viii, Delt. et Pyral., 1854, p. 409.
GROTE: in Bull. iv, U. S. Geolog.-Geograph. Surv. Terr., 1878, p. 679 (from Texas); Check List N. Amer. Moths., 1882, p. 53 (as *Botis reversalis*).
SMITH: List. Lepidop. Bor. Amer., 1891, p. 78, no. 4081.
WEED H. E.: in Insect Life, v, 1892, p. 111 (injurious to Lupines).
LINTNER: 10th Rept. Ins. N. Y. for 1894, 1895, p. 515.

A number of brightly colored and prettily marked caterpillars of comparatively small size were received toward the last part of September from Mr. William Falconer, of Glen Cove, Long Island, with the request for their name.

They were feeding abundantly on the foliage of species of Genista and Cytisus in the greenhouses of Charles A. Dana, at Dosoris. They had not been observed on other plants. According to Mr. Falconer, the common greenhouse Genista (*Cytisus Canariensis*) grown in pots plunged out of doors in summer, seems to be preferred by them. The hardy *Genista tinctoria* — a plant grown out of doors all the time is also an especial favorite of theirs. Mr. Weed has reported this insect as very injurious to various species of Lupines growing in the grass experiment beds of the Mississippi Agricultural College. There appears to be no other record of the food-habits of this species. In this connection it is worthy of note that the English species, *Mecyna polygonalis* Hb., has a similar food-habit; its larvæ being found on Genista and Cytisus, according to Meyrick.*

The work of the larvæ was first noticed about the middle of July, at which time they were quite numerous, in less than half-size and about full-grown, and, as this variation in size had continued for the two months

* *Handbook Brit. Lepidop.*, 1895, p. 418.

following, it was thought that there must be successive broods of the insect. Numerous larvæ of various sizes — some less than half-grown, were received from Mr. Falconer, September 20th. On October 2d the last larvæ pupated and the moths emerged between October 19th and November 5th, except one male which appeared November 21st. Some of the larvæ made fully half their growth within twelve days, and the imagoes emerged in from 17 to 32 days after the last larvæ had pupated. At this rate it would take about 50 days to complete the round of life, but in warm weather growth and transformations are usually much more rapid and these changes might not occupy more than five weeks. If such were the case three or more generations would be possible each year, the number depending upon the length and warmth of the season. At Glen Cove, L. I., the larvæ were seen feeding October 3d. An allied form, *Nomophila noctuella* Schiff., produces several generations a year, and in warm weather completes the round of life in about 50 days. Both insects appear to continue breeding until the frosts compel them to seek shelter for the winter or else kill the larvæ.

Description of the Insect in Several Stages.

Larvæ (full-grown) —Length 1.1 in.; form cylindrical.

Head medium small; pitchy black; clypeus V-shaped, suture deep; labrum, basal joint of antenna, and portions of labium usually white; the white is quite variable in extent not only on the head but also around the tubercles on the body.

Thoracic shield pitchy black; a median stripe and a subdorsal rectangular area on its anterior two-thirds, white; anterior border frequently white; 12 white setæ arise from small tubercles upon its surface—six forming a transverse row along its anterior edge, the others along the posterior edge. Two large tubercles, each bearing two setæ, below the thoracic shield—the upper and smaller nearly in front of the small black spiracle. On the second and third thoracic segments five black tubercles each side—the first two with two setæ each, third and fourth contiguous and one behind the other—anterior with two setæ, posterior with a single seta; fifth larger, with a single seta and near base of leg; small white spots conspicuous at bases of first two tubercles (Fig. 4).

The general color of the upper surface of the body is pale yellowish brown, the two anterior thoracic segments a little lighter. Small black spiracles occur on the first eight abdominal segments, that of the eighth being larger than the others. On each of the segments three black tubercles above the spiracle; two anterior, a subdorsal and lateral, and a posterior, dorso-lateral; each tubercle with a single seta and with conspicuous white marks at base on dorsal and ventral sides. On the ninth abdominal segment the tubercles have coalesced on the median line; the anal shield is well defined, with two median white spots and a number of setæ. The setæ on the tubercles range from 0.1 to 0.25 in. in length. Sublateral line composed of a series of irregular lemon-

yellow spots; a tubercle in the sublateral line with two setæ, and one below on each abdominal segment with a single seta.

Under surface of the body a little lighter than upper; a single transverse white line on first and second abdominal segments; a median pair of small black tubercles on each body segment; and also a more lateral larger pair with three setæ each on abdominal segments one to seven; on leg-bearing segments these tubercles occur at the base of the legs on the inner and outer sides; setæ and tubercles modified by reduction on last three segments. True legs pitchy black, ringed with white at the joints. Prolegs, five pairs, of the same general color, but slightly paler.

FIG. 4.—Head, thoracic, and first abdominal segments of full-grown larva of MECYNA REVERSALIS; greatly enlarged. (Original.)

Pupa.—Length 0.5 in.; transverse diameter 0.12 in. Rather stout, light brown in color, eyes well marked; six abdominal segments exposed beyond the tips of the wing covers. Spiracles brown, prominent; anterior two pairs within prominent ridges. Cremaster pointed, apex blunt and usually with six long curving spines arranged in lateral groups of three (Fig. 5).

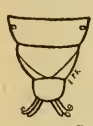

FIG. 5.—Cremaster of MECYNA REVERSALIS, enlarged. (Original.)

Cocoon.—White, thin, and roomy. The pupa may readily be seen through its gauzy tissue.

The perfect insect is a pretty Pyralid with a spread of wing of from one inch to one inch and one-fourth (Fig. 6). It may be recognized by its rich reddish-brown fore wings with darker shades at the base, on the outer margin, and along the veins, together with bright reddish-yellow hind wings with a darker apex. On the under surface, the apex of the fore wing and the fore margin of the hind wing is reddish-purple; there is also on the fore wing an irregular blackish spot at the tip of the discal cell and a small one near its center. The males are most easily recognized by their smaller size.

FIG. 6. The Genista Moth, MECYNA REVERSALIS. (Original)

Guenée has expressed his belief that *M. reversalis* may be identical with the *diversalis* of Duponchal, and has compared it in his description with that species. His description is as follows:

Smaller. The front wings are narrower, a little less rounded at the terminal border, of a lively but pale ferruginous-red, with the costal margin more red, and the fringe slightly tinted with black. The posterior transverse line is wholly punctiform in its entire length. The reniform spot is blackish. The hind wings are pale yellow, unicolored, with a concolorous

fringe, and having only a black apical triangular spot, smaller than in Duponchal's figure and sometimes entirely wanting. The abdomen is wholly yellow. The tibiæ of the middle pair of legs are sulphur-yellow and bear a pencil of cottony black hairs.

Distribution.

This insect appears to be essentially a southern form and its introduction on Long Island accidental, as its reported distribution is apparently limited to Mississippi and Texas, as recorded by Grote and Weed (*loc. cit.*). Guenée gives "North America" as its habitat.

Remedies.

The larvæ had not proved very injurious to the plants that they infested, for when their presence was discovered, it was not difficult to keep them in control by applying fresh hellebore powder, either as a dust or mixed in water. Paris green in water, and the kerosene emulsion killed them readily.

Pyralis costalis (Fabr.).

The Clover-Hay Caterpillar: The Gold-Fringe Moth.

(Ord. Lepidoptera: Fam. Pyralidæ.)

Fabricius: Ent. Syst., iii, pars ii, 1794, p. 240, no. 420 (description as *Phalæna costalis*).

Guenée: Hist. Nat. Ins., viii, Delt. et Pyral., 1854, p. 118 (synonymy, *fimbrialis=costalis*).

Humphreys: Gen. Brit. Moths, i, 1858, pl. 45, fig. 18 (as *Hypsopygea costalis*).

Stainton: Brit. Butt. and Moths, 1859, ii, p. 134 (characters).

Harris: Ins. Inj. Veg., 1862, p. 456 (reference to "clover-worms" in N. H.).

Walsh: in Pract. Entomol., i, 1866, pp. 82–83 ("clover-worms," ravages, notes on habits).

Riley: in Prairie Farmer, Apr. 20, 1867, xxxv, p. 260 (life-history, description, figures, as *Pyralis olinalis*, referred to *P. costalis* in next issue); in Pr. Farmer Annual for 1868, p. 59 (description, ravages, synonymy); in Amer. Ent., iii, 1870, p. 160 (in Mo. and Canad., synonymy, remedies, as *Asopia*); 6th Mo. Rept., 1874, pp. 102–107, fig. 28 (distribution, ravages, remedies, stages described, as *Asopia*); in Rural New Yorker, June, 1882, pp. 158–159 (not the army-worm of Ala. and Tex., as *Asopia*); in 3d Rept. U. S. Entomol. Comm., 1883, p. 136 (as preceding); in Insect Life, iv, 1891, p. 112 (reference); Bull. 31 U. S. Dept. Agr., Div. Ent., 1893, p. 58 (listed).

GLOVER: in Rept. Dept. Agr. for 1867, 1868, p. 73 (reference); in id. for 1870, 1871, pp. 84–85, fig. 48 (abounding in Maryland, as *Asopia*).

WALSH-RILEY: in Amer. Entomol., i, 1869, p. 226 (work in Mich., as *Asopia*).

PACKARD: Guide Study Ins., 1869, p. 328, fig. 251 (brief notice).

STAUD.-WOCKE: Cat. Lepidop. Eur., ii, 1871, p. 202, no. 34.

GROTE: in Bull. Buff. Soc. Nat. Sci., i, 1874, p. 171 (as *Asopia*); in Bull. G.-G. Surv. Terr., iv, 1878, pp. 671–672; in Papilio, ii, 1882, p. 72 (reference).

FRENCH: in Trans. Dept. Agr. Ill., xv, 1877, p. 247 (quotes Riley); in 7th Ill. Rept., 1878, pp. 247–248 (distribution, broods, remedies, as *Asopia*).

GOULD: in Trans. N. Y. St. Agricul. Soc., xxxii, 1878, p. 46.

———: Country Gentleman, xliii, 1878, p. 296 (in Ill.); id., xliv, 1879, p. 488 (in Ill.); id., xlix, 1884, p. 397 (in Mich.).

SAUNDERS: in 12th Ann. Rept. Ent. Soc. Ont., 1882, pp. 45–46, fig. 18 (general account, as *Asopia*).

LINTNER: in 40th Ann. Rept. N. Y. State Agr. Soc. for 1880, 1884, p. 192 (separate, p. 5); in Country Gent., lviii, 1893, p. 349 (general account); 10th Rept. Ins. N. Y., 1895, pp. 483, 487 (reference).

BARRETT: in Ent. Month. Mag., xxii, 1885, p. 137 (rare in England).

COOK: in Beal's Grasses North Amer., i, 1887, pp. 393–395, fig. 146 (as *Asopia*).

EDWARDS: Bib. Cat. Descr. Transform. Lepid., Bull. 35 U. S. Nat. Mus., 1889, p. 110.

RILEY-HOWARD: in Insect Life, 1, 1889, p. 283 (*Asopia costalis* in Ky.); id., iv, 1891, p. 206 (in Ill.).

WEED: in Tech. Bull. i Ohio Agr. Expt. Stat., 1889, p. 26 (bibliography, as *Asopia*); Bull. 2, vol. iv, Ohio Agr. Expt. Stat., 1891, pp. 54–55, fig. 9 (brief account, remedies).

OSBORN-GOSSARD: in Bull. 15 Io. Agr. Expt. Stat., 1891, pp. 263–265 (as *Asopia*, brief account with remedies).

SMITH: List Lepidop. Bor. Amer., 1891, p. 80, no. 4203 (as *Pyralis*); Econom. Entomol., 1896, p. 312, fig. 356 (brief notice).

WEBSTER: in Canad. Entomol., xxiii, 1891, p. 219 (abundant in northern Ohio, as *Asopia*); in Insect Life, iv, 1891, pp. 121–122 (life-history, ravages and remedies, as *Asopia*).

MOFFAT: in 23d Ann. Rept. Ent. Soc. Ont., 1892, p. 44, fig. 15 (mention, plentiful at London, Ont.).

COCKERELL: in Entomologist, xxvi, 1893, p. 102 (listed).

OSBORN: in Insect Life, vi, 1893, p. 72 (*Asopia farinalis* and *A. costalis* in stored hay, remedies), p. 78 (duration of stages of both species), p. 193 (both species injurious in Iowa); in Bull. 32 U. S. Dept. Agr., Div. Entomol., 1894, p. 49 (*Pyralis costalis* and *P. farinalis*, both quite injurious).

MCCARTHY: in Bull. 98 N. Car. Agr. Expt. Stat., 1894, p. 154 (brief mention, as *Asopia costalis*).

ORMEROD: 17th Rept. Inj. Ins., 1894, pp. 15, 18 (reference).
OSBORN-SIRRINE: in Bull. 23 Io. Agr. Expt. Stat., 1894, pp. 883–885, fig. 4 (in Iowa, remedies).
COMSTOCKS: Man. Study Insects, 1895, p. 233, fig. 278 (brief mention).
DAVIS: in Expt. Station Record, vi, 1895, p. 649 (brief, remedies, as *Asopia*).
MEYRICK: Handbook Brit. Lepid., 1895, p. 427 (character, distribution).
HOPKINS–RUMSEY: Bull. 44 W. Va. Agr. Expt. Stat., 1896, pp. 267, 311 (description, remedies, brief).

A correspondent from Sherwood, Cayuga Co., N. Y., has sent me, through the New York State Agricultural Experiment Station at Geneva, under date of February 11, 1893, a package with the statement:

Inclosed you will find specimens of what I take to be empty cocoons found in great abundance near the bottom of a stack of clover hay. I would like to know the name and history of the life of the insect making the same.

The specimens are the cocoons of the clover-hay moth, crushed in their packing. They appear as thin snow-white webs, about half an inch long, intermixed with many black grains which are the excremental pellets of the caterpillars, and with a few brown head-cases of the same which were thrown off at their change to the pupal stage. At this time some of the cocoons, if not crushed, should have contained living pupæ.

An European Insect.

The insect was described by Fabricius over a hundred years ago from European examples as *Phalæna costalis*. It has been referred to the genus *Pyralis* by our more recent writers. For a long time it was known as *Asopia costalis* in this country, while in Europe, *Pyralis costalis* appears to have been preferred by most writers; Humphreys, however, in his "Genera of British Moths," referred the insect to the genus *Hypsopygea*.

Characters of the Pyralidæ.

The family of *Pyralidæ*, to which this insect belongs, comprises a large number of moths of small or medium size, which may often be recognized by their long and slender legs, slender bodies, and wings arranged when at rest in a triangle like the Greek letter *delta*. Many of the species haunt meadows and grassy places, where they are frequently quite injurious.

Description of Moth and Larva.

The moth is about three-fourths of an inch in spread of wings, of a reddish-brown or purplish color. Its front wings are marked with two yellow spots on their front margin, the outer one of which is the larger, and with two faint yellow lines extending from these to the inner margin; the hind wings are crossed by two wavy yellowish lines. The fringes of both pairs are long, with a silken luster and are golden-yellow in color: this last feature has given the moth in Europe the pretty popular name of the "Gold-Fringe." As the insect will seldom be met with by farmers except in its caterpillar form, it may be serviceable to quote its description as given by Mr. Walsh, who was the first to describe it:

FIG. 7.—The clover-hay caterpillar and gold-fringe moth, PYRALIS COSTALIS: 1,2, larva; 3, cocoon; 4, pupa; 5, 6, moth; 7, larva within the web. (From Riley.)

Length half an inch; diameter, 0.07 inch, tapering slightly at each end; color a dirty greenish-brown; beneath, yellowish brown; the first and last segment above, shining, smooth and yellowish-brown with a few irregular whitish hairs; segments 2–11 each, with a transverse row of about six long whitish hairs, each hair proceeding from a lighter colored tubercle with a dark central spot. Head rufous. Legs and prolegs normal, viz., six legs, eight abdominal prolegs and two anal prolegs. Wriggles much and runs backward like a *Tortrix;* suspends itself by a thread, and spins a whitish web while still in the larva state and before the time arrives for passing into the pupa state.

Correspondents of Mr. Walsh give as additional characteristics of the "worms" that they are "ridged," and have "the extremities a little darker than the center."

Its European History.

From its not being recorded as an injurious species by European writers, although known for over a hundred years, it is doubtless another instance of introduced insects becoming pestiferous with us which were not harmful in their native home. It is not treated of by Westwood, Curtis, Whitehead, or other European economic entomologists, so far as I know. Miss Ormerod, in her Seventeenth Report, in an extended notice of *Pyralis glaucinalis* Linn., the "Hay-stack Moth," which is the

species that injures hay in England, refers to *P. costalis* as a moth, "which is sometimes taken here [that is, in England] around stacks," but no mention is made of any injury by our clover-hay worm in that country. Stainton, in his "British Butterflies and Moths," published in 1859, states of it: "Larvæ unknown." That its larvæ and food-plant continued unknown for many years thereafter, appears from the fact that Kaltenbach, in "Die Pflanzenfeinde aus der Classes der Insecten," published in 1872, did not include it in his list of 66 species of insect known to infest *Trifolium pratense* in Europe. And still more markedly, as indicating that our friends across the ocean do not always keep up as they should with our literature, the species is not recorded in M. Roüast's "Catalogue des Chenilles Européennes Connues" of 1883 — a volume in royal octavo of 200 pages.

It would seem that the insect is both rare and local in Europe, for Mr. G. C. Barrett, a distinguished English lepidopterist, in writing of collections made by him in Camberwell, states: "An old favorite with whom I am well pleased to renew my acquaintance, is that lovely creature, *Pyralis costalis*" (*loc. cit.*).

Its American History.

For an account of the operations of the caterpillar in the lower parts of stacks and mows of clover hay, as well as for its earliest description, we are indebted to Mr. B. D. Walsh, the first State Entomologist of Illinois. In the "Practical Entomologist" (*loc. cit.*), in an article entitled "Clover-Worms," he has quoted from correspondents statements of injuries in the following named localities: in McHenry Co., Ill., where the worms occurred in millions in stacks; in Bucks Co., Ohio, where eight inches of the bottom of a stack had been spoiled by them; and in Auburn, N. Y., where the lower part of a stack for two feet was filled with the worms. The article states that the same pest also occurs "in New England and Illinois, and probably in most of the Northern States." Mr. Walsh describes the caterpillar, but not succeeding in rearing it, he was not able to identify it.

The following year (1867) Prof. Riley, having bred the moth, identified it as *Pyralis olinalis*, and in the *Prairie Farmer* for April 20, published descriptions and figures of the several stages of the insect, and gave briefly its life-history. In 1868 he referred it to *Asopia costalis*, in correction of his former identification — the two species being much alike, and liable to be confused. Those who have access to the volumes of the Missouri Reports, may find in the Sixth Report a six-page notice of the

insect giving its past history, its natural history, remedies for it, and descriptions and figures of its three stages.

Life-history.

Its life-history, as given by Prof. Riley, is essentially the following:

The moths are seen abroad in the evenings, or on cloudy days of May, June, and July, especially as they are flitting around infested clover stacks; if these are near dwelling-houses, they are often attracted to lights in the rooms. The eggs are presumably deposited on the stacked clover by the moths creeping into them for that purpose. The caterpillar lives within a delicate cylinder of silk, which it spins. There are probably two or more broods during the year, as active caterpillars of all sizes are to be found in midwinter. The cocoons are formed near the outside of, or entirely away from, the stack or mow.

The above is not very full, and is, as may be seen, in part problematical. Prof. Webster of the Ohio Agricultural Experiment Station has materially added to it through experiments made with the caterpillars taken late in April and reared in breeding cages, where they fed on dry hay from an infested stack. On May 25th the first pupæ were observed, and moths commenced to issue therefrom June 12th. Growing clover plants were potted and placed in breeding cages, in the heads of which, it was thought, eggs were deposited. On July 1st young larvæ, from quite small to half-grown, were found in the heads, now turning brown, but the leaves continuing green. Full-grown larvæ and pupæ were taken from the cages on August 6th, and on the 8th, moths (of the second brood) began to emerge. The latter were given fresh growing clover plants, in the heads of which larvæ were found August 15th.

From the above, Prof. Webster infers that eggs may be laid by the moth on plants in the field, and the larvæ subsequently carried to the stack or mow: and also that moths may oviposit in the stacks in the field early in August (*loc. cit.*).

Injuries by the Insect.

As illustrating the injuries that may follow the presence of this insect, Prof. Webster states that a stack of hay in Hudson, Summit county, Ohio, of about twenty tons, fully three-fourths of which was timothy, had been damaged fully 50 per cent. In other cases in the vicinity, stacked hay had been so badly injured by the insect that it had been burned on the ground during the months of September and October (*loc. cit.*).

That timothy may be injured by the clover caterpillar seems to have been hitherto unknown, and that its range of food may be still further extended through future observations is not at all improbable, from the mention made by Prof. Webster that large numbers of the moths had been seen in June, in Ohio, about straw stacks and straw sheds.

Clover-hay also Injured by Another Pyralid.

In 1893, Prof. Osborn, of the Iowa Agricultural Experiment Station, reports that this insect attracted considerable attention in the State during that year. And what is more interesting, he found that not all the injury could be attributed to *Pyralis costalis*, but that in some cases the injury had been caused by *Pyralis farinalis* (*loc. cit.*).

Remedies and Preventives.

Prof. Riley recommended for arresting the increase of the insect, 1. That as the caterpillars feed only on old hay, the new should never be placed in contact with the old. If stowed in a bay, all refuse and waste of the old should be first removed and destroyed. 2. If possible, the hay should be stacked so as to permit free circulation of air beneath it, for the prevention of moisture that seems to invite attack. 3. Salt the hay, especially the lower two or three feet of the stack or mow.

The only experiment for destroying the insect when discovered at work in hay, is, we believe, that made by Prof. Webster. About five tons weight of badly infested hay was taken from a stack, and while being restacked, was thoroughly dusted with a mixture of ten pounds of pyrethrum powder mixed with fifty pounds of flour. The following day a small quantity of the hay thus treated was examined, and most of the larvæ were found to have been destroyed. The entire stack was not given the examination thereafter that was promised, and the experiment therefore failed of being conclusive of the efficacy of the pyrethrum application.

With this insect, as with many others, a preventive of attack is the desideratum. Hay once infested to any considerable extent is so defiled by the excrement of the caterpillars, and it seems also, by an accompanying mold, as to be wholly unfit for feeding to stock.

When it is learned where the egg-deposits are made — whether in the field or in the garnered hay, and their inviting causes or conditions — we may be able to announce an effective preventive.

Grapholitha Interstinctana (Clemens)

The Clover-seed Caterpillar.

(Ord. LEPIDOPTERA: Fam. TORTRICIDÆ.)

CLEMENS: in Proc. Nat. Sci. Phila., 1860, p. 351 (described as *Stigmonota interstinctana*).

WALKER: Cat. Lepidop. Het., xxviii, 1863, p. 413 (as *Dichrorampha scitana*).

GROTE: in Bull. Buff. Soc. Nat. Sci., i, 1874, p. 92 (described as *Grapholitha distema*).

ZELLER: Beitr. Kennt. Nordamer. Nachtf., iii, 1875, pp. 90–91, pl. 9, fig. 28 (as *Grapholitha* [*Ephippiphora*] *interstinctana*).

WALSINGHAM: Illus. Lepidop. Heteroc. in Brit. Mus., 1879, p. 76 (mention).

COMSTOCK: in Rept. U. S. Dept. Agr. for 1880, 1881, pp. 254–255 (synonymy, habits, description of stages, distribution).

FERNALD: in Trans. Amer. Entomol. Soc., x, 1882, p. 52 (synonymy, distribution).

COOK: in Beal's Grasses North Amer., i, 1887, p. 392–393 (common about Lansing, Mich.).

WEED: in Bull. Ohio Agr. Expt. Stat., Tech. Ser., 1, no. 1, 1889, p. 30 (bibliography).

OSBORN-GOSSARD: in Insect Life, iv, 1891, pp. 56–58; the same in Bull. 14 Io. Agr. Expt. Stat., 1891, pp. 166–169, fig. 1 (life-history, habits, remedies); also in 22nd Ann. Rept. Ent. Soc. Ont., 1892, pp. 74–75; in Bull. 15 Io. Agr. Expt. Stat., 1891, pp. 260–262 (life-history, remedies).

FLETCHER: in Insect Life, iv, 1891, p. 13 (destroyed by stacking hay).

GILLETTE: in Bull. 12 Io. Agr. Expt. Stat., 1891, pp. 535–536 (common at Ames, found at Champaign, Ill., remedy, as "clover-leaf caterpillar").

RILEY-HOWARD: in Insect Life, iv, 1891, p. 87 (reference).

RILEY: in Rept. U. S. Dept. Agr. for 1891, 1892, p. 246 (Osborn's work referred to); Bull. 31 U. S. Dept. Agr., Div. Entomol., 1893, p. 58 (listed).

SMITH: List Lepidop. Bor. Amer., 1891, p. 93, no. 5009.

GOSSARD: in Bull. 19 Io. Agr. Expt. Stat., 1892, pp. 571–589, fig. 1 (extended account).

OSBORN: in Insect Life, v, 1892, p. 112 (abundant in Iowa); in id., vi, 1893, p. 78 (duration of stages); in Bull. 30 U. S. Dept. Agr., Div. Entomol., 1893, p. 44 (plentiful, considerable loss); in Bull. 32 do., 1894, pp. 49–50 (very abundant).

LINTNER: in Country Gent., lviii, 1893, p. 773 (ravages, life-history, distribution, etc.); Tenth Rept. Ins. N. Y. for 1894, 1895, p. 496 (abstract of preceding), p. 510 (mention).

OSBORN-SIRRINE: in Bull. 23 Io. Agr. Coll. Expt. Stat., 1894, pp. 885–887, fig. 5 (life-history, remedies).

A correspondent from Miami County, Indiana, sends the following inquiry and information of a clover-seed insect, which, although not of frequent occurrence, is at times the occasion of serious harm to the crop that it chances to attack.

While threshing clover seed this fall, we noticed that a good deal of it had been hulled out like beans eaten by bugs, leaving only a thin hull. This is the first time we have noticed anything of the kind here, and we should like to know what the insect or midge is that does it, and what preventive measures to use to guard against them in the future. I inclose sample of seed as it comes from the huller. Most of the damaged seed has been blown out by cleaning.

I might add that it is only what is known with us as the little clover that is thus affected. The big or mammoth clover, that ripens seed from a month to six weeks earlier, does not seem to be touched. We thought it might have been done by some insect that is always with us, but which has increased sufficiently to be noticed by reason of the extreme drouth which we have had continually since June — in fact, there has not been rain enough to lay the dust in all that time.

One other thing that we are interested in knowing is, will the seed that is saved and sacked be safe from further damage? We are anxious to know about this, as we want to save seed to sow next spring.

J. W. J.

Description of the Insect.

The insect committing the injury as above reported is known to us in its larval stage, as the clover-seed caterpillar. The moth was described and named by Dr. Clemens in the year 1860. The caterpillar was first observed, so far as known, by Prof. Comstock, at Ithaca, N. Y., in 1874, and at Washington, D. C., in 1875; his description of the larva and pupa is given herewith:

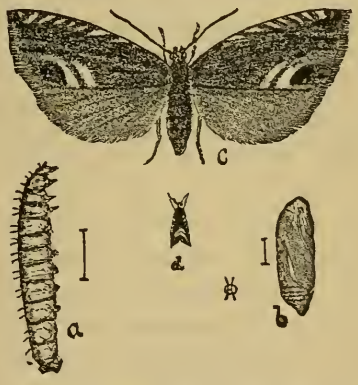

FIG. 8.—GRAPHOLITHA INTERSTINCTANA: *a*, larva; *b*, pupa; *c*, moth enlarged; *d*, natural size. (After Osborn.)

Larva: Length 8 mm., subcylindrical, tapering slightly at each end; legs and prolegs normal. Color, dirty white, often with a greenish tinge; head, dark brown, trophi, black; prothoracic shield, yellowish with a brown hind border interrupted in the middle. Body with many delicate whitish hairs. The dorsal piliferous tubercles of each segment arranged in two pairs, of which those of the anterior pair are closer together than those of the posterior pair.

Pupa: Length, 5 mm., moderately slender. Wing-sheaths extend to sixth abdominal segment; antennæ and posterior tarsal sheaths ending at tip of wing-sheaths, the tarsal sheaths being a trifle the longer. Dorsum of each visible abdominal segment except the last with two transverse rows of backward-directed teeth, those of the anterior row being the strongest. Anal segment blunt at tip, with six stout blackish excurved hooks at its posterior border, two dorsal and four lateral, none ventral; also a number of very delicate hooked filaments. General color rather light brown, darker on wing covers and dorsum of thorax.

FIG. 9.—Wing of GRAPHOLITHA INTERSTINCTANA. (After Zeller.)

To aid in the identification of the moth the description by Mr. Grote is transcribed, as it is much better than the original one by Dr. Clemens.

Imago: A tiny blackish silky species resembling the European *compositella*, but with only two white lines on the internal margin of the primaries. Eight white costal marks disposed in pairs, crowded toward the black apices and becoming straighter and shorter; the first pair more oblique and divaricate. A silvery subterminal streak (not seen in certain lights, according to Prof. Comstock) runs from opposite the cell over the median nervules tapering to internal angle. Secondaries fuscous with pale fringes. Beneath iridescent, greenish in certain lights, with minute white costal dots over the outer half of the wing. Body scales beneath whitish.

Figure 8 represents the insect in its several stages, after Osborn, and figure 9 a single wing, after Zeller.

Life-history and Habits.

The caterpillar — about one-fourth of an inch long when full-grown, and of a dull greenish-white color, often becoming tinged with red posteriorly as it approaches pupation — eats into the young florets and later into the forming seed, causing the seed to blight and shrivel up, as above described. The caterpillar is developed from eggs that are deposited during the last of May and in June, at the base of the head. It may be found nearly mature the last of June eating into the florets of the lower part of the head, gradually working upward with its growth, until the entire head may be ruined. About the middle of July maturity is reached, and the white cocoons are spun among the flowers; some of the caterpillars, however, descend to the ground for pupation. Twenty to thirty days are passed in the pupal stage, when the perfect insect emerges as a little brown moth, measuring from three- to four-tenths of an inch in spread of wings, and marked with eight short oblique white lines on the outer margin of the front wings, and with two conspicuous longer white ones, oblique and somewhat curved, on the inner margin.

The moth has a peculiar habit of performing, immediately after alighting, two or three revolutions, the head being the pivot and the tip of the abdomen describing a circle; the movement is spirited and usually reversed before coming to rest.

Successive Broods of the Insect.

A second brood of the caterpillars may be found feeding in the heads in August, and a third brood the last of September or in October, which hibernate as larvæ in the crowns of the plants and tighter leaf-sheaths and other sheltered places close to the ground. In the latitude of Wash-

ngton, D. C., where the earliest moths of the first brood have been observed about the first of July according to Prof. Comstock, there may be three annual broods of the insect.

Mr. Gossard observed the first brood of adults at Ames, Iowa, about May 20th, all disappearing by June 20th; the second brood of moths appeared a little before July 14th and disappeared by August 20th; the third brood was first noticed some time before September 8th, and on the 19th of that month the third brood of caterpillars was found feeding at the bases of the leaves near the roots. October 9th some imagoes were noticed, possibly a partial fourth brood, though it is likely they were but belated individuals of the third brood. The moth is frequently taken some distance from clover, and this suggests it may have other food-plants. It has been reared from white clover, *Trifolium repens*, and frequents some of the Compositæ, as *Helianthus*.

Exemption of the "Mammoth Clover" from Attack.

That the mammoth clover is not attacked by this insect, is an interesting statement. Its earlier ripening is, as suggested, the probable explanation of its immunity. This variety also escapes the attack of the clover-seed midge, *Cecidomyia leguminicola*, on the authority of a correspondent of the *Farmers' Review* of Chicago, as it ripens its seed between broods of the clover-seed midge, and thus escapes that insect enemy (*Insect Life*, iv, 1892, p. 74).

Distribution.

The economic literature of this insect is quite limited. It is probably widely spread, but its injury to the seed is so much like the clover-seed midge that its effect has doubtless been often ascribed to that of the midge — both operating on the clover-heads in the month of June. Thus far it has only been reported from Washington, D. C., Pennsylvania, New York, Massachusetts, Maine, Illinois, Michigan, Missouri, Iowa, and now from Indiana.

Remedies and Preventives.

The only way known for checking the injuries of the clover-seed caterpillar, and for reducing its numbers, is to cut the clover early in June, soon after the first brood of caterpillars have hatched, thereby preventing their progress to maturity, and the development of moths for a second brood. The hay should be shaken but little and stacked soon so as to destroy by stacking as many of the caterpillars in it as possible.

The following preventives have also been recommended:

Sowing new crops as remote as possible from old and infested fields.

Pasturing infested fields in the autumn so as to feed off the aftermath, thus depriving the hibernating larvæ of many good shelters. If manuring is practised, apply in the spring and of a kind that will leave no refuse in the autumn for shelter.

If the field be badly infested in May or June, it may be well to leave narrow strips uncut to which the moths will be attracted for oviposition and as soon as they have disappeared the strips may be cut and quickly stacked, thus destroying many larvæ. When the clover is to be turned under, this should be done some time in October or November or in early spring when the larvæ are near the ground. The furrows should be turned completely over and rolled so as to bury the larvæ and kill them.

Replying to the inquiry of the safety of the hulled seed,—the seed that is sacked is perfectly safe from further injury by the insect, as no larvæ, pupæ, nor eggs of the moth can remain in it after it has passed the huller.

Parasites.

Prof. Comstock succeeded in rearing a small, light brown Ichneumonid from one of the cocoons, which Mr. Cresson identified as *Phanerotoma tibialis* Hald. It was originally described by Haldeman in the *Proceedings of the Academy of Natural Sciences of Philadelphia*, iv, p. 203, as *Sigalphus tibialis*. It is 3.5 mm. long, of a light brown color and with a large yellowish spot on the back of the abdomen. The insect occurs at Ames, Iowa, though it has not been bred there from *Grapholitha interstinctana*.

Another Ichneumonid, *Glypta leucozonata* Ashm., was reared from this insect by Miss Murtfeldt at Kirkwood, Mo. *Microdus laticinctus* was found to be the most abundant parasite at Ames, Iowa; from about forty *Grapholitha* caterpillars Mr. Gossard reared eleven specimens of the parasite. The number of broods of the two insects correspond exactly it is said, — examples of the parasite usually appearing before the moths fly and lingering until they have all disappeared. *Microdus laticinctus* has also been reared from *Tmetocera ocellana;* its habitat is given as Can., Mo., and Io. *Bracon vernoniæ* Ashm., was observed at Ames, Io., associated with *Grapholitha interstinctana* in marked numbers and under circumstances that tend to indicate its being a parasite of this insect, although it was not reared from clover-seed caterpillars.

Antispila nyssæfoliella (Clem.).

The Sour Gum-tree Case-Cutter.

(Ord. LEPIDOPTERA: Fam. TINEIDÆ.)

CLEMENS: in Proc. Acad. Nat. Sci. Phila., 1860, p. 11 (description of larva and cocoon with account of habits); Tineina N. Amer., 1872, pp. 19–20, 22, 102–103 (life-history).

CHAMBERS: in Canad. Ent., vi, 1874, p. 167 (*cornifoliella* a possible var. of *nyssæfoliella*); in id., ix, 1877, p. 196; in id., xi, 1879, p. 127 (cases of several species); in Psyche, iii, 1880, pp. 63, 149 (habits and molts of larva).

PACKARD: 5th Rept. U. S. Entomol. Comm., 1890, p. 658 (on *Nyssa multiflora* [*sylvatica*] with descriptions after Clemens).

SMITH: Cat. Ins. N. J., 1890, p. 358 (common on pepperidge, *Nyssa sylvatica;* very destructive).

WATERS: in Insect Life, iv, 1891, pp. 137–138 (how the cases are cut).

LINTNER: 10th Rept. Ins. N. Y. for 1894, 1895, p. 510 (received from New York City).

A leaf of *Nyssa sylvatica* was received September 21st, from Dr. H. G. Dyar of New York from which fifteen oval cases had been cut by a leaf-miner which had mined at least four-fifths of the leaf—on one-half of the leaf, only a few spots of the parenchyma remaining. This was undoubtedly the work of the above-named insect. The larvæ of this insect were collected by Dr. Dyar Sept. 15th, and the cases were cut soon after. Early in August of 1891 the insect was observed by Mr. Waters, infesting all the leaves of a sour gum at Glens Falls, N. Y. Dr. Clemens found the larvæ mining the leaves in incredible numbers in earlier years, and Dr. Smith has recorded it as very destructive in New Jersey.

Description of the Moth and Larva.

Head above dark brown. Face, labial palpi and fore-feet shining yellowish-ochreous. Antennæ dark brown; basal joint yellowish-ochreous. Fore-wings dark brown, with a greenish reflection, and the base with a bright coppery hue. Near the base is a rather broad, bright-golden band, broadest on the inner margin, where it is nearest the base, and constricted at the fold of the wing; a spot of the same hue on the costa at the apical third of the wing, and one on the inner margin, midway between this and the band; cilia somewhat coppery, and rather grayish at the inner angle. Hind-wings purple-brown; cilia grayish-ochreous.

The larva mines the leaves of *Nyssa multiflora* [*sylvatica*] in September. The head is dark brown; first segment dark brownish; body very pale green, with dark atoms along the dorsum; ventral surface with a line of two black spots. After the last molting the first segment is black, and the dorsal spots become a black, vascular line. When full fed the larva weaves an oval cocoon within the mine, and cutting the two skins of the

leaf into a correspondent form, permits it to fall to the ground. There is thus left an oval hole in the deserted mine. The imagoes appear during the following May. (Clemens.)

The Larva and its Mine.

In larvæ bred by Mr. Chambers he found "nine blackish spots behind the cervical shield on the dorsal surface, and twelve on the ventral surface." In its last stage, when taken from its cocoon, it was "depressed, fat, snowy-white with the mouth-parts tinged with ferruginous, but otherwise immaculate. It had a single black ocellus about the middle of each side of the head." The larva is completely apodal. There are probably not more than two molts, as Mr. Chambers never met with more than two exuviæ in a mine. The mines are at first linear and finally end in a blotch which frequently in their extension and enlargement, obliterates more or less of the linear portion.

The Pupating Case.

The preparation for pupation has been well described by Dr. Clemens: "The larva weaves an oval cocoon within the mine; and when the upper and lower membranes are well carpeted within its limits, they are cut in an oval form, and the cocoon permitted to fall to the ground." The cutting of the case has been described by Mr. Waters as follows: "I had the good fortune to see the oval holes made by the insect. The cut was made by a swinging of the head from side to side, depressed and then elevated; then the convex edges of the cut were brought together; then the insect turned and in the same way cut the other side. I did not see the final movements, as my attention was called away for a few moments, and when I again looked the pieces were cut off and lay on the bottom of the tumbler, in which a cluster of leaves were, and the edges had been drawn together." Dr. Clemens found that the case was open at both ends after it dropped to the ground and then the larva secured it to surrounding objects by little cables of silk to prevent the rains of autumn and spring from washing it away, and at maturity the pupa is thrust from the delicate cocoon. According to Mr. Chambers it is easier to recognize the species by the variation in the form of the cases than by the markings of the imago. The oval cases are about 0.2 inch in length by 0.1 inch in breadth, and of a quite uniform size and shape.

FIG. 10.—Pupating cases of ANTISPILA NYSSÆFOLIELLA, enlarged. (Original.)

The severed ends of the silken anchoring cables described by Dr. Clemens may be seen at the ends of the cases (Fig. 10).

Items in its Life-History.

Dr. Clemens mentions finding the larvæ mining leaves in the latter part of August and in September, from which one may infer that he failed to find them at other times. The cases received from Dr. Dyar were made during the last half of September. Mr. Chambers found larvæ of all the species as early as July 1st, and in increasing numbers from that time until the fall of the leaves. He succeeded in rearing *A. cornifoliella* in the latter part of July from leaves gathered in that month. The other species he was unable to rear except from mines gathered in the autumn. It would thus appear quite probable that there are two generations of this insect in a season. There is no record of the time required to complete the life-cycle, except that of the autumnal brood, and even that is not complete.

An Allied Species.

This insect is similar in habit to the resplendent shield-bearer, *Aspidisca splendoriferella* Clem., which mines the leaves of the apple-tree in a similar manner and has also the same habit of cutting cases from the leaves in which the larvæ pass the winter and pupate and from which the pretty moths emerge the following May. Unlike *Antispila nyssæfoliella*, the resplendent shield-bearer does not allow its case to fall to the ground, but fastens it securely to a twig or branch of the tree.

Remedy.

In the event of the insect multiplying to the extent of becoming injurious to species of Nyssa grown for ornament, either by mining the leaves or riddling them with holes, an effective remedy should be found in thoroughly spraying the ground beneath the attacked trees in the late autumn or early spring with undiluted kerosene or a strong kerosene emulsion. This would reach and kill the insect within the fallen pupating cases remaining underneath the tree, securely anchored to the dead grass or other permanent objects instead of to the leaves which would easily be carried away by winds.

Tischeria malifoliella (Clemens).

The Apple Leaf Miner.

(Ord. Lepidoptera: Fam. Tineidæ.)

Clemens: in Proc. Acad. Nat. Sci. Phila., 1860, xii, p. 208; Tineina N. A., 1872, pp. 141–142 (brief descr. of larva, mine, and imago).

Chambers: in Canad. Entomol., iii, 1871, p. 208 (food-plants); Tin. U. S.-Can., in Bull. G.-G. Surv., iv, 1878, p. 165; in Canad. Entomol., v, 1873, p. 50; in id., vi, 1874, p. 150; in Cin. Quart. Journ. Sci., ii, 1875, p. 111; in Psyche, iii, 1880, p. 68.

Frey-Boll: in Stett. Ent. Zeit., xxxiv, 1873, p. 222 (occurrence in Germany).

Packard: in Bull. 7 U. S. Ent. Comm., 1881, p. 136 (mine and food-plants).

Lintner: 1st Rept. Ins. N. Y., 1882, p. 330; Rept. to Regents for 1886 [Third Rept. Ins. N. Y.], in 40th Rept. N. Y. St. Mus. N. H., 1887, p. 137; 7th Rept. Ins. N. Y., 1891, p. 354; in Count. Gent., lvii, 1892, p. 809 (mines, distribution, remedies).

Brunn: in 2d Rept. Dept. Entomol. Cornell Univ., 1883, pp. 155–157, pl. 6, figs. 1–1 d (life-history, etc.).

Saunders: Ins. Inj. Fruits, 1883 and 1889, pp. 114–115 (brief notice).

Weed: in 15th Rept. Ins. Ill., 1889, pp. 45–50, figs. 1–1 d on p. 45 (literature, description, distribution, life-history, parasites, remedies).

Walsingham: in Insect Life, ii, 1890, p. 326 (in Texas).

A box of apple leaves, sent from Schenectady, N. Y., to show the condition of the foliage of an orchard in early autumn, was received during the last of September. A similar condition of the leaves had been observed in August of the preceding year.

The Insect.

The leaves had been extensively mined by the caterpillar of a Tineid moth, known as *Tischeria malifoliella*. The winged insect is a small creature, as are most of the Tineidæ, measuring only across its spread wings, about one-fourth of an inch. The front wings are of a brilliant dark brown color, shaded with purple and sprinkled with numerous yellowish dots: the hind wings are dark gray. The full-grown caterpillar measures two-tenths of an inch in length. Its head is black or dark brown, circular, flat, and nearly as broad as the first segment; its body pale green with a green dorsal stripe (with the exception of the first segment, which is brownish), broad anteriorily and tapering slightly toward the end. The several segments are so deeply cut (more so than in the figure cited) as to give almost the appearance of a series of connected balls.

The Mines.

The larva on hatching eats into the upper surface of the leaf, leaving a small white spot and slender white line as the commencement of its mine. This gradually widens and curves in a trumpet shape, or like that of a mussel, and at this stage is crossed with a series of gradually enlarging white crescents, contrasting with the brown of the interspaces. Later in the season, as shown in the leaves collected on September 22d, the mine becomes enlarged into a broad patch, inclosing the crescent-marked trumpet-form and almost obliterating it, yet by careful examination it can always be found. The thin and wrinkled epidermis of the leaf which covers the mine becomes of a dull reddish color, and at times, when the mines are numerous, almost the entire upper surface has assumed this peculiar brick-red color. The mines do not show on the under side of the leaf, but when held to the light and viewed from above they are readily seen.

Its Life-History.

It is not known definitely when the eggs of the moth are deposited, but as it has been seen abroad in May, it is presumably toward the latter part of that month or in early June. The egg seems not to have been observed. The growth of the larva is slow, for, when observed toward the last of September, it was immature and still feeding. It probably feeds until prevented late in the season by the drying of the leaf. According to Clemens, the larva is remarkably cleanly in its habits, and instead of allowing its "frass" to accumulate within its mine, it ejects the pellets through small round holes in the under surface of the leaf. It hibernates within the leaf in its larval stage. Preparatory to pupation, it densely lines the upper and lower surfaces of the mine with silvery white silk. "In the spring it transforms to a pupa at one end of the mine, making no cocoon, and in a short time forces its way partly out through the upper surface of the mine and there gives forth the moth" (Brunn). A single example of the pupa has been seen, and its description given by Mr. C. M. Weed, *loc. cit.* Mr. Brunn has published a detailed description of the larva.

Its Injuries Seldom Serious.

We do not hear of any particular harm from this insect. Even when the foliage shows so severe an attack as in the leaves received, it occurs so late in the season — usually brought to notice in September — that it can not interfere materially with the functions of the leaves. The action of the lower surface of the leaf which is of principal importance, would be scarcely affected by its presence.

Distribution.

It is not uncommon in the State of New York, but occurs locally, in various portions of it. Prof. C. M. Weed represents it as very generally distributed throughout Illinois, being common in nearly all the orchards and nurseries examined by him. He has also recorded it from Kentucky, Michigan, and Pennsylvania. Lord Walsingham has received it from Texas. It was also found by Prof. Frey, in Germany, in 1871, within the leaves of apple trees imported from this country.

Food-Plants.

This insect is not restricted to the apple for food, but has also been observed mining the leaves of different species of *Cratægus*, the sweet-scented crab, blackberry, raspberry, and dewberry (*Rubus Canadensis*). and will doubtless be found on others of the Rosaceæ.

Remedy.

If this species should ever become annoyingly abundant a simple and effective remedy would be gathering the fallen leaves from beneath the trees that have shown in the autumn indication of the attack and burning them.

Cecidomyia betulæ (Winnertz).

The Birch-seed Midge.

(Ord. DIPTERA: Fam. CECIDOMYIDÆ.)

WINNERTZ: in Linnæa Entom., viii., 1853, p. 234 (original description),
LOEW, F.: in Verh. Zool. Bot. Gesell. in Vienna, 1878, pp. 15–17, Taf. iv., fig. 4 (figures gall; corrects description).
WACHTL: in Entomol. Biolog. Studien, Serie i, 1878, pp. 9–11 (found on a Swedish var. of *Betula pendula*, viz., *valecardia*).
LINTNER: in Country Gent., li., 1886, p. 287 (discovery recorded); the same in 3d Rept. Ins. N. Y., 1886, pp. 85–86, 141, 143; 4th do., 1888, pp. 27, 205, 206 (parasites of).
TRAIL: in Scottish Naturalist, 1888, same in separate, as, Gall-making Diptera of Scotland, p. 31 (mention).
THEOBALD: British Flies, 1892, p. 63 (brief account).

Catkins of the white birch infested with footless, orange-red larvæ were communicated by Mr. W. H. Payne, Albany, N. Y., on March 25, 1886, and a little later the same insect was found by me infesting the catkins of birch in Washington Park. In the following October the larvæ were so abundant in Washington Park that of several white birches

of which the catkins were examined, each and every one showed many of the seed-galls. Of some of these, more than one-half of the seeds were infested, and a number of galls were observed to contain two larvæ. On October 9th they were apparently mature and ready for pupation, the window-like spot for the escape of the insect being visible. The presence of the insect is easily recognized by the transformation of the normal alate seed into a globose ball, displaying on its side a round spot where the shell has inwardly been eaten to a thin pellicle to admit of the escape of the contained insect. (Pl. I, fig. 1, *a*, *b*, *c*.)

The insect was also found in catkins examined in other parts of Albany; quite abundantly on a small birch on the grounds of Grace Protestant Episcopal church; and at West Albany, near the railroad station.

Identification of the Insect.

From catkins collected May 3d in Washington Park, a number of the imagoes were obtained the same day and on a few following days examples of which were submitted to Baron Osten Sacken, who pronounced them identical with the European *Cecidomyia betulæ* Winnertz. At this time it was found that many of the galls had already disclosed their occupants. Some infested catkins which had been collected by me during the month of October, 1886, failed to give any of the producing insects, probably from having been deprived of moisture during the winter and spring, as Mr. Inchbald had stated in a letter to me, that they require moisture for their development and need to be sprinkled with water occasionally.

Development of the Larvæ.

Catkins collected September 11, 1896, in Washington Park, were found to be quite abundantly galled. At this time the larvæ varied from the full grown ones in white cocoons and with distinctly windowed galls, to small individuals not one-sixth their size; most of them were full grown though not with distinct windows. On the 18th inst. it was found that all the larvæ were full grown, each with a distinctly windowed gall; they had shrunken a little and become more rotund and the surface of the skin was finely corrugated. Each was surrounded with a white cocoon, and it is evident that they pass the winter in this condition.

According to Theobald, the larvæ of this species pass the winter in the seed-capsules of the birch, *Betula alba*. They pupate in the same place, sometimes two lying side by side in the same capsule. The perfect insect appears the latter part of March and during April.

European History of the Insect.

Baron Osten Sacken, in response to an inquiry, has kindly given me the following account of its occurrence in Europe:

The gall you send also occurs in Europe on *Betula alba;* it was first discovered by Kaltenbach, who communicated it to Winnertz. The latter published a rather imperfect description, drawn from dry specimens (*Cecid. betulæ* male and female, in Linnæa Entom., viii, p. 234; 1853). In 1878 Dr. Franz Löw in Vienna published an article on the same fly *with figures of the gall;* he corrected some of Winnertz's statements, showing for instance that the male antennæ count 14, the female antennæ 15 joints (Verh. Zool. Bot. Ges. in Vienna 1878, pp. 15–17, Taf. IV, fig. 4). In the same year, 1878, but independently from Löw, Mr. Wachtl in Vienna described and figured the same gall in his Entomol. Biolog. Studien, Serie I, pp. 9–11. He found it not only on *Betula alba*, but also on a Swedish variety of *B. pendula*, called *B. valecardia* Linn. He also bred a parasite, *Torymus pallidicornis* Boh., and found the pupa of the fly, *Leucopis griseola* among the galls.

Description of the Insect.

The following description of the larva has been prepared from specimens taken from the galls September 11, 1896.

Larva (full grown).—Length 0.06 in.; width about 0.02 in.; form oval; color a light orange; segments distinct—14, as in other Cecidomyid larvæ. The skin is smooth and is sparsely invested with glandular, seta-like processes which are longer anteriorly—they appear more like direct continuations of the dermis than ordinary setæ. The structure of the head could not be determined satisfactorily from the material at hand.

Later the larva becomes somewhat thicker and more rotund: color a deep orange; surface of the skin finely corrugated and without the seta-like processes described above. It was inclosed in a fine white cocoon which is probably excreted as it appears to have no filamentous structure even under a powerful microscope—possibly the cocoon is excreted by the seta-like processes.

"The perfect insect is a dusky yellow, with the top of the thorax black; the abdomen also occasionally dark. Legs pale yellow. Antennæ dark brown, 12 to 13 jointed in male, apical joint with a very short petiole; in the female 12 sessile joints. Wings limpid; transverse veinlet placed a short distance before the middle of the first longitudinal vein [? subcosta]; second longitudinal [radius] nearly straight, joining the costa near the tip of the wing; the second branch of the third longitudinal [cubitus] bending round to the hind border. Halteres grayish-white. Third segment of oviduct white; no valves." (Theobald.)

In the male the petiole of the terminal segment of the antenna is very short or wanting (Pl. I, fig. 3). In the female the apical segment is much longer and apparently double, as a slight constriction divides it; arrangement of setæ and processes somewhat verticillate (Pl. I, fig. 4). The male antenna is composed of 14 segments, and an equal number obtains in the female if the terminal, semi-double segment be counted as one. The discrepancy in earlier writers is due to difficulty in seeing all the segments and possibly to variation in the number in some individuals.

In the specimens before me the transverse veinlet is absent, unless it is represented by a chitinous process near the basal sixth of the first longitudinal. The third longitudinal vein (cubitus) is not forked, but is as represented; its tip curving to the hind margin of the wing (Pl. I, fig. 2). The empodium is large; lateral aspect suboval; ventral aspect triangular; claws strongly curved (Pl. I, figs. 5, 6). The terminal segment of the male is subquadrate, relatively small, and is carried with its tip turned upward; the large subtriangular clasps bear a number of long setæ and numerous very fine ones (Pl. I, fig. 7).

Its Chalcid Parasites.

From galls received through the kindness of Mr. Peter Inchbald of Fulworth Grange, Harrogate, England, three species of Chalcid parasites were obtained, which were determined by Mr. Howard, as *Torymus* sp., female, *Tetrastichus* sp., and *Entedon* sp.— one female and five males.

Some galls, gathered in Albany on March 21st, which had begun to disclose their imagoes on May 5th, also gave out quite a number of Chalcid parasites, the first of which made their appearance on April 28th. Others emerged about the middle of May, and continued to appear until the 25th of June, the last date recorded. These were also submitted to Mr. Howard, who found them different from those bred from the examples received from Europe, and for which a new genus would probably have to be founded. In some characters they come close to *Merisus*, of which Dr. Riley bred and described two species from *Cecidomyia destructor*, but they are separated from this genus by the metanotal and claval characters.

Diplosis cucumeris n. sp.

The Melon-vine Midge.

(Ord. Diptera : Fam. Cecidomyidæ.)

Lintner: in Country Gent., liii, 1888, p. 725 (attack recorded, name proposed); 5th Rept. Ins. N. Y., 1889, p. 306 (reference); 8th Rept. do., 1893, p. 212 (as in C. G.; referred to *Cecidomyia* in each case).

"Shoots" of muskmelon were communicated by Mr. T. C. Barker, of Lowell, Mass., in August of 1888, and again in September of the follow-

ing year. They showed a quite interesting form of attack, in which the smaller leaves had been transformed into small, irregular, subovate, downy galls. These gave out their insects, which were found to be a species of *Diplosis* new to science and its description is herewith given.

Description.

DIPLOSIS CUCUMERIS n. sp. Plate II.— Eyes black, coarsely granulate, deeply emarginate anteriorly, and composing most of the head. Vertex with a small tubercle bearing a large curved seta; similar setæ appear to arise near the posterior margin of the eyes and curve anteriorly (fig. 1). Front dull yellowish. Male antennæ over twice the length of the body, each composed of fourteen segments; basal two short; the others much elongated, and with a basal and a medial enlargement; basal enlargement subspherical and separated from the medial by a cylindrical shaft of about twice its length and half its diameter; distal portion of the segment of the same size and a little longer (fig. 4). The medial enlargement is usually somewhat irregular, over twice the length of the basal, and tapering proximally; each end constricted roundly to the naked shaft. Bulbs or enlargements clothed with numerous short hairs and bearing at the place of greatest enlargement whorls of long setæ; the two longest of which on the dorsal side are two to three times the length of an entire segment (shown in part at fig. 4, *a*, *b*), the others are about half the length of a segment; on the larger bulb there is a submedial whorl of shorter setæ. There are also three whorls of arched filaments, "*filets arqués*," which arise from pits in a similar manner to that of setæ. From each pit arises single stems which quickly branch; these bend and recurve to the adjoining pits in the whorl where they unite with the stems arising therefrom, and thus each whorl is a continuous structure extending around the segment. The components of the whorl of the basal bulb vary considerably in length, most of them being but little longer than the bulb itself (fig. 4, *e*), though a dorsal one is prolonged to a length one and a half times that of the segment (shown in part at fig. 4, *c*). On the larger bulb there is a basal whorl of arched filaments about two-thirds the length of the bulb (fig. 4, *f*), and at its apex another extending nearly to the tip of the segment (fig. 4, *g*), excepting the dorsal arch which is prolonged to a length of twice that of the entire segment (shown in part at fig. 4, *d*).*

In the female, besides the two small basal segments, there are twelve vase-shaped segments (fig. 3); pedicel distal, naked, and enlarged at both extremities; body of the segment gently rounded out and bearing setæ which in length are nearly equal to that of a segment and numerous very small ones between; the large setæ show a tendency to form ill-

*These arched filaments, *filets arqués*, were described by Kieffer (*Bull. 7 des Séances Ent. Soc. Fr.*, 1895, p. cxcii-cxciii). The same year Reuter (*Acta Societatis pro Fauna et Flora Fennica.* xi, No. 8, 1895, pp. 11–12) questions the accuracy of the description and thinks these processes to be membranous lobes with thickened borders. The following year Janet (*Bull. 7 des Séances Ent. Soc. Fr.*, 1896, pp. 183–185) supports Kieffer in his description of these processes, and advances a theory to account for their development. If a membrane is present, it is extremely attenuated. It is worthy of note that to all appearances these processes arise in the same manner as setæ, except for the anastomosis.

In a preparation of the male antennæ of *Diplosis pyrivora* Riley, a number of the arched filaments became loosened and escaped from their attachments but the anastomosis, where each arch is joined to the base of the next, remained unbroken and distinct. In this preparation the components of the arches may be seen diverging at various angles—another evidence in favor of there being no connecting membrane.

defined whorls at the extremities of the enlarged portion of each segment, but there are a number scattered over the entire enlarged part; antennæ equal in length to the abdomen. In dried specimens many of the antennal segments in both sexes are considerably distorted, and the same may possibly be true of living individuals; third segment about one-half longer than fourth. Mouth-parts yellowish; labial palpi long, compressed, four-segmented, the third and fourth segments two to three times the length of the second, all bearing scattering, stout setæ; labium densely setose.

Thorax light brown with a few scattering microscopic hairs on the dorsum; scutellum prominent, domed, yellowish, and with several long bristles laterally. Wings large, hairy; second longitudinal vein (radius) joining costa beyond the apex. Halter long, slender, clothed with hairs, and dilated apically. Coxæ large, hind pair extending to the third abdominal segment; trochanter subcuboidal; femur slender, gibbous apically and extending beyond the tip of the abdomen; tibia of nearly equal length and dilating gradually distally; first tarsal segment very short, second about equal to tibia, third one-half second, fourth a little shorter, and terminal very short and with two claws (fig. 5). First and second pairs of legs longer than third, all clothed uniformly with coarse, slightly curved hairs similar to those of the wings and abdomen.

Abdomen grayish, thickly clothed with hairs, and with long setæ arising from hind margin of segments, especially laterally. In the female the fourth and fifth segments are slightly stouter, the posterior tapering to the short ovipositor (fig. 1). The male bears the terminal segments partly curved over the back. Two lateral pieces support the large, curved claspers, which are nearly as long as the segment and obtusely rounded at the apex. They are borne in a crossed position with their tips toward the base of the segment (fig. 7). Protruding below, the tip of penis may be seen — represented in outline at fig. 6. Ovipositor of female apparently short, ellipsoidal, and but slightly extruded.

Length of body 0.075 inch, of wing 0.1 inch. Described from four males and eleven females.

In the first sending of Mr. Barker on August 27, 1888, the Cecidomyids had probably been given out about the 1st of September, for upon opening the box on September 12th, all except one example were found dead.

The second sending on August 13, 1889, when opened on September 7th, contained nine dead Diplosis with their pupa-cases. In 1892 additional material was received from Mr. Barker, who had changed his residence to another portion of the city in the meantime. Thus it would appear that the insect has become one of those which regularly attack the melon and that it is not confined to a single locality.

In the box in which the above were bred, several Chalcids were found in two species. They were sent to Washington for examination and Mr. Howard returned answer that they were *Lysiphlebus cucurbitaphidis* Ashmead, and *Isocratus vulgaris* Walker — in all probability parasitic on

the common cucumber plant-louse. The melon leaves and tips when received were badly infested with this aphis, *Aphis cucumeris* Forbes, and had been sent for the purpose of showing the extent of their injury and obtaining a remedy for it.

Diplosis setigera n. sp.

The Hairy Melon-vine Midge.

(Ord. Diptera: Fam. Cecidomyidæ.)

The preceding insect was reared from melon-tips for several years and it was only after close study that a second species was discovered operating in a similar manner. The general appearance of the two insects is so close that they might easily be confused, and only during the year of 1891 were specimens of this species secured; the rearings of former years were all *D. cucumeris*. It is worthy of record that two distinct species of this genus are injurious to melon-tips, and it will be seen by the following description that they are by no means so closely allied as one might possibly expect from their attacking the same plant and upon the same grounds at Lowell, Mass.

Description.

Diplosis setigera n. sp. Plate III.—Eyes black, coarsely granulated deeply emarginate anteriorly, broadly united dorsally in the male, less so in the female, and composing most of the head. Numerous large setæ arise on the dorsum of the head and curve anteriorly. Male antenna one-fifth longer than body, composed of fourteen segments, basal two short, the others much elongated; basal and medial bulbs subspherical, nearly equal; subbasal and distal shafts equal (fig. 1); on each bulb there is a whorl of setæ (*s*) of nearly uniform length which extend about to the next bulb; there is also on each bulb a whorl of arched filaments, "*filets arquès*" (*a*), of a length nearly equal to that of the setæ and arising just distal of them. Female antennæ a little shorter than body, composed of fourteen segments; the two basal short; third about one-half and fourth a little longer than the normal segments; the others are nearly cylindrical, a little over twice as long as broad and pedicellate distally (fig. 2); each segment with a well-defined whorl of large setæ at its base, a less complete whorl at the apex of the enlargement, the latter invested with numerous small setæ; the small ones are absent along certain lines on the enlargement and the naked places are occupied by what appear to be transparent tubercles, but which are probably special sense organs; there is a transverse row at the basal third and oblique rows pass over the distal angles of the enlargement; the basal and apical rows are connected by longitudinal rows; there are also a few scattering tubercles near the latter; the more usual arrangement of these interesting structures is shown

in fig. 2, and at *y*, *y*, two of the more prominent tubercles are shown in outline. Labial palpi 4-segmented; basal short; second and third nearly equal, about twice the length of the first; the fourth as long as the intermediate two. Labium yellowish, bearing a few stout setæ, and rounded anteriorly.

Thorax: dorsum black, villous; pleura brownish; scutellum domed. Pedicel of halter slender; distal portion subelliptical in outline, villous, yellowish. Wings large, densely villous and with a yellowish cāst; second longitudinal vein (radius) joining costa beyond the apex of the wing; margin of the wing densely ciliate and slightly sinuate at the tip of the first branch of the third longitudinal vein. Coxæ large, rhomboidal; hind pair extending to the third abdominal segment; trochanter subglobose; femora stout, slightly gibbous distally, hind pair extending beyond the tip of the abdomen in the male; tibiæ rather stout, one-fifth shorter than femora gibbous apically; tarsi slender, first segment very short; second nearly equal to tibia; third, one-half second; fourth, two-thirds of second; and last one-half of fourth, and bearing a pair of stout, recurved claws and a well-developed empodium (fig. 4).

Abdomen of male brownish-black, with numerous long setæ; the fifth and sixth segments are the largest, from which it tapers slightly to the eighth; the following segment bears the appendages; the side pieces are large and rounded laterally and posteriorly, from their latero-posterior portions the claspers arise from a broad base and taper rapidly to a rounded apex.

Abdomen of female villous, tapering posteriorly; seven distinct segments visible besides those modified to form the extensile ovipositor, which consists of a long, stouter, basal segment and a much more slender terminal segment (fig. 3), which latter bears at its tip a pair of minute processes (fig. 3, *c*).

Length of body, exclusive of appendages, 0.08 in.; of wing, 0.11 in.

Compared with the Pear Midge.

This species is closely related to the pear midge, *Diplosis pyrivora* Riley. It is apparently a more hairy form, though the badly rubbed condition of the specimens of the pear midge examined would not permit of the formation of a very accurate opinion in regard to this point. The structure of the male antennæ in both species is quite similar; in *D. pyrivora* the arched filaments differ only in being much denser and darker in color than in *D. setigera*—the general arrangement of filaments and setæ is apparently the same. The orderly arrangement of the transparent tubercles on the female antennæ, described above, is not so apparent in *D. pyrivora*, though the tubercles are larger than in *D. setigera*. The facets of the eyes in the male are smaller and more distant than in *D. pyrivora*, and the same is probably true in the female. The apical portion of the halter is suborbicular in outline in *D. pyrivora* while in *D. setigera* it is subelliptical. Wings apparently much more

hairy than in the pear midge. The ovipositor in the female of *D. pyrivora* is much longer and more slender, and terminates in lanceolate, acuminate genital valves.

Anthomyia sp.?

The Raspberry-cane Maggot.

(Ord. DIPTERA: Fam. ANTHOMYIIDÆ.)

About the middle of May, wilted and blackened tips of raspberries were received from D. F. Harris, of Adams, Jefferson county, N. Y., which at the first sight were thought to be the result of the operations of the raspberry-cane girdler, *Oberea bimaculata*, but on examination the peculiar girdling punctures were not to be found. On request, a large number of tips were sent, that the insect, which proved to be unknown, might be reared and identified. The infested tips first soften, then bend over, blacken, dry, and break off at an average distance of about six inches from the end. In fresh tips received, the discoloration at first was about an inch in extent, but gradually advanced for two or three inches down the unshriveled portion of the cane. The larva causing the injury was usually found in a short burrow in the pulpy matter at the lower part of the discoloration. It is shining-white, pointed at the head and obtuse at the other extremity, and showing in transparency a v-shaped internal organ of which the apex is toward the head. The attempt to rear the larva was not successful, as the tips under different methods of treatment were so quickly attacked by mold that the larvæ soon died.

Observed in Canada.

It was evidently dipterous, and is probably the "raspberry-cane maggot, *Anthomyia?*" of Mr. Fletcher, mentioned in Bulletin 11 of the Central Experimental Farm of Canada, May, 1891. The insect was not identified by Mr. Fletcher. He has simply published of it: "This is the maggot of a small black fly which lays a single egg in the axil of one of the upper leaves. The young maggot bores down the stem until full grown, and then changes to a brown puparium inside the stem." On request made to Mr. Fletcher for any additional knowledge that he may have subsequently secured of it, he has kindly replied:

"I am sorry to say that I have never had another opportunity to study the Anthomyian in raspberry canes. I have never found it except in one garden here [Ottawa], where it occurs intermittently, and has not been abundant since I first observed it, until last year, and then unfor-

tunately I did not hear of it until too late to obtain specimens. I am ashamed to say that I have allowed all my first collections to be destroyed by *Dermestes*, and have nothing but one wing left. I remember reading somewhere that Mr. G. C. Davis, of Michigan, had detected it in some numbers."

Observed in Michigan.

Mr. Davis has referred me, as containing all that he knew of the insect, to a brief notice entitled: "A Dipteron Raspberry Girdler," published in *Insect Life*, vii, 1894, pp. 199–200. His attention had first been called to it by a fruit-grower in Lansing, Mich. On visiting the locality it was found that about half of the young shoots had been killed by the maggot early in May. The infested tops had been destroyed as soon as seen and only a few specimens could be secured. The larvæ were then "about five mm. long, white, with black jaws, truncated posteriorly and sloping gradually to the pointed head. In general appearance they resemble very closely the larvæ of Anthomyiidæ. They work only in the young shoots of the black varieties. Entrance is made near the top of the shoot in a leaf axil, and from this entrance the larva works its way in an irregular course down through the pith until within a few inches of the ground, when it girdles the cane ['by making a complete circle near the outside of the shoot so close to the bark that it can be distinguished by close inspection without breaking the stems']."

Only the one berry patch at Lansing was found to be infested. Two weeks later Mr. Davis heard of the work of the insect in the same manner, at Costello, Pa., where the injury to the canes was stated to be considerable.

By transferring the larvæ every few days to fresh shoots Mr. Davis succeeded in feeding them until the last one had attained a length of 11 mm. when it died.

How the Attack may be Indentified.

The attack of this insect may always be readily distinguished from that of the raspberry-cane girdler, notwithstanding the bending over of the tips in the same manner, by the absence of the two rings of punctures about an inch apart, between which the egg of the beetle, *Oberea bimaculata*, is placed—the position indicated by a dark colored spot marking the puncture. For account of this insect, see Saunders' *Insects Injurious to Fruits*, and *Fifth Report on the Insects of New York*, 1889. Moreover, the two attacks may also be separated by that of the fly occurring during the middle of May when the canes are but a few inches in height, and that of the beetle, toward the latter part of June.

Its Probable Occurrence in Pennsylvania.

With this difference in time in mind, the error has just been detected of my referring to the *Oberea* a raspberry cane attack in Great Bend, Pa., given in the *Country Gentleman* of May 23, 1878 (page 328) as follows:

"To-day [May 14th] as I entered my patch of choice raspberry bushes, I found that the tops of nearly half of the young canes, which are from a few inches to nearly two feet above the ground, were wilted and lopped down. On a closer inspection I found that a very small white worm had entered the cane from three to eight inches from the top and eaten clear around close inside the bark. I fear that my crop for next season will be ruined."

There can hardly be a question that the above was the work of the Anthomyia fly larva, and not that of the beetle. This would give us at present the following known localities for the insect, although in all probability it is pretty widespread, but has often been mistaken for that of the *Oberea:* Ottawa, Canada; Lansing, Mich.; Adams, Jefferson county, N. Y.; Costello, Potter county, Pa.; and Great Bend, Susquehanna county, Pa.

Remedy.

The wilting of the tips of the canes is so conspicuous that the presence of the insects may be at once recognized. By cutting off the tips containing the young larvæ and destroying them, the attack can be arrested, and if a local one, immunity from its repetition secured unless through a new introduction.

Anthrenus scrophulariae (Linn.)

The Carpet Beetle.

(Ord. Coleoptera: Fam. Dermestidæ.)

Mrs. H. A. Pratt, of Gloversville, N. Y., communicates the fact of her finding hundreds of the beetles collected on the spikes of the blossoms of the garden rhubarb (*Rheum rhaponticum*), where she watched them for two or three days. In the sunshine, they readily took wing, and at nightfall their number was much smaller and they seemed quite stupid. From their returning the following day with the sunshine, in full force, it was thought that they may have sought a warmer place for the night, or had fallen to the ground, as many had been seen to do, and remained there during the period of rest.

Fig. 11. — The Carpet beetle, Anthrenus scrophulariæ. (After Riley.)

Mrs. Pratt suggested that their fondness for these flowers might be utilized for collecting and gathering them for subsequent killing by crushing or scalding; and that if the plants were cultivated in gardens, and allowed to blossom, the beetles would be drawn from our houses to feed upon them.

That they would serve as attractive food-plants for drawing the beetles is very probable, and similar suggestions for the growing of peonies, spiræas and other blossoms known to be frequented by them, have previously been made, but it is very doubtful if it would aid in lessening the ravages of their larvæ within doors. The general opinion is that the first business of the mature beetle, after mating, is the deposit of eggs in places where its young may find their proper food, beneath carpets and other woolens, and then to make their exit through the windows to seek the moderate amount of food that the mature insect requires during its brief existence. No eggs have been found in the ovaries of such as have been examined which had been taken while feeding on flowers, apparently indicating that killing them at this time would serve no useful purpose. It is recalled, however, that the beetles are frequently found in copulation on flowers in our parks, and from this it would seem possible that the eggs were still to be deposited in houses to be entered for the purpose.

In this possibility, it would be well if the females taken in copula, on flowers late in June, could be examined for eggs that they might contain at this time. Possibly the eggs of Anthrenus are not developed till late in life, and that an amount of food is needed for their development, as Prof. Smith has shown to be the case in the rose-bug, *Macrodactylus subspinosus*, where the female feeds for from ten to fourteen days before the commencement of her oviposition. (See Twelfth Annual Report of the New Jersey Agricultural Experiment Station for the year 1891, page 355.)

Prof. H. M. Seeley, of Middlebury College, Vt., has also sent me *Anthrenus scrophulariæ* taken from the blossoms of the garden rhubarb, under date of June 1, 1887.

As everything in relation to the destructive habits of this household pest is of interest, it may be mentioned here that statements have been received of this beetle having eaten holes into lace window curtains. These have seldom been credited, but in one instance it was not doubted, where it appeared that the hole had been made for the purpose of reaching the body of a cut-worm moth, *Agrotis* sp., which lay within its folds. The Anthreni are very fond of other dead insects, and our collections are not infrequently visited by *A. scrophulariæ*.

The following translation from Olivier — an entomologist of the preceding century, may be of interest as containing some information respecting the peculiar

Habits and Transformations of Anthrenus Larvæ:

The Anthrenus larvæ [of some species] pass nearly a year in this state, eating and destroying insensibly the ligaments that hold together the bones of animals, skins, hairs, feathers — in one word, all animal materials which are not in fermentation, and which are somewhat dried. They occur indifferently in all seasons of the year, but the time in which they are the most abundant, and in which they commit the greatest ravages, is toward the end of summer, when they have nearly acquired their full growth. They pass the winter either in the state of larva or of pupa, and the perfect insect does not ordinarily appear until in the spring; still, they are seen in all seasons, yet in fewer numbers. The larva, in growing, changes its skin several times, but that which is very singular, is that it does not leave the larval skin when it passes into the pupal state; the skin only parts along the length of the back, the borders of the fissure recede one from the other, and leave an opening which will facilitate the emerging of the perfect insect. It should be farther observed that the larval skin is not adherent to that of the pupa, but is entirely disengaged therefrom; and when it undergoes its final metamorphosis, and the perfect insect shows itself, the pupal skin opens along the back, at the place where the larval skin is already open; the insect escapes by this opening, leaving, one within the other, the two skins that it has abandoned — that of the pupa and that of the larva. (Olivier: *Encyc. Method.— Hist. Nat. Ins.*, 1789, iv, pp. 148, 149.)

Pyrophorus noctilucus (Linn.).

The Cucuyo.

(Ord. Coleoptera: Fam. Elateridæ.)

Linnæus: "Mus. Lud. Ulr. [1764], 81;" Syst. Ent., Edit, xii, i, pars ii, 1767, p. 651, no. 4 (as *Elater noctilucus*).

Fabricius: Ent. Syst. em., i, pars ii, 1792, p. 218, no. 10 (as *Elater noctilucus;* habitat).

Westwood: Introduct. Class. Ins., i, 1839, pp. 239, 241–242 (general description, habits, synonymy).

Kirby-Spence: Introduct. Entomol, 6th Ed., 1846, pp. 540–542 (as *Elater noctilucus*, its light, habits).

Perkins: in Amer. Nat., ii, 1868, pp. 422–432, 1 fig. (general account of appearance and habits).

Packard: Guide Study Ins., 1869, p. 462, fig. 425 (brief notice).

Figuier: Insect World, 1872, pp. 512–514, fig. 554 (popular account).

Glover: in Rept. U. S. Dept. Agr. for 1873, 1874, pp. 154–155, fig. 4 (reference).

Wood: Insects Abroad, 1874, pp. 159–165, fig. 160 (popular account).

DIMMOCK: in Kingsley's Stand. Nat. Hist., ii, Crust.-Ins., 1884, pp. 362–363, fig. 415 (brief notice).

TASCHENBERG: Brehms Tierleben, Insekten, ix, 1892, pp. 111–113, 1 fig.

Although the insect is not a member of the New York fauna, or even that of the United States, a brief notice of it in this volume, may be pardoned in consideration of the frequency with which examples of it are brought to our notice by those whose interest has been excited by its wonderful light-giving power, and are desirous of information respecting it.

It is the famed lightning-bug of Tropical America, known by the natives as the *Cucuyo*, and is represented in figure 12. Several living examples of it were contributed, June 16th, to the State Entomological Collection by Mrs. Edmund H. Smith of Albany. They had been brought to her a short time previously by a relative who collected them in the Island of San Domingo.

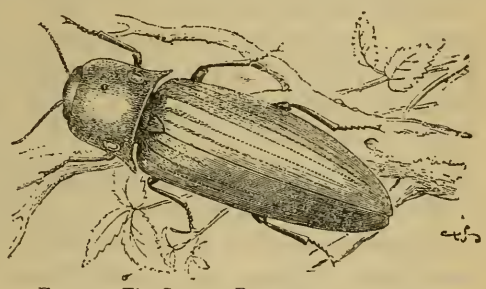

FIG. 12.— The Cucuyo, PYROPHORUS NOCTILUCUS. (After Wood.)

They are large beetles, of about one inch and a half in length, belonging to the family of *Elateridæ*, popularly known as snapping-beetles, from their habit of springing several inches in the air as the only means by which they can regain their feet when placed or fallen upon their back. This is accomplished through an apparatus (spine and socket) on their lower side, specially designed for the purpose.

They belong to the genus *Pyrophorus* of Illiger, which has but a single representative in the United States, viz., *Pyrophorus physoderus*— a species which is said to be plentiful on the pine-barrens and among the saw-palmettoes of Florida in the month of August, and of which an interesting account is given in Mr. Glover's Report for the year 1873.

The genus has large representation in South America,—about one hundred species, according to Dimmock, being known. Two species have recently been described from New Caledonia, an island in the Pacific ocean.

The scientific name of the tropical species under notice, *Pyrophorus noctilucus*, has been aptly chosen, as it means "the night-flying light-giver." Unlike our common lightning-bugs which with their graceful flights attract admiring eyes in the evenings of June, these do not emit their light in fitful flashes from the tip of their abdomen, but from the two

small oval wart-like spots near the lateral borders of their prothorax, not far from the head. These spots are ordinarily of a dull yellowish-white color, but when the insect is disturbed or when in flight, they quickly light up with a yellow-green glow that is almost dazzling to the eye. So brilliant is it that it is conspicuous in broad daylight. At night, the hour may be told upon even the yellow face of a watch when held near it, and it is claimed that a printed page may be read by its aid.

On the under side of the body between the thorax and the abdomen, is another quite large light-giving place of a lenticular form, covered with a thin membrane, and only seen when the body is arched upward in the attitude assumed when the insect is about to make an upward spring. Travellers tell us that the light from this phosphorescent organ is distinctly seen as of a peculiar reddish color, when the insect is flying overhead. This beautiful insect is found in the West India islands, in Brazil, Guiana, and in Mexico. It is related that at the time of the Spanish conquest, a battalion just disembarked, did not dare to engage in battle with the natives because the Cucuyos, which were shining in the trees, were supposed to be the matches of the arquebuses ready to fire upon them. Figuier, the popular French writer on natural history relates: "When the Mexican ladies wish to adorn themselves with these living diamonds, they place them in little bags of light tulle, which they arrange with taste, on their skirts. Sometimes imprisoning these animated flames in gauze, the graceful Mexican women twist them in ardent necklaces, or else roll them around their waists like a fiery girdle. They go to the ball under a diadem of living topazes or animated emeralds, and their diadem blazes or pales according as the insect is fresh or fatigued. When they return home after the soirée they give them a bath which refreshes them, and put them back in a cage, which sheds during the whole night a soft light in the chamber."

Another writer states: "I saw a lady at the 'Retreta' once, with a coronet and stomacher of them, and all the crown jewels of Spain could not have made her so resplendent."

Writers represent the Cucuyo as being short-lived in captivity, but these received as above, had their lives prolonged quite beyond expectation, and former experiences with the beetles; and this notwithstanding the hard treatment which they had undergone. Not one of them had a foot (tarsus) remaining when brought to me and two had lost the preceding joint (tibia) from one or more of their legs. Still they were able to travel with considerable rapidity, but made no attempt at flight. Until near their death they frequently used their spring to regain their

feet when fallen on their back in attempting to climb the sides of the rather shallow box in which they were confined.

Sugar, and sugar cane soaked in water, were given them, but it is not certain that they partook of either. They were apparently fond of ripe strawberries, and would remain for a long time with their head resting on freshly cut slices, slowly imbibing the juice after their jaws had seemingly become fixed and incapable of crushing the pulp. Raspberries had no attraction for them. They drank moderately from drops of water placed in front of them, the antennæ moving the while as if betokening relish. Each day they were given a bath for a brief time in a dish of water, and immersed therein.

They continued to give out their light when disturbed, from both their upper and lower organs, in its usual brilliancy up to within two or three days of their death. One of the beetles died early in July, the other two on August 6th and 10th. Their capture at San Domingo was at least three weeks before they were presented to the State collection, which would give them a period of captivity of over two and one-half months.

Crioceris asparagi (Linn.).

The Asparagus Beetle.

(Ord. COLEOPTERA: Fam. CHRYSOMELIDÆ.)

HICKS: in Amer. Entomol., ii, 1869, p. 53 (plentiful on Long Island).

RILEY: in Amer. Nat., xvii, 1883, p. 199 (reference); in Ann. Rept. Dept. Agr. for 1881–1882, p. 177 (mention); Bull. 23 Md. Agr. Expt. Stat., 1893, pp. 90–91 (brief account).

LINTNER: in Canad. Entomol., xvi, 1884, p. 182 (at Geneva, N. Y.); 7th Rept. Ins. N. Y., 1891, p. 335 (reference); 8th do., 1893, pp. 116, 221, 250–253 (description, introduction, distribution, natural history, remedies); 9th do., 1893, pp. 342–343, fig. 20 (spread in the State); 10th do., 1895, pp. 498, 517 (reference); in Country Gent., lx, 1895, p. 455 (northward spread of insect).

LUCAS: in Ann. Soc. Entomol. France, 1888, pp. 102–104 (parasites of beetle); in Bull. Séances Entomol. Soc. Fr., 1888, pp. cxlv–cxlvii (habits).

RILEY–HOWARD: in Insect Life, i, 1888, p. 29 (southward spread of insect), pp. 61–62 (its enemies); in id., iv, 1892, p. 401 (taken at Nashua, N. H.); in id., v, 1892, p. 99 (at Rochester, N. Y.).

COQUILLETT: in Insect Life, ii, 1890, p. 234 (*Myobia pumila* parasitic on).

SMITH: Cat. Ins. N. J., in Final Rept. State Geol., ii, 1890, p. 214 (common on asparagus); Ann. Rept. Ent. Dept., N. J. Agr. Expt. Stat. for 1892, 1893, p. 393 (mention); in Insect Life, vi, 1893, pp. 191–192 (simple remedy for); the same in Ann. Rept. Ent. Dept., N. J. Agr. Expt. Stat. for 1893, 1894, p. 445; Econom. Entomol., 1896, pp. 211–212, fig. 204 (brief account).

RITZEMA BOS: Tierische Schäd. Nützlinge, 1891, pp. 357–358.
WEED, C. M.: Insects and Insecticides, 1891, pp. 204–206, fig. 109 (brief account with remedies).
FORBES: in Insect Life, v, 1892, p. 73 (kerosene emulsion for).
TASCHENBERG: Brehms Tierleben, Insekten, ix, 1892, p. 194, fig. 2 (brief mention).
HENSHAW: in Psyche, vi, 1893, p. 557 (reference).
WEBSTER: in Insect Life, vi, 1893, p. 186 (westward spread); Bull. 51 Ohio Agr. Expt. Station, 1894, pp. 85–89, figs. 1–3 (distribution, description, life-history, remedies).
LOWE: Bull. 75 N. Y. Agr. Expt. Stat., 1894, pp. 425–427, Pl. IV, figs. 1–5 (general account); the same in Ann. Rept. do. for 1894, 1895, pp. 729–731.
COMSTOCKS: Manual Study Ins., 1895, pp. 575–576, fig. 701 (brief notice).
HOWARD: in Proc. Ent. Soc. Wash., iii, 1895, pp. 222, 223 (distribution may be confined to Upper Austral life-zone).
HOPKINS–RUMSEY: Bull. 44 W. Va. Agr. Expt. Stat., 1896, pp. 291, 317 (brief mention).

(The above are additional to the references given in the First Report.)

A letter given below from a gentleman in Magnolia, Mass., received during the last week in May, 1895, was of special interest, as indicating a new locality for a gradually spreading introduced insect pest, in its almost extreme northern extension:

I have grown asparagus very successfully for ten or fifteen years, but this spring it has been attacked by thousands of small black and yellow beetles, which do not allow it to put its head above ground without gnawing it and leaving it covered with exuviæ.

I suppose this pest is well known to you, and I should be much obliged if you would indicate any way of destroying it. T. J. C.

Magnolia, Mass.

Reply was made through the *Country Gentleman* of June 13th, as follows:

The insect that is occurring so abundantly and is so destructive at Magnolia is without much doubt a recent appearance of that well-known pest, the asparagus beetle, *Crioceris asparagi*, at that locality. Will the writer of the above please send examples for positive identification? If proved to be that species, its occurrence at Magnolia will be of considerable interest to those of our entomologists who are giving attention to the distribution and rate of progress of our introduced insect pests.

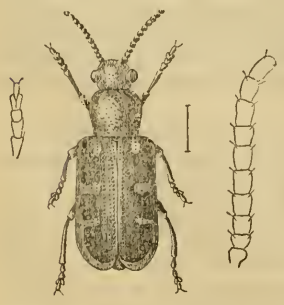

FIG. 13.—Asparagus beetle (a common six-spotted form), enlarged about six diameters, with further enlargement of antenna and front tarsus.

In accordance with the request, a number of the beetles were forwarded, and were found to be the well-known *Crioceris asparagi*.

Progress of the Insect in the Eastern United States.

For a long term of years following the first observed injuries in 1859, the beetle in this country was confined to Long Island and the immediate vicinity of New York City. While in the main keeping near the sea-coast, it has now extended to the southward as far as Fortress Monroe in Virginia. Within the last ten years, it has been found at Geneva and at Rochester in Central and Western New York, and quite recently it has been reported from localities in Ohio. To the northward, in the New England States, it made its appearance at Amherst, Mass., in 1892, and the same year in Nashua, N. H. Magnolia, on the sea-coast in north-eastern Massachusetts, is nearly as far north as Nashua.

Range of Insects Limited by "Life-Zones."

Particular mention is made of the above-named localities for the asparagus beetle, as indicating that its range to the northward as an injurious insect will be largely if not entirely limited to a certain zone known as the "Upper Austral life-zone." From data drawn from long-continued observations and studies, certain "life-zones" have been mapped, upon the belief that both animals and plants are restricted in their distribution —according to Dr. C. Hart Merriam—"by the total quantity of heat during the season of growth and reproduction." These life-zones, as they have been plotted, while not strictly agreeing, "conform in a most gratifying manner" (Merriam) to the isotherms shown on our most reliable maps, and to the contour lines of elevation indicated in the recent "Gannett's Nine-sheet Contour Map," published by the U. S. Geographical Survey.

Probable Examples of such Limitation.

The probability of the limitation of insect pests to certain life-zones, irrespective of the broader distribution of their food-plants, has lately been made the subject of study by Mr. Howard, Chief of the Entomological Division of the U. S. Department of Agriculture. It was first suggested to him by the discovery that the San José scale in its recent introduction into the Eastern United States—although it had been distributed by nurseries over the entire State of New Jersey—was not found in its northern portion (Dr. Smith); and that the infested portion of New Jersey, Long Island, and all of the infested localities in Maryland, Virginia, Pennsylvania, and New York, lay within the Upper Austral zone. He has also called attention to the probability that the asparagus beetle may be subject to the same northern limitation, although its occurrence at Amherst, Mass., and Nashua, N. H., appeared to him to mili-

tate against such a belief. A study of the Gannett map, above referred to, seems to me, on the contrary, to give a marked confirmation to the theory. From the loops and curves of the 100-feet contour lines which elsewhere define the northern boundary of the Upper Austral zone, followed along the southern and eastern New England sea-coast and inward along the river valleys, it appears in every way probable that Amherst, Nashua, and Magnolia in reality fall within the Upper Austral, and will be so indicated in future corrected and extended life-zone maps. It will be of interest to recall the fact that the last-named locality is indebted for its name to the wild growth there of the *Magnolia glauca* at the most northernmost natural habitat of any American Magnolia.

Relief Afforded Through This Limitation.

If this limitation of insect ravages by our accepted life-zones shall be established, it will relieve us from the fear of the spread of certain insects over entire States into which they have been introduced; and, as of still greater importance, of an unnecessary expenditure of labor and money for the extermination of a pest, when its wide distribution will be prevented by constant climatic conditions. Thus, Upper Austral zone insects, if such there be, could not establish themselves over much the larger portion of the New England States and New York — in the latter limited, outside of Long Island, to a narrow strip along the Hudson river reaching nearly to Saratoga, and the larger area taking in Oneida lake and the smaller lakes of Western New York, and the territory northward and westward from the east of Oswego along Lake Ontario, the Niagara river, and a narrow strip bordering Lake Erie, possibly not quite to the southwestern corner of the State. In Plate IV, the Upper Austral life-zone in New York and contiguous portions of adjoining States as outlined for me by Dr. Merriam on a section of the "Gannett Map," is represented in crosshatching upon a New York State Weather Bureau map received from Director E. A. Fuertes.

If the San José scale is not to be exterminated in our State, — while the famed "apple belt" bordering Lake Ontario and the fruit region of the Hudson River valley will be exposed to it — there would still be reason for thankfulness that it is subject even to this degree of limitation.

The Upper Austral Life-Zone in New England.

In view of nearly one-half million of dollars ($475,000) already appropriated by the legislature of Massachusetts for the extermination of the gypsy moth, it would be a matter of rejoicing if this costly foreign

introduction shall prove to be an Upper Austral zone insect. Certain it is, although perhaps only accidental, that by far the greater part of the infested locality in northeastern Massachusetts is bounded by the Gannett contour line of 100-feet elevation, which, there is reason to believe, will hereafter be accepted as the boundary line in that part of New England of the zone above named.

Remedies.

In reply to the request in the inquiry for indication of a method for destroying the insect, the following remedies for the asparagus beetle are given in the *First Report on the Insects of New York*, 1883, viz., employing fowls for hunting the beetles, dusting freshly air-slacked lime over the larvæ upon the plants, cutting away the young seedlings, and the removal of the seed-stems when the asparagus season is over. Of these, the lime remedy is the most simple and, it is believed, the most effective.

Lina scripta (Fabr.).

The Cottonwood-leaf Beetle.

(Ord. COLEOPTERA: Fam. CHRYSOMELIDÆ.)

(Read before the Association of Economic Entomologists, at its Seventh Annual Meeting, at Springfield, Mass., August 28, 1895.)*

FABRICIUS: Syst. Eleuth., 1801, p. 438, no. 99 (as *Chrysomela*).
MELSHEIMER: Cat. Coleop. U. S., 1853, p. 124 (as *Melasoma*).
CROTCH: Check List Coleop. Amer., 1873, pp. 98, no. 5768 (as *Plagiodera*).
SNOW: in Observer of Nature, Nov. 23, 1875.
OSBURN: in Trans. Kans. Acad. Sci., iv, 1875, pp. 24–25 (habits, stages, larval description).
RILEY: in N. Y. Weekly Tribune for Oct. 9, 1878; in Am. Entomol., iii, 1880, pp. 159–161, figs. 61–64; in Ann. Rept. Dept. Agr. for 1884, 1885, pp. 336–340, pl. viii, figs. 1, 2 (general account, as *Plagiodera*); in Insect Life, iii, 1891, p. 430 (larvæ and pupæ eaten by *Megilla maculata*); the same in Proc. Ent. Soc. Wash., ii, 1892, p. 169.
PACKARD: Bull. 7 U. S. Ent. Comm., 1881, pp. 115, 116, figs. 53–54 (brief notice, as *Plagiodera*); in 5th Rept. U. S. Ent. Comm., 1890, pp. 428–433, figs. 157, 158 (history, ravages and remedies, from Riley).
DIMMOCK: in Psyche, iii, 1882, p. 393 (as *Plagiodera*, secretion of).
TOWNSEND: in Psyche, iv, 1884, p. 222 (abundance in La.).
MEEHAN: in Insect Life, i, 1888, pp. 51–52 (on poplar in Pa.).

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*Published in Bull. No. 2—New Series. U. S. Dept. Agricul.. Divis. Entomol.—Proceedings of the Seventh Annual Meeting of the Association of Economic Entomologists, 1895.

TRELEASE: in Psyche, v, 1889, p. 173 (as *Plagiodera*, abundance in West and South).
CASSIDY: in Bull. 6 Col. Agr. Expt. Stat., Jan., 1889, p. 17 (annual defoliation of cottonwoods; as *Plagiodera*).
BRUNER: in Bull. 14 Agr. Expt. Stat. Neb., 1890, pp. 83–91, figs. 48–50.
LUGGER: in Bull. 9 Minn. Agr. Expt. Stat., 1889, pp. 53–55, figs. 3, 4 (life-history, remedies).
ALDRICH: in Insect Life, iv, 1891, p. 67 (controlled by arsenites in South Dakota).
ORCUTT-ALDRICH: in Bull. 22 So. Dak. Agr. Expt. Stat., 1891, pp. 98–101, figs. 13, 14 (food-plants, habits, remedies).
BEUTENMÜLLER: in Journ. N. Y. Microscop. Soc., vii, 1891, p. 36 (references to description of early stages).
LINTNER: 7th Rept. Ins. N. Y., 1891, p. 219 (abundant on Ausable river); in Syracuse Journ., May 9, 1894 (injury to basket willows in N. Y., habits, history, remedies, etc.); 10th Rept. Ins. N. Y., 1895, pp. 500, 517 (reference).
WILLIAMS: in Bull. 35 So. Dak. Agr. Expt. Stat., 1893, pp. 85–86.
CHITTENDEN: in Insect Life, vii, 1895, p. 419 (referred to *Melasoma*).
WICKHAM: in Canad. Entomol., xxviii, 1896, p. 202 (occurs chiefly on poplars and cottonwoods).

The wonderful multiplication of species of insects, not usually injurious or, indeed, even rare, as the result of the cultivation of a crop on a large scale and in extended areas, is often brought to the notice of the economic entomologist, in appeals made to him, to suggest remedies available against the ravages of some (to the culturist) new insect pest.

FIG. 14.—The cottonwood beetle, LINA SCRIPTA. (Original.)

A recent occurrence of this character, is the threatened destruction of the basket-willow industry of Onondaga and some others of the Central and Western New York counties, from the ravages of the insect which has been known for the last score of years as the Striped Cottonwood beetle. Scientifically it is *Lina scripta* (Fabr.).

The Insect at Liverpool, N. Y.

In May of 1894, there was sent to me by Internal Revenue Collector Von Landberg, from Syracuse, N. Y., a bottle of beetles, with the information that the willow raisers of Liverpool and Salina and neighboring localities were experiencing great trouble and serious loss from the ravages of a beetle which was destroying acre after acre of the basket willows.

What the insect is.— It was readily identified by me; and the request for its identification and a remedy for it, was answered virtually as follows: "The beetle is a member of the destructive family of leaf-eating beetles, known as *Chrysomelidæ*, which is found from New York to Texas, in Oregon and California, but is the most destructive along the Missouri

river. It has received in the Western States the popular name of 'the cottonwood beetle' from its special fondness shown for the foliage of the cottonwood, *Populus monilifera*. In recent years it has become almost equally injurious to willows. It was first brought to public notice by Prof. Snow, in the year of 1875, by its widespread destruction of the cottonwood in Kansas; and a few years later (1878) by Prof. Riley, in his accounts of its more serious ravages in Nebraska and Dakota, where the rapidly growing cottonwoods had been extensively planted by new settlers in the treeless plains of that region. Many thousands of trees were killed through their defoliation for successive years — the remnants of the leaves turning black and shriveled as if struck by 'fire blight.'

Its occurrence in New York.—"The beetle has never before, so far as known to me, appeared in injurious numbers in the State of New York. It has not been a common insect with us. Indeed, it had never come under my observation until in the year 1890, when, during the early part of July (4th to 7th) both the larvæ and the beetles were found by me in Keene Valley in the Adirondack mountains, feeding on willows growing along the banks of the Ausable river: nearly a hundred were collected for the State Collection. Not a single example of the insect has since been seen by me in the five following years of collecting in that locality.

The larva.—"The larva is at first black: when full grown it is of an elongate form and measures nearly a half-inch in length. It is then of a dingy-yellowish color, with head and legs shining black, two rows of black spots on the back, and in line with these, a row of black tubercles on each side. These tubercles when the larva is disturbed, throw out from each one (for its defense from its enemies through the pungency of the odor) a globule of a milky fluid, which is drawn into them again when the alarm passes away.

FIG. 15.—LINA SCRIPTA: *a*, egg-mass; *b*, single egg; *c*, newly hatched larvæ; *d d d*, larvæ of different sizes; *e*, pupa; *f*, a middle joint of larva, showing tubercles. (After Riley, in Rept. Commis. Agricul. for 1884.)

The beetle.— "The beetles are oval, more flattened than the Chrysomelids usually, and vary in length from two-tenths to three-tenths of an inch. The head is black. The thorax is mainly black centrally, with its outer sides bordered with red. The wing-covers are dull yellowish, with about seven black spots and lines, and the inner margins joining over the back, also black, and the body beneath blue-black.

FIG. 16.—LINA SCRIPTA; *a*, usual markings; *b*, *c*, *d*, *e*, variations. (After Riley, in Rept. Commis. Agricul. for 1884.)

Successive broods.— "The injurious character of the beetle is intensified by there being two or three broods of it each year. The brood now present with you is from eggs that were laid on the willows early in the season. Under favoring conditions for multiplication, the subsequent broods will be more numerous and of course more destructive.

Remedy.— "It is fortunate for your willow-growers that we have a comparatively simple remedy for this new willow pest, otherwise the industry so important to your people might be seriously impaired. A thorough spraying of the willows with Paris green in water should kill all the insects in their larval and perfect stages that feed upon the leaves."

Directions for preparing and using the spraying mixture, and information of pumps available for the purpose, accompanied the above.

The Insect's Destructiveness at Liverpool.

In some correspondence following, a partial success was reported to me as the result of the spraying recommended. The increase of the insect could not be kept down, and consequently in several instances, entire fields of willows had been destroyed, and plowed up. Some other suggestions were made by me, and were, I believe, faithfully tried. Early in May of the present year, I was notified that the ravages of the insect had commenced — that it was spreading more numerously and seriously than before—that the willow-growers were discouraged, and would be compelled to abandon the culture unless the insect could be controlled. My presence was requested, but I was prevented from making the desired visit at the time, and it was necessarily deferred until the month of August. Although then too late to see the active operations of the insect, I was able to look over the ground thoroughly—to meet and confer with the willow-growers and basket-makers—to learn from them the extent and importance of the industry—its threatened destruction, and what was being done to avert the calamity.

How the Basket Willow is Grown.

The willow grown is the European Osier. It is propagated from pieces cut by a machine into nine-inch lengths and set six inches into the ground. These are placed about fourteen inches apart, in rows three feet apart, permitting the use of a cultivator between them and hoeing as often as necessary. The fields are liberally enriched with barnyard manure. An ordinary soil is as well adapted to the growth as a wet one. It can be cut for use the first year, but is not in full vigor till the third or fourth year, and continues to yield good crops for ten or twelve years, when it should be plowed up and set out anew. A good growth will average about six feet in height. It is cut in November when the leaves have fallen. It may then be steamed for loosening the bark, and the peeling is done by children in the shops of the basket-makers.

The steaming — submitting to exhaust steam for about twenty minutes in large boxes holding two tons of the willows placed on a heavy truck for convenience in gathering and delivering the willows — is done by two firms in Liverpool, one of which, Mr. A. H. Crawford, treated 1,800 tons the last year.

Its Yield and Value.

The green willow is worth from $15 to $45 per ton; when peeled and dried, six cents a pound. The growers raise from ¼ an acre to 60 acres. Mr. E. P. Black, a very successful grower, who finds an abundant return for the labor bestowed upon his crop, cultivates 20 acres. The yield is from three to eight tons per acre. About 500 acres are grown in the town of Salina, Onondaga county.

Extent of its Cultivation in Western New York.

In addition to Onondaga county, where the crop is grown the most extensively, it is also grown in Oswego, Oneida, Madison, Cayuga, Schuyler, Seneca, Wayne, Ontario, Livingston, Monroe, Genesee, and Wyoming counties, but I am not able to give the extent of cultivation in the several counties, or the comparative amount of injury from the willow beetle in them.

Not a Native Species.

As before stated, the willow of Western New York is not a native, but has been introduced from France. It is the Osier or basket-willow of Europe, *Salix viminalis*. A German willow is grown to a limited extent. It is a taller and stouter plant, sometimes attaining 12 or 14 feet in height. It is not as subject to insect attack, but it is less serviceable for baskets, being coarser, less pliant, and only adapted for the heavier bottoms of

baskets. A small proportion of osiers are imported annually from France, Belgium, and Germany, but they are decidedly inferior to the home grown.

The Basket-Making Industry.

This industry is at present, the sole one of Liverpool, since the salt industry proving unremunerative, has been abandoned. About 150 families are engaged in the manufacture of baskets, employing the children and often the entire household. It has been a profitable industry, as shown by the fact that most of the dwelling-houses in Liverpool are owned by their occupants, and have been paid for out of its proceeds. The amount invested in this place in the growing and manufacture, is estimated at a million and a half of dollars. The above, perhaps uninteresting details are given to show the economic importance of the insect ravages which will next be noticed.

Steady Increase of the Insect.

This willow-feeding insect was known as injurious in Onondaga county as far back as the year 1875, when 57 acres of willows were destroyed in a swamp in Clay, Onondaga county. This was discouraging to the willow-growers: fewer willows were grown for a time thereafter, and but little was heard of the insect. Our first recent information of it is that a gentleman who collected insects in Liverpool, took some of the beetles on basswood in 1887. From that time it seems to have been steadily on the increase, but not until the last year (1894) had it multiplied to such an extent as to claim general attention. Its destructiveness the present year is greatly in excess of that of the preceding. It is stated that the cutting of this year will fall short of that of 1894 by 1,000 tons. A grower who grew 65 tons in 1894, will this year cut but 25 tons. Many fields have been abandoned, and will be plowed up, and others will only be cut in order to permit of a possible more successful growth another year. There is a wide-spread discouragement and a fear that the industry, which is the sole support of the town, is doomed.

Transformations and Habits.

In inquiring into the life-history of the insect, no definite information could be given me of the time required for its transformations or the number of the broods; the number is generally thought to be three. The hibernating beetle makes its appearance toward the last of April, and is in readiness to attack the sprouts as soon as they start in May. It is said that they do not feed on the leaves, but at first only upon the

ends of the tips. When the willows are more advanced, with the second brood of beetles, this tip-feeding habit becomes more harmful, as they then girdle the twigs by eating away the bark, causing the tips to bend over and die, necessitating the putting out of one or more side shoots, which seriously impairs the value of the plant, producing unsightly bends, necessitating trimming before use, and materially interfering with the stripping of the bark. The larvæ feed only on the leaves. The eggs, being laid on the under surface of the leaves in clusters averaging about 40, the larvæ on emerging, in company eat away the epidermis and the parenchyma between the small reticulating veins, leaving the upper epidermis unbroken. This feeding habit renders a more thorough and careful spraying of the arsenites necessary in order to reach the under surface of the leaf and kill the larvæ in their first stage. Later they separate and eat through the leaf.

So familiar are the growers with the larvæ in their several moltings that the only name by which they are spoken of is "hangers." The beetles are known as "hard-shells."

Early Retreat to Hibernating Quarters.

I was disappointed upon finding at my visit made on August 22d, that the beetles had already gone into their winter quarters, for Mr. Bruner, Entomologist of the Nebraska Agricultural Experiment Station, in his notice of the insect, Bulletin No. 14, has stated: "The perfect insect in the fall, after the first heavy frosts, leave the cottonwoods, poplars, and willows where they have been feeding and seek some shelter." Only about a half-dozen could be found by careful search to show me. A few weeks before, the air had been, at times, filled with them in the streets of the village, "gathered," it was said, "in swarms like companies of gnats and midges." They had commenced to retire for hibernation during the first half of July, and by the 1st of August nearly all had disappeared. They are now to be found in old stone walls, under rubbish of all kinds, in the crevices of rocks and stones and occasionally in houses.

Eggs — Abundance and where Laid.

Should it be desirable to attempt the destruction of the eggs of this beetle, it is of importance to know that the first deposit is by no means confined to the willows but that they are placed on various plants and weeds and even on other than vegetable growth, but presumably in close vicinity to the willows. As showing the abundance of egg-clusters, it was stated that 700 clusters had been picked from a row of willows 20 rods

long in passing over them once; and as illustrating the abundance of the beetle,— three bushels of them had been gathered in a day by one person from his fields by the aid of the "bug-catcher" which had been devised to serve in the present emergency.

Remedies.

The efforts made to arrest the increase and ravages of this pest have been these: hand-picking the beetle, or shaking them into vessels with water floated with kerosene, collecting the egg-clusters, spraying with Paris green or London purple in water, dusting by hand with Paris green and lime, and collecting the beetle with the "bug-catcher."

The hand-picking and jarring have proved quite effective, where small fields have been treated in this manner — say of an acre or less; with larger ones it would be virtually impracticable. Perhaps the best — the tallest and most uniform and less injured — field that I saw was a half-acre to which the owner and his son had given time each day to this method of protection. Although not so informed, I suspect from the good condition of the leafage, that lime had been applied to kill the larvæ. The next most productive fields that came under my observation were those of Mr. Black, where the ground had been well enriched and carefully cultivated, sprayed at different times with a sprayer that would cover six rows at once, and the "bug-catcher" faithfully used. It is hardly necessary to state that this gentleman is not one of the "discouraged willow-growers." Although his pay-roll runs into thousands of dollars, there yet remain thousands on the profit side of the balance-sheet.

Machine for Collecting the Beetles.

It remains only to speak of the "bug-catcher"—so-called. It was devised by one of the willow-growers, and, if without knowledge, as it is believed, of our western "hopper-dozer," it is certainly an ingenious contrivance, and the originator is entitled to considerable credit, for it is producing, even in its present crude form, excellent results.

The bottom of the machine (described from recollection merely) is of a single piece of two-inch plank, twenty inches broad and four feet long. The sides and ends are about eight inches high. At the back are fastened two diverging arms extending forward nearly twice the length of the frame, and their ends sufficiently far apart to receive two rows of willows as the horse drawing the machine passes between them. To these arms are fastened two cross-pieces, and also a longitudinal arm which may be adjusted in a slot so as to depress or elevate the arms according to the

height of the willows at different periods of growth. A pair of bent arms like those of a plow are also attached at the rear for holding and guiding the machine. Its bottom is covered to a moderate depth with kerosene—the too free movement of which is controlled by several transverse slats forming compartments. A series of slats arranged in pairs like a gable-roof with space between each pair to permit the beetles to fall into the kerosene, are fastened in a frame which may be lifted out whenever the accumulated beetles require removal. The slats prevent the willows as they are pressed downward by the arms from coming in contact with the kerosene.

As the machine is drawn forward, the willows entering the ends of the arms are brought nearer together in such a manner that before they are released from beneath the arms, the beetles upon them are shaken upon the slats and drop into the kerosene. A large proportion of the beetles is gathered and killed by this method. It is found, however, that as they drop to the ground at a moderate alarm, the passage of the horse between the rows dislodges many of them. To obviate this, machines have been made which are propelled by hand, having a wheel in front after the manner of a wheelbarrow. Their use, however, has been found quite laborious, but there seems to be no good reason why they may not be made much less cumbersome.

The machines above described, are represented, from photographs in Plates V, VI, and VII.

Galerucella luteola (Müller).

*The Elm-Leaf Beetle in Albany.**

(Ord. Coleoptera: Fam. Chrysomelidæ.)

(Read before the Association of Economic Entomologists at its Springfield Meeting, August 28, 1895.)

For more than a decade past, I have watched with interest the steady, although slow, progress of this destructive insect northward along the Hudson river valley. When it was first observed in the State of New York, does not appear on record, but as early as 1879, the elms in Newburgh, N. Y. (60 miles to the north of New York city), were nearly all stripped of their foliage by "an insect new to that locality," which proved

* Published in advance in the Proceedings of the Seventh Annual Meeting of the Association of Economic Entomologists, 1895, pp. 50–56.

to be this insect. In 1883, many accounts were received of its destructiveness and remarkable abundance in Westchester county, in portions now embraced within the limits of New York city. In 1887, it created considerable alarm in Poughkeepsie, 74 miles from New York and almost midway between that city and Albany. In 1890, the citizens of Hudson became excited over its advent. In 1891 it was seen in New Baltimore, and a year later it reached, and commenced its operations, in the southern portion of Albany.

When First Observed in Albany.

The first example of the beetle to come under my notice, was taken within my house, on a window, on the 25th of September, 1894. It was learned later that its operations had arrested the attention of Superintendent of Parks, Egerton, in 1893, while engaged in the construction of a new park near the southern limit of Albany. And still later, upon visiting a locality where the insect had been very destructive, a little to the north of the new park, it was learned that the injury to the elms had commenced in the spring of 1892.

Its Abundance in July of 1895.

On the middle of July of the present year, the capture of several of the beetles abroad, led me to examine the elms near my residence. At the base of a large Scotch elm, *Ulmus montana*, large numbers of the pupæ were found lying on the hard dried ground between the branching roots and on the adjoining brick pavement. Examination of the other elms on Hawk street, between Hudson avenue and Hamilton street, while some of the trees were apparently exempt, more of them showed a similar abundance of pupæ with an occasional newly-disclosed beetle among them. In places twenty-five pupæ could be counted to the square inch. Many were also seen in crevices of the bark. They were transforming rapidly, for of five placed in a vial on the 15th, two had changed to the perfect insect on the 17th and the remainder on the day following.

From the fact that no larvæ were noticed either at the base of the trees or descending the trunk, it was evident that their descent must have commenced, at the least, two weeks earlier, or more probably, in the month of June. Absence from the city for the month following June 10th, had prevented my making any observations during this time upon the development of the brood.

A Second Brood.

I was again absent from Albany from July 15th to August 12th. On my return a great surprise awaited me. It had been predicted that only a single brood of the insect would occur in the northern extension of the insect in New York, Professor Smith having shown that there was but one annual brood in northern New Jersey, and the statements made of two broods in the vicinity of New York city, were believed to rest on inaccurate observations. But here was unquestionable evidence of a second brood, in much larger numbers, as might be expected, than the first. Many elms had their foliage entirely destroyed. A notable illustration of the severity of the attack was afforded in the condition of a row of nine English elms, *Ulmus campestris*, in Hawk street, opposite my residence—centrally in the eastern portion of the city. The elms were slender, and by sawing away the lower branches, had attained a height of nearly one hundred feet. Every leaf had been destroyed, except a few which still retained their form although skeletonized, on the extreme lower branches.* At their base, against the trunks the larvæ, in the circular form that they assume when in readiness for pupation, and the pupæ, were lying to the depth of an inch or more in places where they had not been swept away. On any of the trunks, hundreds of the larvæ were within range of the eye at any one time, descending to the ground, and many had transformed to pupæ in the crevices of the bark. Opposite to this row, and on my own premises, was a wide branching Scotch elm, *Ulmus montana*. The leaves of this had been much less eaten—had not been destroyed, although all showed the peculiar eating away of the epidermis of the under surface and the parenchyma, characteristic of the work of the larvæ. In such numbers were the larvæ descending the trunk, that for several succeeding days they were repeatedly swept down with a broom, before spraying them with kerosene, pouring hot water over them, or sweeping them into piles of leaves for burning. The largest proportion of the larvæ, instead of transforming at the base of the tree, crossed the sidewalk and collected against the side of the house and a brick wall adjacent, or in the crevices at the ends and sides of the adjoining first course of bricks in the walk. Many were observed in the attempt to climb up the side of the house and wall, but almost invariably fell before attaining a height of two feet. At one point where a small shrub of a few inches in height had sprung up against the house, there were swept

*All of the infested European elms observed in the city, have been much more badly eaten toward their tops, as if attack had commenced at the highest point.

up on August 23rd, from an of area eight by ten inches, nearly a pint measure full of the larvæ and pupæ with a few of the newly transformed beetles. From a partial count, it was computed that this collection embraced 9,750 individuals.

Transformations.

A few facts relating to the transformations of this brood may be of value: the time intervening between the descent of the larvæ and their pupation, was not noted; it probably did not exceed five days, for of 100 taken August 15, almost one-half pupated on the 18th and the remainder on the 19th. Those taken in their curled form, pupated within two days, as observed in 150 examples taken from the base of a tree on the 16th, 58 of which became pupæ within 30 hours, and all within 48 hours.

The time from the pupa to the imago, was seven days, as was observed in several lots that were separated soon after pupation, which in each instance gave the beetle — at the first of a pale tint of yellow with entire absence of black on the elytra — on the 7th day.

The descent of the larvæ was apparently completed by the 25th, none being seen upon the trunks after this date.* The degree of development of the brood at this time, was about that of the first brood when observed by me on July 15th. From this we may infer a period of about six weeks for transformations of the brood, or about a week less than that which has been recorded for the earlier brood in New Jersey.

Do Many Larvæ Drop From the Trees?

Writers upon the habits of this insect have stated that many of the larvæ drop from the tree instead of traveling down the trunk, particularly when the elms have drooping branches. This would seem reasonable, but it was not confirmed by my observations. The Scotch elm on my premises which has been referred to, has long and somewhat drooping branches which extend over an extension to the house, but I have not been able to find at any time during the season a single larvæ or pupæ upon its roof, although fallen leaves in corners offered convenient resting-places for them. Nor in the hours that I have passed under the elms in my study of the insect have I seen one of the larvæ upon my clothing or known it to occur on others.

*There seems to have been some later than this — perhaps by dropping from the leaves — for they continued to be found in small numbers near the wall until September 9th; pupæ were noticed until the 12th, and the beetle, abroad, until the 24th September. On the 3rd of October one came to light in my office in the capitol, of a remarkably dull color, suggesting the idea that it may have been drawn from its hiding-place after its development from the last larvæ brought by me within doors.

Preference for Different Species of Elms.

The preference shown by the elm-leaf beetle for certain species of elms has often been stated by those who have written upon it. While all agree in the statement that the European elms are the more infested by it than our native ones, yet there is conflicting testimony in regard to the liability to attack of the American elm, *Ulmus Americana*. Dr. Riley has stated of it in *Bulletin No. 6 of the Division of Entomology* (1885),— "this species is practically free from the ravages of the beetle." In Circular No. 8, May 1895, of the same division, Mr. Marlatt has written: "The American species, *Ulmus Americana*, is notably exempt," but adding this qualification: — "All species of elms, however, are attacked more or less, and in absence of sufficient foliage of the favorite varieties, the injury to less palatable sorts becomes almost equally marked."*

Decided Preference for the English Elm.

The decided preference of the beetle for the *Ulmus campestris* has been strikingly shown during its presence in Albany. A number of trees of this species have died and are being cut down in this the fourth year of their attack, while others — notably the row previously referred to as opposite my residence, will unquestionably share the same fate the coming year, unless conditions should prove unfavorable to the beetles' multiplication. None of the Scotch elms, *Ulmus montana*, so far as I have discovered, have been killed, and although the foliage of some of the smaller trees has been about one-half destroyed, there is little probability of their succumbing to the attack, unless they should finally yield to partial defoliation through several succeeding years. Just across the street from the doomed elms above mentioned is a large American elm (their branches almost intermingling), which seems to be entirely free from the insect. Not a larva has been detected upon its trunk, or indications of it upon the foliage, when its branches were carefully examined from the house-top. A quarter of a mile from this point are the Capitol and the Boys' Academy parks, in which all of the trees, according to the State Botanist, are American elms. No trace of the insect was found in these parks when search was made for it during the last week of August. These three species of elms are the only ones which have been identified by me in the infested section of Albany.

* In the discussion that followed the reading of this paper, it was stated that the *U. Americana* under certain circumstances had been known to be quite as badly injured by the insect as the European species.

The Slow Spread of the Insect.

Perhaps no better illustration of the slow distribution of this insect when left to its natural spread and unaided by facilities for transportation by railroad or boat, can be given, than the fact than in this the fourth year of its presence in Albany, it has not yet extended itself over a large portion of the city, or to any markedly injurious degree over one-half of its extent of four miles as measured from its southern to its northern boundary. As stated by Dr. Riley,* "the insects deposit mostly on the trees nearest to where they develop, and are only partially migratory before ovipositing."

On a short tour of inspection made on August 26th, there were found on Myrtle avenue, near Philip street, a portion of which bounds the new park (Beaver park) in the vicinity of which the insect was first noticed and reported, eight English elms which had been killed by it the present year. The feeble leafage put out in the early spring was soon consumed by the larvæ which had hatched from the comparatively few eggs, presumably, that the beetles had deposited under the enfeebled condition of the trees. The next street, Bleecker place, gave two or three dead trees, and others badly defoliated. Next in order, Elm street, between Eagle and Philip, showed similar defoliation, and one large elm, between 70 and 80 feet in height, where, it was said, the larvæ and pupæ had been abundant about two weeks previously, upon which not a single leaf could be seen. Two blocks to the northward, where the attack had probably reached a year or two later and the beetle had not yet become very abundant, the badly eaten trees were putting out a new growth of leaves. A few blocks further north are the Hawk street elms, previously mentioned, which, in the steadily increasing numbers of the insect, had been so continuously fed upon, that not a vestige of new growth was discoverable. The preceding year there had not been the slightest apparent injury to their foliage.

The examination extended over only a half-mile, and although each street crossed showed marked evidence of the injury wrought by the insect, yet a steady decrease was easily to be seen in the successive streets between Beaver park and the capitol grounds. To the north of the capitol the infestation has not been of a character to arrest public attention, and it is only upon looking for the insect or its work, that it is to be found.

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* *Bulletin No. 6 Division of Entomology*, 1885, p. 13.

Not Known North of Albany.

It is reported as not yet having appeared at Menands, three miles to the northward of Albany, nor have I learned of its presence in Troy, Schenectady and other neighboring northern localities, in reply to inquiries made, accompanied by information and illustration that should ensure its detection if it occurred. It is proposed to follow up hereafter, by personal observation, the progress of this insect along the Hudson river valley, until it shall reach Fort Edward, beyond which we do not expect it to extend.

Only a Small Portion of Albany Infested.

It may be stated here that the insect thus far has not spread injuriously over the western part of Albany; in fact, it is virtually limited to the southeastern corner. At the time that myriads of the beetles were descending the elms in Hawk street, not a single example could be found in Washington park, three-fourths of a mile west of the Capitol park, nor leaves showing larval feeding, on any of its at least half-dozen species of elms. As narrowing the infested area still more closely — on Washington avenue, within three blocks of the capitol, and about three-eighths of a mile from the stripped Hawk street trees, are several English elms which are so absolutely free from attack that, for this reason, it was questioned if they could possibly be some other species, until they were identified as the *U. campestris* by the State Botanist.

Recommendations for Controlling the Insect.

While it is undoubtedly true that the best remedy for this pest is spraying with an arsenical mixture so as to furnish the larvæ of the first brood with a poisoned diet upon their hatching from the eggs, yet experience has shown that this remedy is not the one to be relied upon, or urged, for the protection of the shade trees that line the streets of our cities. The labor and expense attendant upon it will certainly prevent its ever being generally accepted, or even an approach to such an acceptance. It is, however, the remedy to be depended upon for the preservation of the elms of our city parks and extended private grounds, where the needed appropriation or the necessary outlay may be made for the purpose. Improved apparatus can readily be commanded, by the aid of which the largest elm can be effectively sprayed at a moderate cost.

The lessee or owner of a city residence will not be at the expense of purchasing a powerful force-pump and sufficient hose — fifty feet or more

— to reach up into the treetops, for the preservation of the two or three beautiful elms that may shade and beautify his premises. True, he might with a simple and inexpensive force-pump and the few feet of attached hose, spray the entire foliage of his trees from his housetop, but it would be labor almost wholly lost, in placing the arsenite upon the upper surface of the leaf, instead of beneath, where needed.

Instead, therefore, of urging upon the citizens of Albany the impracticable, viz., arsenical spraying, I have contented myself (after indicating the spraying as the proper remedy when it can be employed) in urging with all earnestness, by voice and through the public press, the necessity of a watchful and persistent warfare against the insect, at each home where it occurs, beginning at the time when the larvæ are descending the trees and the first pupa—so readily recognizable in its orange-yellow garb —is seen beneath it, and continuing it for the ensuing two or three weeks, or until the last pupa has been killed. The killing of the larvæ and pupæ is simple and involves no outlay, or a very moderate one. It only requires that hot-water drawn from a hot-water faucet be poured over them, or that they be sprinkled with kerosene. Where the method of making kerosene emulsion is known, this may be sprayed upon them, using one part of the emulsion to four of water.

As somewhat militating against this remedy, it has been represented as requiring frequent—almost daily repetition. This is not necessary. Intervals of five days will suffice. If all the larvæ and pupæ are killed on any one day, there could be no pupal transformation into the winged insect until the sixth or seventh day thereafter. The simplicity of this method is therefore evident, and there seems to be no reason why, through its use, 90 per cent of the insects that descend the trees from the elms upon our walks, may not be destroyed. In consideration of the many contingencies that attend the hibernation of all insects, and the fatality known to exist in that of the elm-leaf beetle, we would not have much to fear or to suffer from the small fraction of the remaining 10 per cent of the brood that might successfully accomplish their hibernation.

Galerucella cavicollis (Lec.).

A Cherry-leaf Beetle.

(Ord. COLEOPTERA: Fam. CHRYSOMELIDÆ.)

Galeruca cavicollis. LECONTE: in Proc. Acad. Nat. Sci. Phila., 1865, p. 216 (original description).

From Mrs. H. D. Graves, of Ausable Forks, N. Y., examples of beetles were received on June 10th of which "thousands" were feeding on the foliage of her cherry trees left by the late frost. Submitted to Dr. John Hamilton, answer was returned that it was *Galerucella cavicollis* (Lec.), which had been found abundantly in Canada, but was rare in this region. Its only recorded food-plant is wild cherry.

Mr. G. C. Davis states, in *Insect Life*, vii, 1894, p. 200, that he had received the insect from Bellaire, Mich., where, during the latter part of May, it was causing damage to cherry trees of that locality. Some wild cherry trees in the vicinity were found, on examination, to have a few of the beetles on them. Mr. Davis received the larvæ on July 10th, and has given description of them in the above cited notice.

Mr. Schwarz refers to the insect (*Insect Life*, iv, p. 94) as a common northern species. Dr. Horn in his *Galerucini of Boreal America* (*Trans. Amer. Ent. Soc.*, xx, 1893), gives its occurrence "from Canada to the New England and Middle States westward to Wisconsin; North Carolina." Dr. Packard, in his *Insects Injurious to Forest and Shade Trees* (page 529), under *Galeruca sanguinea*, states: "We observed this leaf-beetle in great abundance at Berlin Falls, N. H., September 13th, eating holes in the leaves." Dr. Packard must have written *sanguinea* in error for *rufosanguinea*, as the European *sanguinea* Fabr. (*Lochmæa cratægi* Forst.) has not been found in this country. The beetles observed by him, were in all probability *G. cavicollis*, as *G. rufosanguinea* is a more southern form, occurring according to Dr. Horn, in North Carolina, Maryland, and Pennsylvania, and recorded in New Jersey by Dr. Smith. The two species very closely approach and resemble one another, differing mainly in the slightly coarser punctured and less shining elytra in the latter. If the identification of Walsh (*Practical Entomologist*, ii, 1866, p. 9) was correct, it has also been taken in June on buttercups, *Ranunculus acris*, in the vicinity of Albany, N. Y.

It is probable that *G. cavicollis* has but a single brood. The beetles feeding on the foliage, June 10th, were probably hibernated individuals that may already have been abroad for two or three weeks, although

the number reported at this time is larger than would be expected to survive the ordeal of hibernation. From July larvæ, September beetles would be produced.

The occurrence of this insect on the garden cherry while previously known only on the wild, is but another instance of the many similar changes known of our native insects from wild to cultivated food-plants.

Under date of July 10th, Mrs. Graves wrote that the beetles sent from the cherry trees were also feeding on a young chestnut tree. Presuming on the correctness of her observation, no examples were asked for verification.

Another species of *Galerucella* which at a casual inspection can hardly be separated from the cherry species, is *G. decora* Say, numbers of which have been collected by me in Keene Valley, N. Y., from June 21st to August 8th. Its food-plant is willow. Prof. Riley states that it was abundant and very injurious in a willow plantation near Washington, in the larval stage in June, and that its natural history appeared not to differ materially from that of the elm-leaf beetle (*Rept. Commis. Agricul.* for 1884, p. 336).

Blissus leucopterus (Say).

The Chinch-Bug.

(Ord. HEMIPTERA: Subord. HETEROPTERA: Fam. LYGÆIDÆ.)

This insect, the injuries of which are so widespread and so serious in many of the Western States, but which we seldom have occasion to report in our State — has caused some injury to grass and grain in Western New York the present year. In the *Second Report of the State Entomologist* an account is given of its operations in the years 1882 and 1883 in several of the towns of St. Lawrence county. Since then its presence has occasionally been reported in different localities in comparatively small number, but not sufficient to attract attention until in 1894, when statements were received from Alleghany county of its having ruined meadows and many acres of timothy. This present year it has attacked grain in the same county, in a few instances, but no account of severe injury from it has come to my knowledge. Judging from the past history of its New York operations, there is not much to be apprehended from its continuation in 1896, unless unusually favorable conditions for its increase should prevail.

Recent studies upon this insect have shown that the account of its hibernation, as given by me in my Second Report, page 154, based on earlier writers and followed by later ones, is incorrect and misleading in its suggestion of useless methods of dealing with it.

Mr. C. L. Marlatt, of the Division of Entomology at Washington, in an article on "The Hibernation of the Chinch-Bug," published in *Insect Life*, vii, 1894, pp. 232–234, states as follows: "In every account of the chinch-bug which I have seen, stress has been placed on the hibernation of the adult in rubbish of any sort, such as thick matted grass of headlands and unmown places, piles of corn fodder, hay piles, or about haystacks, dried leaves under trees, particularly in hedgerows, or any other like situation. In the course of very careful and extended investigations carried on in Kansas during a year of excessive chinch-bug abundance, I failed entirely to find any basis for the above supposition. Repeated careful search throughout the late fall and winter failed to discover a single living chinch-bug in any such situations, even when such supposedly favorable hibernating conditions occurred in and adjoining fields which were alive with chinch-bugs late in the fall." He further found "what is probably the normal hibernating place of the chinch-bug, in the dense stools of certain of the wild grasses, such as the blue-stem and other sorts, perhaps including tame varieties which incline to the stooling habit. *In these situations only were chinch-bugs found during the winter*, and so numerously that a single stool of grass would contain hundreds of these insects."

Mr. Marlatt points out, in consideration of this peculiarity of hibernation, the futility of the usual recommendations for lessening injury of the insect, such as burning up all loose rubbish about farms and in fence corners, and leaves in hedgerows, and the removal of hedges. Instead of these, the burning over of grass lands where the hibernation occurs, at once suggests itself. To be successful the burning should be done after a prolonged dry spell, and preferably in midwinter, after a succession of warm days, during which the bugs would be drawn by the warmth nearer to the surface, where they would be more readily reached by the fire.

The San José Scale, and Some Other Destructive Scale Insects of New York.*

(Ord. HEMIPTERA: Subord. HOMOPTERA: Fam. COCCIDÆ.)

What Scale Insects Are.

There is a large class of small insects — some, indeed most, of which require a magnifying glass for their observation, which are particularly detrimental to fruit culture, yet from their inconspicuous appearance usually escape notice until discovered when search is made for the cause of the languishing condition or death of the tree or shrub infested by them. Even then it is rather difficult to believe that the true cause has been found in what often seems to be merely an unnatural roughening of the bark or a moderate incrustation formed upon the surface.

Classification.

The species more commonly met with (the Diaspinæ) have received the name of *bark-lice*, from the appearance of the young as they travel over the bark for a few days after they are hatched; and of *scale-insects*, from the scale-like covering secreted by the insect and beneath which it is hidden after it has fastened itself to the bark. Scientifically, they, together with the "mealy-bugs," are known as Coccidæ. In classification they have place in that division of the Hemiptera (a large order of suctorial insects) known as Homoptera, the wings being of a uniform thickness throughout, and thereby distinguishing them from the other division (Heteroptera) in which the front wings are thickened in their basal half to a degree, often, approaching the elytra or wing-covers of beetles. It is to this last-named division that the popular name of "bugs," has become attached. All of the Hemiptera are suctorial, and take their food through a beak or proboscis instead of by biting jaws. They differ greatly in their structure, and in mode of development: the latter, in some of the families, as in that of the Aphididæ or the plant-lice, is of intense interest.

Development.

The development of the Coccidæ is quite peculiar. The females do not become perfected into winged creatures, but with age assume the form of scales, or galls, or of grubs covered with wax or powder; or become degraded beneath their sheltering scale into barely more than egg-sacs, retaining only such simple organs as are essential to their life during the

*Reprinted from *Bulletin of the New York State Museum*, Vol. 3, No. 13, April 1, 1895.

reproduction of their young. The male, however, undergoes a complete transformation and becomes winged, but with only a single pair of wings of very simple structure (see in Figures 3, 2, and 3 in Plates VIII, IX, and XIV. It lives but a day or two, dying speedily after the fulfillment of the purpose of its being. It takes no food, for in this stage it possesses no mouth or digestive organs.

Some Species Useful.

A few species of the Coccidæ are of service to us, such as the *Coccus cacti* from which the valuable dye, cochineal, is obtained; the *Carteria lacca* which excretes the material known to us as shellac; from another species we have the commercial article known as china wax; and still another species occurring in Arabia produces a solidified honey-dew called "manna," which "is thought by some to have been the heaven-sent manna that nourished the Hebrews in their wanderings."

Number of Species.

About 125 species of North American Coccidæ have been described, and others are being brought to notice each year, either from having been previously overlooked, or recently introduced from abroad. All of them are destructive in proportion to their rapidity of multiplication and the greater or less economic importance of the plants that they infest.

Before proceeding to the consideration of the San José scale,—the subject of this bulletin, it may be of service to refer briefly to a few other species which, although common in the State of New York, and quite harmful to the trees that they infest, are still almost wholly unknown to the fruit-grower and to others who are suffering from their presence. From the figures given of them, they may at once be distinguished from the San José scale.

The Apple-tree Bark-louse.

The most common of these is the apple-tree bark-louse, shown in Fig. 1 of Plate VIII, in its natural size as it occurs on the bark of trunks and limbs, often more abundantly than is represented in the cut, completely covering the bark and overlaying one another, and lending an increased diameter to the infested twig. The color of the scale is brown or ash-gray, nearly approaching that of the bark. The female scale measures about one-twelfth of an inch in length, of a long, usually more or less curved form, pointed at one end on which a magnifier may show the yellowish cast-off skin of the insect, and rounded at the other end. From its peculiar shape it has been frequently written of under the name of the oyster-shell bark-louse. It bears the scientific name of *Mytilaspis pomorum*

Bouché. The male scale is of a considerably smaller size, the sides nearly straight, less rounded at the larger end, and of a brighter color. It will seldom be found associated with the females on the bark, as its natural place is on the leaves on either side, especially along the midrib (Riley). If a recent uninjured female scale be carefully lifted after oviposition—at any time during the winter—from fifty to a hundred small, oval, white eggs may be found underneath it, which would ordinarily give out the young insect about the first of June in the latitude of New York.

This destructive scale is far from being confined to the apple, but may also be found on the plum, pear, raspberry, wild gooseberry, wild cherry, red currant, sugar and swamp maples, white and black ash, birch, poplar, willows, linden, horse-chestnut, elm, etc. It will be seen from the above, that it has a large number of host-plants.

The Scurfy Bark-Louse.

This scale-insect, known to science, as *Chionaspis furfurus* (Fitch), is quite common in the State of New York, where, it is believed to be more numerous and more injurious than in any other of the United States. I have recently seen an orchard of the Kieffer pear, in Columbia Co., N. Y., in which the trunks, of from three to four inches in diameter, were so thickly coated with the scales that at a little distance they appeared as if they had been whitewashed.

The scale, as it appears when scattered over the bark, and the male and female scales magnified, are shown in Fig. 2 of Plate VIII. The young larva, the mature female, the male pupa, and the male, are represented in Figure 3 of the same Plate, which has been prepared under the supervision of Mr. L. O. Howard, of the Entomological Division at Washington, to illustrate the insect in his article on the "Scale Insects of the Orchard" shortly to appear, and kindly furnished for use in this Bulletin by consent of the Department of Agriculture in advance of its own publication.

Dr. Fitch has described so faithfully the appearance of a badly infested tree and of the scale, that his account is transcribed herewith: "The bark of the limb [pear tree] was covered with an exceedingly thin film, appearing as if it had been coated over with varnish, which had dried and cracked and was peeling off in small irregular flakes, forming a kind of scurf or dandruff on the bark. In places this pellicle was more thick and firm, and elevated into little blister-like spots of a white and waxy appearance, of a circular or broad oval form, less than the tenth of an inch in diameter, abruptly drawn out into a little point at one end, which point

was stained of a pale yellowish color and commonly turned more or less to one side." This refers to the female scale, shown in enlargement at *c* of Fig. 2, Plate VIII. The male scales, which usually congregate by themselves (enlarged at *d* in same figure), are only from one-fourth to one-third as large, narrow, usually straight, three-ribbed, and of a snowy-white color. The eggs found beneath the scales are of a purplish-red color. They hatch about the first of June.

This scale attacks the apple, pear, black cherry, choke cherry, and mountain ash. I have recently found it abundantly on the Japan quince, *Pyrus japonica*, in Washington park, Albany, large plots of which were being killed by it.

The Pine-leaf Scale-insect.

This is another white scale which is quite conspicuous on the leaves of the pine and the spruce on which it occurs. It attacks mainly transplanted trees, and had not been seen by Dr. Fitch, when described by him, on those growing spontaneously in the forests. The foliage of a large number of Austrian pines (*Pinus Austriaca*) growing in Washington park, in Albany, a few years ago, was so thickly covered with the scales that it was literally whitened with their myriads. Hundreds could be counted on a single leaf. Nearly all of the infested trees were taken up and burned. Large numbers of the scales were eaten into and destroyed by a little lady-bug,—"the twice-stabbed lady-bird,"—and to the abundant presence of this scale-eating insect, may be owing the fact that in late years the scale has been far less destructive (see *Fifth Report Insects of New York*, 1889, page 266).

The scale, known as *Chionaspis pinifolii* (Fitch), is represented in Fig. 1 of Plate IX, in natural size upon the leaves, and much enlarged, beneath. They are of an elongate oval form, of a pure white color with a waxy luster, and with the conspicuous yellow cast skins resting on the smaller end. Dr. Fitch, in his Second Report, 1856, has devoted a half-dozen pages to the insect and its lady-bug destroyer.

The White Scale.

A troublesome scale frequently infests conservatories and house plants, which may be recognized from the representation of infested leaves and the magnified scales shown in Fig. 2 of Plate IX.

The scales are white and are sometimes so abundant as to give a white-washed appearance to the trunks of the trees that they infest. It is known, in science, as *Aspidiotus nerii* Bouché. Its specific name of *nerii* is drawn from the botanical name of the oleander, *Nerium*, which is one

of its favorite food-plants. Ivy, when grown within doors, is quite subject to its attack, and is liable to be killed by it unless care is taken to prevent the multiplication of the scale. Prof. Comstock reports having studied the species on the following named plants: Acacia, magnolia, oleander, maple, Yucca, plum, cherry, currant, English ivy and lemons from the Mediterranean.

The scale of the female is nearly circular, flat, whitish or light gray, with the dull orange exuviæ (cast skins) central or nearly so. The ventral scale (as distinguished from the exuviæ) is a mere film applied to the bark. Diameter when full-grown, one-twelfth of an inch. The male scale is snowy-white, slightly elongated with the light yellow larval skin nearly central; diameter one-half that of the male. It is distributed over all the United States, and over much of Europe.

The Maple-tree Scale-insect.

This is one of our largest scale-insects, and, at the time of hatching of the eggs in late June and early July, is more conspicuous than any other found in this part of the United States. It is observed more frequently upon the soft maple, *Acer dasycarpum*, than elsewhere, but it is often found infesting grapevines, where it is known as the grapevine bark-louse. It was described forty years ago as *Coccus innumerabilis* — now included in the genus *Pulvinaria* — the specific name applicable both to the myriads in which it appears in some localities and to the immense number of eggs produced by the female: often a thousand or more can be counted from underneath a single scale. Fig. 1 of Plate X illustrates the scale as it appears when attention is usually drawn to it. It is then seen as a white, cottony mass of from three- to nearly four-tenths of an inch long, about one-half so broad, of a suboval form, bearing upon the narrower end a brown scale darker at the margin, somewhat flattened down or bent upward near its middle to nearly a right angle, oval, broader behind, where it is notched and apparently cleft for a short distance on its middle; on the front is a medial ridge for about one-fourth or one-third its length; it usually shows five transverse wrinkles or folds and about the same number of raised lines running outwardly on each side to the hinder margin. A common appearance of the adult scale is shown at *b* of Fig. 3 of Plate X, and at *a*, *b*, and *c*, immature forms in Fig. 4.

The white cotton-like mass, which is a characteristic of the genus *Pulvinaria*, is a secretion thrown out by the insect for the protection of its eggs, and also of the young insects for a short time after their hatching.

In Fig. 2 of Plate X (after Walsh and Riley) the scales and egg-masses are shown on osage-orange as *Lecanium Maclurœ*, and on maple as *L. acericola*, but both are now referred to *P. innumerabilis*.

This scale had become very abundant upon the maples in the streets of Brooklyn in 1890, and was reported as having killed a large number of the infested trees.* In 1884, it was excessively abundant and quite destructive over the larger part of the State of Illinois. Further particulars of it, and available remedies, may be found in the *Sixth Report on the Insects of New York*, 1890, pp. 141–147.

The Plum-tree Scale-insect.

In Plate XI, the plum scale is shown — an apparently new and destructive plum pest, which has during the past year made its appearance in different localities in the State of New York, particularly in its western portion. Examples of it were received by me on May 14th and 15th from Dr. Collier of the Geneva Agricultural Experiment Station, and from C. M. Hooker and W. C. Barry, of Rochester. No record could be found of its previous occurrence as infesting the plum. On submitting it to Prof. T. D. A. Cockerell, of Las Cruces, New Mexico, who has made special study of scale insects, it was determined by him, with a possible doubt, as *Lecanium juglandis* Bouché. This determination has not been accepted by some entomologists, while as an explanation of difference of opinion in regard to it, it has been suggested that two closely resembling species are associated on the infested trees.

The species of *Lecanium* are large, conspicuous scales, as may be seen covering the branch in the figure, approaching a half globe in form, and in the season of reproduction, containing within their capacious bodies a very large number of eggs — a thousand, or it may be two thousand or more. From their rapidity of multiplication they may prove very injurious to the trees that they infest, but, fortunately, their size, and their tenderness during a portion of their existence, exposes them to parasitic attack and to destruction from certain weather conditions. They are amenable to treatment with kerosene emulsion, and to the methods which will be recommended for the destruction of the San José scale.

Prof. M. V. Slingerland, of the Cornell University Experiment Station, has made a study of this insect in the plum orchards of Western New York, the results of which are published in Bulletin 83 of the Station — describing it, narrating its destructiveness, naming the few plants upon

**Eighth Report on the Insects of New York*, 1893, page 177.

which it is believed to have passed from the plum, its life-history, its natural enemies, and approved methods for combating it.

This scale has been found abundantly in some localities in Eastern New York; in Orange county, it has been mistaken by some fruit-growers for the San José scale, but from their great dissimilarity in appearance, there is hardly an excuse for confounding them.

The figure representing an infested plum branch is from a photograph taken by the Geneva Experiment Station, and employed in illustrating a brief notice of the insect by Prof. S. A. Beach, in *Garden and Forest* for July 18, 1894, from which paper it has been obtained.

In the preceding brief notices of some of our more common scale insects, particular mention of the insecticides available for their destruction and methods of application, have been omitted, as those which will be indicated for use against the San José scale, will be found equally serviceable against each one of them.

The San José Scale.

The San José Scale—from the many different fruit trees that it infests, the rapidity of its multiplication through its successive broods during the year, and the short time in which it kills the trees that it attacks—is justly regarded as one of our most pernicious scale-insects. Its character is indicated in the specific name of *perniciosus* given to it by Prof. Comstock when first described by him in 1880, in the *Report of the Commissioner of Agriculture* for that year. He has written of it: "It is said to infest all the deciduous fruits grown in California, excepting peach, apricot, and the black Tartarean cherry.* It attacks the bark of the trunk and limbs as well as the leaves and fruit. I have seen many plum and apple trees upon which all the fruit was so badly infested that it was unmarketable. In other instances I have seen the bark of all of the small limbs completely covered by the scales. I think that it is the most pernicious scale-insect known in this country."

The Los Angeles (Cal.) Horticultural Commission, in their report for 1893, say of it: "This pest, if not speedily destroyed, will utterly ruin the deciduous fruit interests of this coast. It not only checks the growth of the tree, but it covers the tree literally entirely, and the fruit nearly as much so, and, if left unchecked, the tree is killed in three years' time."

* It has since been found on the peach and apricot.

Introduction and Spread.

As with the larger number of our more injurious pests, the San José scale is not native to North America. Where it originally occurred is not known. It is frequently found upon plants imported from Japan (Coquillett), and also occurs in Chile and in Australia. It is believed to have been brought into California in or about the year 1870. It first attracted the attention of fruit-growers at San José, in Southern California, in 1873. In 1882 it had extended into all the fruit-growing districts of California, and had entered Oregon and Washington. It is also found in Nevada, but when first observed there is not known. It is reported in one locality in Idaho, in 1894 (Aldrich), and as well established at Las Cruces, New Mexico (Cockerell).

Occurrence in Eastern United States.

It was quite a surprise when not long ago the discovery was made that this destructive insect had crossed the continent and had made its appearance in the Atlantic States. Its first recognition was by Mr. L. O. Howard, of the Division of Entomology at Washington, in August, 1893. A supposed fungus disease on pear sent from Charlottesville, Va., to the Department of Agriculture and shown to Mr. Howard, was "at the first glance recognized as that scourge of western orchards, the San José scale (*Aspidiotus perniciosus* Comst.)."

Investigations, etc., by the U. S. Department of Agriculture.

During the autumn, two of the assistants of the Entomological Division, Messrs. Schwarz and Coquillett, were sent to Charlottesville, to examine and report upon the infestation. It appeared from their examinations that it was limited in extent, being almost wholly confined to a pear orchard of about a square acre in area, but that it affected pear, peach, plum, apple, currant, rose, quince, gooseberry, and raspberry, and that it had already been present there for several years. It was subsequently learned that, in all probability, it had been introduced on nursery stock purchased from a New Jersey firm. Mr. Hedges, the owner of the orchard, was of the opinion that it had been brought on currant plants purchased in New Jersey eight years previously. Mr. Schwarz reported on the situation of the infested orchard, the plants attacked, other infested places adjoining, habits of the scale, and its observed enemies. Mr. Coquillett reported upon the infested locality, and the conjectural sources of the scale. (*Insect Life*, vi., 1894, pp. 247–254.)

Early in the spring of 1894, through the co-operation of the U. S. Department of Agriculture and the Virginia State Board of Agriculture,

Mr. Coquillett, who had conducted very successfully most of the experiments in California for the destruction of scale insects by inclosing the infested trees with tents and fumigating them with hydrocyanic acid gas, was intrusted with the operations for destroying the scale in Charlottesville by the same method—always effective when properly conducted. It appears in his report submitted (*loc. cit.*, pp. 324–326), that 326 trees and shrubs were subjected to the gas treatment. Examinations made a few months thereafter disclosed no living scales.

In Maryland.—In March, 1894, the scale was sent to the Division of Entomology on peach twigs from a large peach orchard in Riverside, Charles county, Md. It was learned that the scale had been introduced in 1887 and 1888, on peach trees purchased of a New Jersey nursery. Many of them had died, and nearly all of those that remained were found to be thoroughly encrusted with the scale, so that at the time of examination they were being taken up and destroyed. (Other trees to which the scale had spread, had been treated by their owner during the preceding winter, apparently with good results, with the three principal winter washes, viz., strong kerosene emulsion; lime, salt, and sulphur; and resin wash.) A trunk-washing in April with strong kerosene emulsion was successful to the extent of killing 90 per cent. of the scales. Several sprayings were made during the summer with different mixtures—some of them under the direction of Mr. Coquillett—by which most of the scales were killed. At the time of Mr. Howard's report (from which most of these items relating to the eastern presence of the scale have been drawn) in August, it was thought safe to say that the insects would be completely stamped out in this locality by the close of the year.

In Florida.—At the same time of the discovery of the Maryland locality, the scale was also received from De Funiak Springs, Florida. At the request of the fruit-growers of that section of the State, the Department of Agriculture sent Mr. H. G. Hubbard to make examination and report. The insect was practically confined to the peach and plum, but occurred also, in small numbers on Kieffer pears, and on pecan and persimmon. Many thousands of trees were infested, and nearly every orchard within a radius of five or six miles was more or less attacked. Arrangement was made for the Experiment Station of Florida to undertake the work of destroying the scale, by going over all the infested trees in the district with five or six applications of the resin wash. If the weather should prove favorable for the use of the wash, there was reason to believe "that the nuisance will have been abated by the close of the

season in Florida, although extermination [from the peculiar condition of the infested locality] may not be found possible."

Discovered in other States.—In consideration of the discovery that some at least of the above-noticed infestations of this pernicious California scale, were traceable to New Jersey nurseries which were, in all probability, still serving as distributing centers for the distribution of the pest over nearly all the country, a circular was prepared by Mr. Howard, describing and figuring the scale and warning fruit-growers of its exceeding dangerous character, which was distributed in the first week of April (1894) to all eastern agricultural newspapers and to nearly 12,000 eastern fruit-growers whose addresses were obtained from the pomologist of the Department. This circular—with its excellent illustrations,* description of its appearance, explanation of the manner of spreading of the insect, and the best remedies for it—as might naturally be expected, excited much interest and alarm. Scale insects of many kinds as well as insects belonging to other groups, were sent to the Department with the inquiry if they were the San José scale.

As a result of the distribution of this circular, the following additional localities were ascertained:

Neavitt and Chestertown in Maryland; Bartle, Indiana; many points in New Jersey; Atglen and Lewisburg, in Southeastern and Central Pennsylvania. It was also received from Middletown, Idaho, and from British Columbia.

Referring to the above attacks, Mr. Howard gives encouraging reports: The orchard of 7,000 trees in Atglen, Pa., under direction of Dr. J. B. Smith, Entomologist at Rutgers College, New Jersey, had been treated three times at intervals of ten days, with kerosene emulsion, with absolute success.

At the Lewisburg locality, the few infested pear trees that had been bought of the New Jersey nurseries in 1890, had all been killed but one. Other trees to which the scale had spread were being treated by the owner with every prospect of extermination.

At Bartle, Indiana, two young apple trees from New Jersey were infested. These were taken up and burned, and no more of the insects were discoverable by careful search. (A second infestation has since been discovered at North Madison — see *Rural New Yorker*, liv, p. 87).

At Neavitt, Md., a 10-acre orchard of peach trees was badly infested — nearly every tree was languishing from the attack. Many had been

*I am indebted to the Department for the privilege of introducing them in this paper: see Plates XIII and XIV.

taken up and destroyed. Full directions were given for spraying, and the success of the operations will be watched. The source of this infestation could not be definitely ascertained, but it was thought by the owner that the first affected trees had come from a Missouri nurseryman — not from New Jersey.

Chestertown, Md., showed but few infested trees. They had been treated by the owner with thick whale-oil soap of the consistency of molasses, with every prospect of extermination of the scale. The infested trees had been received from New Jersey in 1890. As a summary of the above, Mr. Howard states that the scale had been exterminated (in 1894) in Indiana and Virginia, and the probabilities were strong of a like result before the close of the year, at the other localities named, except in Florida and New Jersey.

It has since come to the knowledge of the Division of Entomology, that the scale has been found abundantly in three new localities in Maryland. It has also been discovered in a locality in Southern Georgia; in an orchard in Southern Ohio; in Newcastle Co., Md.; in Jefferson Co., Indiana; at City Point, Va.; and at Bristol, Pa. In some of these localities the infestation was quite limited, and it is believed to have been exterminated. (L. O. Howard: Further Notes on the San José Scale, in *Insect Life*, vii, 1895, pp. 285, 286.)

The San José Scale in New York.

During the meeting of the American Association for the Advancement of Science, at Brooklyn, N. Y., in August last — in a paper read by Dr. Smith before the Association of Economic Entomologists on "The San José Scale in New Jersey," it was incidentally stated that an orchard in Columbia County, New York, was known to be badly infested with the scale. The particular orchard was not named, but later, at my request, the information was obtained from Dr. Smith, that Mr. L. L. Morrell of Kinderhook, had not long ago purchased a number of young apple trees (Ben Davis variety) from one of the New Jersey nurseries. Two years later (in 1894), on examination of these trees by one of the owners of the nursery (a relative of Mr. Morrell), they were found to be badly infested, and advice was given that they should be at once taken up and destroyed. A week or two later it was learned from Mr. Morrell that this had been done, and it was thought that with the destruction of the entire purchase, the scale had been exterminated.

Thinking it important to know whether the measure had been entirely successful, I visited Mr. Morrell early in November, and was met with

the unpleasant intelligence that he was fearful that he still had the insect with him, for he had found upon a single pear what he believed to be the scale. It proved to be such,— perhaps a half-dozen of individuals being scattered over its surface.

On examining his orchards, the scale was found abundantly in one of them — a young pear orchard in which a few trees had borne fruit, for the first, the present year. Some of the trees were moderately infested — perhaps a half-dozen scales or less being found upon them; on others the scale was so numerous as to fairly encrust the branches and most of the trunk. It was apparent that the latter were those upon which the insect had been introduced, and from which they had been scattered throughout the orchard by the agency of birds or otherwise to individual trees in various portions of it.

Most, if not all, of the stock of this orchard, had been purchased of the New Jersey nursery two years preceding the planting of that which had been taken up and destroyed — the condition of this having been overlooked at the time. A large portion of the orchard was critically gone over by me, and the trees marked which called for special care in the application of the winter wash recommended, and those which should be at once taken up and burned. The examination of the remainder of the orchard was subsequently made, and a number of infested trees discovered. So determined was Mr. Morrell to rid himself of this pest, that rather than wait for a winter treatment, all of the infested trees, as he has informed me, were taken up and burned: he believed that he did not have a scale remaining in his orchard. If it should prove that in this he has been over-confident, there is every reason to believe that within another year, the scale will be exterminated in this locality.

As the scale occurs also on the leaves — usually in rows along the midrib on the upper side, it was recommended to Mr. Morrell that the leaves from the worst infested trees which at the time of my visit were lying on the ground beneath or near them, should be raked together and burned, in order to prevent the chance of the scales being carried by the winds over the entire orchard.*

The infested trees were entirely of the d'Anjou variety. In two other orchards of Mr. Morrell, of the Kieffer pear, not a scale was found, nor on the apple, cherry, and plum trees that were examined. The infesta-

*Dr. Smith does not believe that the fixed scale can be carried on fallen leaves. He states (*Bulletin* 106 *New Jersey Agricul. Coll. Expt. Station*, 1895, page 15): "Only such as are affixed to the tree itself have any chance of reproducing their kind. Those that fix to the leaves fall with them, and as these dry or decay the insect dies for want of food before attaining maturity."

tion was apparently confined to the two purchases made at the New Jersey nursery and had not extended beyond them.

The Scale on Long Island.

In September of last year the scale was discovered in abundance in some of the nurseries on Long Island by Messrs. Sirrine & Lowe, who had been commissioned by the State Agricultural Experiment Station at Geneva for conducting some entomological investigations especially desired on Western Long Island, under an appropriation of $8,000 made by the Legislature of 1894 to the station named, "for the purpose of agricultural experiment investigations, instruction and information, in the Second Judicial department" of the State of New York.

Among the earlier results of their investigations was a discovery of the San José scale in great abundance in some of the nurseries on the Island. The following notice of its first observation was communicated to *Garden and Forest*, of November 7, 1894:

The San José scale was observed first in the market at Jamaica on some Bartlett pears said to have been grown on the Island. The scale was also conspicuous on some fancy varieties of pears exhibited at the Queens County Fair; and by tracing the fruit to its source some of the infested nurseries were located. We have found the scale on pear, apple, peach, and quince stock in several nurseries.

The nurserymen were unable to give any definite information regarding the length of time that they had had the scale, but it was thought by some of them that it had been with them for the past twenty years. This, under the circumstances, is impossible: they had doubtless mistaken some other scale for it. Nor can anything definite be learned of the source of the infestation. If known to them they have been unwilling to communicate the fact. It is stated that the stock that was infested was not grown by them, but was received from other nurseries. It would be of material service in the efforts that are being made for the extermination of the scale in the east if the localities of these "other nurseries" could be learned, but for some unknown reason it is being withheld. This unfortunate reticence is reflecting on all the other nurseries of the State of New York, for it seems to be implied that from some one or more of them the Long Island infested stock was originally received. It is conceded that its source was not the New Jersey nurseries.* The Geneva nurseries have been inspected by Mr. Lowe, with the result, it is inferred, that the scale was not found therein. The Rochester nurseries have been strongly suspected. Mr. W. C. Barry, when consulted, believed them to

*It has since been learned that one of the Long Island nurseries has been receiving stock nearly every year since 1888 from one or the other of the New Jersey nurseries.

be entirely free from its presence, and this belief was subsequently carried to approximate certainty by examinations made by Mr. Sirrine, from which it resulted that the reported San José scale at Rochester, when examined at Washington, was found to be *Aspidiotus ancylus* — a closely resembling, but comparatively harmless species.

Condition of the Long Island Nurseries.

It would be of interest if the exact condition of the Long Island infestation could be given in this Bulletin. I can state, however, from information received from Mr. Sirrine, under date of March 22d, that he had visited the following nurseries on Long Island: — of Fred Boulon, Sea Cliff; Keene & Foulk, Flushing; Parsons & Sons, Flushing; Isaac Hicks & Sons, Westbury Station; R. P. Jeffery & Sons, Smithville South; P. H. Foster, Babylon; W. C. Wilson, Astoria; Gabriel Marc & Co., Woodside, and the Long Island Nursery Company, Brentwood.

The last six of the nine above-named nurseries were found to be free from the scale. In the worse infested of the three, as soon as the attention of the proprietors was called to the destructive enemy that they were harboring, a large number of trees were taken up and burned. The remainder were sprayed, according to directions given by Mr. Sirrine, and would be followed by other sprayings in the event of the first not proving to be entirely effectual.

In the other two nurseries, the few trees that had been found to be infested had been destroyed, and it was thought that such further work would be done before the time for shipment, that no infested stock would be sent out from them.

It was probably one of these two, that had been reported as intractable last summer. As represented at the time, the owners were indifferent to the evil pointed out to them that would result from the multiplication of the pest, and indisposed to take any measures against it. When again seen by Mr. Sirrine in March, they would give no assurance of adopting the measures deemed necessary for preventing the distribution of their infested stock. The only promise that could be obtained from them was, that "they would treat with gas the stock they sold, providing that they had the time." A promise so broadly qualified could carry no weight with it. Unless a satisfactory understanding can be had with the firm, its name, if furnished to me, will be given in a foot-note, as a protection to purchasers of Long Island stock.*

*The name of this nursery has since been given me as the Parsons & Sons Company, at Flushing, Long Island. In a letter addressed them on April 8th, the following questions were asked, and the reasons stated why replies were needed: 1. Have you taken steps to learn by applica-

There is scarcely a doubt but that infested stock has been sent from these nurseries to many places in the State of New York. If the attempt that is being made for the extermination of the scale in the State during the present year is to prove successful, it is of the utmost importance that each locality where possibly infested trees have been delivered within the past five years (dating back to the probable establishment of the scale on Long Island) should be ascertained, and carefully inspected as soon as possible. Request was accordingly made of the proprietors of these infested nurseries, that they would furnish the State Entomologist with a list of their New York sales from and including the year 1890 to the present. One of the firms promptly complied with the request, so far as it could be done without involving excessive labor, and sent to this office extended lists, at the same time offering to open their books for further examination and transcription by any one who might be commissioned for the purpose.

It is due to this firm — Keene & Foulk, Bloodgood Nursery, Flushing, L. I., that they be specially mentioned and commended for the earnest manner in which they are working for the extermination of the scale in their nursery. They have asked for suggestions and directions and have promptly and faithfully carried them out — not only in burning and spraying, but also in arranging, under the best approved method, for the fumigation by the hydrocyanic acid gas treatment of all the stock that they send out this season; the latter should insure the destruction of any scattered individual scales that may have been overlooked. They will also, upon request, replace at half-price, all such infested stock that has

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tion to Mr. Sirrine or by other proper means, of the extent of the infestation in your nurseries? 2. Have you taken up and burned the stock that was found to be the worst infested? 3. To what extent and with what results have you sprayed with proper insecticides such other infested stock as it was not thought necessary to wholly destroy? 4. Have you arranged for treating the nursery stock sent out this season with hydrocyanic acid gas, according to the approved directions published and accessible to you? 5. Have you sent out any nursery stock this year which may have been infested without having been subjected to the gas treatment?

In the answer returned by the Parsons & Sons Company to the above-mentioned letter, the only reply to the questions proposed is that found in the following — prefaced by, "We only knew last fall of the San José scale." "He [Mr. Sirrine] has informed us now of the plants infected, and we shall take them up and burn them as soon as possible. It is our intention to destroy rather than to spray. In the plants now sending out we have not noticed any infected; it would be impossible in any event to subject to the gas treatment while in the rush of sending off trees."

Is it possible — as may be inferred from the above, that up to the middle of April, absolutely *nothing* had been done by this company toward freeing their nurseries from this dangerous insect?

In the absence of present legislation authorizing entrance upon private grounds for the destruction of the San José scale, it only remains for purchasers of trees, shrubs, etc., subject to its attack to protect themselves so far as they may, by withholding orders from localities known to be infested and where no efficient measures have been and are being taken for its extermination.

been received from their nursery in former years before its condition was known.

In consideration of what they have done and are doing for the protection of their customers (and, at the same time, of their own interests), it is believed that orders may be more safely sent to them than to other nurseries where the scale may be reasonably looked for — where no thorough inspection has been made — where it may exist without having been detected, and where no gas fumigation, as a safeguard against such a contingency, is practiced.

From the two other known infested nurseries on Long Island, no notice has been taken of the request for lists of New York sales of possibly infested stock, sent them under date of Feb. 15, 1894.*

The San José Scale in New Jersey.

Nearly all of the infestation in the Atlantic and adjoining States having been clearly traceable to the sale — without knowledge or suspicion of their dangerous condition — of infested trees by two nurserymen in New Jersey, there will naturally be a deep anxiety to learn what has been done in New Jersey toward the prevention of further distribution of the dangerous pest, through purchases that may have been made in 1894 or to be made hereafter.

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* The following letter was addressed to each of the three nursery firms above referred to:

GENTLEMEN:— Will you be kind enough to favor me with a list of the addresses of all the persons in the State of New York to whom you have made sales during the last five years (1890–1894) of nursery stock which might possibly have been infested with the San José scale which you have in your nurseries?

We are expecting to get a bill through our present Legislature by means of which we shall be able to have each locality into which infested stock may have been introduced, examined by an expert, and such measures taken as give promise of exterminating the scale in our State during the present year.

If you will furnish me with the list requested, it will aid much in this undertaking.

You will also see that in consideration of the serious character of this pest and the danger of its introduction into new localities, that not until we are able to report as free from infestation, all the nurseries of the State, especially those on Long Island which have been widely published (without names), will there be a willingness on the part of fruit-growers to order stock from nurseries actually having or suspected of having, the dreaded San José scale.

One of the largest nurseries in New Jersey which had made wide distribution of the scale, has sent me a list such as I ask of you, and is doing everything in its power to prevent distribution of any infested stock.

I had asked Mr. Sirrine to procure such a list for me, but I have thought it better to make a personal request.

We must, if possible, in the interests of both fruit-growers and nurseries, as soon as it can be done, exterminate the scale from our State.

I am very desirous of being able to say in the Bulletin which is nearly ready for publication, that I have reliable assurance that no further distribution of the scale will be made from New York nurseries. The name of your nursery will not appear in it.

Very truly yours,

From a Bulletin entitled "The San José Scale in New Jersey" (*Bulletin 106 of the New Jersey Agricultural College Experiment Station*), prepared by Dr. J. B. Smith, Entomologist of the Station, and issued in January, 1895, we learn that the introduction of the scale in New Jersey occurred either in 1886 or 1887, upon a "Kelsey" plum ordered by the two nurseries under the representation of its being curculio proof, from the San José district, California. It is also known that some Idaho pear stock brought from nurseries on the Pacific Coast were also infested.

As soon as Dr. Smith became aware (in April 1894) of the existence of the scale in the State, he at once, with his accustomed energy, entered upon the task of finding the nurseries from which the infested stock had been sent, and so far as possible, the other infested localities within the limits of the State. Two large and well-known nurseries, widely separated, were soon located, and these, so far as could be ascertained, were the only distributing centers. The owners, upon being informed of the dangerous character of the pest that they were harboring, and the effect that it might have upon their business in the future, immediately took active steps for stamping out the insect upon their bearing trees, upon which it mainly occurred, and promised to prevent, through fumigation or otherwise, further shipment of infested stock. In one of the nurseries several blocks of young stock were at once torn up and burned.

The scale had been distributed from these nurseries to a number of orchards throughout the State (nearly one hundred were known to Dr. Smith), but nowhere in sufficient numbers to have spread from the orchard in which it was at first introduced. In all of these, it is believed that measures will be taken by their owners for the prevention of further spread, and toward extermination.

The work will be carefully watched, and, with our knowledge of the zeal, persistence, and ability shown by Dr. Smith in all of his operations against the noxious insects that are so unfortunate as to intrude within his jurisdiction, we have every assurance that, if extermination is possible, it will be speedily effected.

The Two Infested New Jersey Nurseries.

The interest felt among the fruit-growers of New York in the New Jersey nurseries, from which large purchases have been made each year, has been already mentioned, and will warrant a more particular reference to their present condition. Quite a satisfactory account of one, and an encouraging account of the other, can be given, based on letters from Dr. Smith, from correspondence with the proprietors of the nurseries at the

suggestion of Dr. Smith, and from statements made in a recent number of the *Rural New Yorker* (of March 9th). The article in the *R. N. Y.* written by a gentleman connected with that journal, after a visit to Little Silver, N. J., to examine into charges that had been "publicly made that the Lovett Company had done practically nothing to exterminate the scale," publishes the names of "the two nurseries as those of Wm. Parry and the Lovett Company." There can, therefore, be no impropriety in the mention of their names in this Bulletin.

The Wm. Parry Nurseries.— The nurseries of Wm. Parry are gladly mentioned, for the same reason given for making public the name of the nursery of Keene & Foulk, of Long Island. Unqualified praise is due Mr. Parry for his strenuous efforts for the extermination of the scale in the widely-known and far-famed "Pomona Nurseries," at Parry, and the aid so freely extended, in the endeavors being made for its extermination wherever his extended sales may have borne it.* Promptly upon receiving a request for a list of New York sales which may have distributed the scale throughout the State, the desired list, embracing several hundreds of names, scattered through nearly every county, was sent to me, without any suggestion of compensation for the labor which it necessitated.

The expression of the confidence with which it is believed, orders could be sent at the present time to the Bloodgood Nursery, would apply in, at least, equal force to the Pomona Nurseries, where operations against the scale have been conducted largely under the direction and supervision of the New Jersey State Entomologist, Dr. J. B. Smith.

The Lovett Company Nurseries.— Of the condition at the Lovett Company Nurseries, the following is reported in the *Rural New Yorker*, *loc. cit.* Some bearing trees upon which the scale had been located last autumn by Dr. Smith, had meantime been cut down and destroyed. Satisfactory apparatus for treating the infested nursery stock was found. Upon the scale being pointed out by Dr. Smith on a considerable number of young pear and apple trees that were heeled in, and in patches here and there in rows, they were cut down as fast as found, and, finally, Mr. Lovett agreed to chop out and burn the entire block. The larger part of the nursery stock had been heeled in, after having been treated with gas. The scales upon them, according to Dr. Smith, had been "practically killed," and, if treated again before being sent out, he would consider them safe. Mr. Lovett would "guarantee to destroy every tree

*We are indebted to Mr. Parry for the detection of the scale at Kinderhook, N. Y., in the summer of 1894, as noticed on page 210.

where Dr. Smith had found the scale, and, also, to give all these trees a second treatment with gas." The *Rural New Yorker* concludes its account thus: "If this is done, there will be little danger of importing the scale from this nursery. This statement refers simply to the trees now in the nursery. What has already been sent out we do not know."

Much may be inferred, and seems to be implied, in the short sentence last quoted. It is here that the Lovett Company has chosen to place itself in a position exposing it to just and severe criticism. It virtually declines to do anything toward undoing the evil which it has perpetrated — for the most part unwittingly, we believe — in the distribution of infested stock in the State of New York.

Request was made of them from this office in November, 1894, for a list of sales such as Mr. Parry had sent me — stating fully its character. After several months' delay, reply was made (February 4th), declining the request upon the ground of the immense labor that it would involve, but offering to place their order books at the disposal of any persons who might be sent for their examination. As this plan did not seem feasible to Dr. Smith — after further correspondence with him, he was asked to procure, if possible, the desired list from the company for me, for which the expenses incurred would be paid. Dr. Smith wrote them, urging compliance with my request. The letter received from the company in answer contained the following proposition: "If he [Prof. Lintner] will send us, or you either, a remittance of $250, we will attempt to make the examination desired. * * * But we want a clear understanding before we begin as to the settlement of cost of sending the list he requires." No comment on this modest proposal is needed!

The course taken by this firm has been so unaccountably strange in other respects as to expose them to suspicions which possibly may do them injustice. On the authority of Dr. Smith, the statement is made, that during last autumn [in September] in a visit of observation made them, he found that practically all of the trees in their nursery blocks were infested by the San José scale. He notified them of this fact at the time, and showed to both the president and secretary of the company who were with him, the infested trees and the scales.

Under date of December 28th following, the Lovett Company, writing to the Director of the Ohio Agricultural Experiment Station in relation to some infested apple trees that had been sent by them to Clermont County, Ohio in 1890—disavow all knowledge of the scale. They say: "We would like very much indeed to have some branches of the trees referred to for examination ourselves. We have made a critical examina-

tion of our trees here in the nursery and also fruiting trees, and can find no trace whatever upon any of them of the San José scale or other scale. Having read reports upon the San José scale, we are confident that we could detect this insect if t existed upon our trees." (*Bulletin* 56 Dec., 1894, *Ohio Agr. Exper. Stat.*, p. 83).

It is fortunate that since this letter was written, such pressure has been brought to bear upon the firm that it has taken the effective measures for the destruction of the scale reported in the *Rural New Yorker* cited, and in letters received from Dr. Smith.

As no aid is to be obtained from the company toward the examination of stock that it may have sent into the State of New York, request is herewith made of each person who within the last five years has received from the nurseries of the Lovett Company, Little Silver, N. J., fruit trees and ornamental shrubs, or other plants on which the scale is known to occur, that he will send his name to the State Entomologist, at Albany, with mention of the fact. If the arrangement proposed can be carried into effect, examinations will be made by competent persons of all such stock for the detection of the scale if present.

The San José Scale in Ohio.

It is learned from Prof. F. M. Webster, that an infested locality in Clermont county, Ohio, had come to his notice in December of 1894. The scale had probably been introduced in 1891 on apple trees purchased of the Lovett Company, of Little Silver, N. J. Prof. Webster reports: "The orchard comprised about 600 trees, probably one-third of which were more or less infested — twenty-five at least so badly as to preclude all possibility of saving them, and at least double that number that could only be utilized by cutting off the trunks at a short distance above the ground and grafting them, first disinfecting the stumps. The pest had been noticed the previous year. * * * A smaller orchard set at the same time and with trees from the same nursery, was found infested to a much less extent, though the scales were badly scattered through the orchard. * * * The owners of these two orchards will take this scale in hand and stamp out the pest before it gets a stronger foothold or becomes more widely spread." (*Bull.* 56 *Ohio Agr. Exper. Stat.*)

Description of the Scale.

The female scale, greatly enlarged is shown at Fig. 4 of Plate XII and at *b*, in Fig. 2 of Plate XIII. It is flat, almost circular in outline, dark mottled with gray in color, with a small elevated spot at or near its center

which is black or yellowish; it measures about one-sixteenth of an inch in diameter, but under some favoring conditions may attain a size of one-eighth of an inch; in its original description it is given as 0.08 of an inch.

Professor Comstock described the male scale as "black, somewhat elongated when fully formed. The larval skin is covered with secretion; its position is marked by a single nipple-like prominence which is between the center and anterior margin of the scale. The scale of the male is more abundant than that of the female." It is often oval in shape, and of a smaller size than the female. It is represented at 5 in Plate XII.

When occurring upon the bark of the twigs or leaves and in large numbers, the scales lie close to each other, frequently overlapping, and are at such times difficult to distinguish without a magnifying glass: see Fig. 1 of plate XIII. The general appearance that they present is of a grayish, very slightly roughened scurfy deposit. The natural rich reddish color of the limbs of the peach and apple is quite obscured when these trees are thickly infested, and they then have every appearance of being coated with lime or ashes. When the scales are crushed by scraping, a yellowish oily liquid will appear, resulting from the crushing of the soft, yellow insects beneath, and this will at once indicate to one who is not familiar with their appearance, the existence of healthy living scales on the trees. (*Circular No. 3, 2d series, U. S. Dept. Agriculture*, Washington, 1893.)

As before stated, the scale is also found upon the fruit. When present in large numbers, to the extent of covering the entire surface, it interferes seriously with the proper development of the fruit, causes it to crack, often to fall from the tree, or when it remains thereon, renders it unmarketable. It is a conspicuous object from the little depression which it causes (at least late in the season) and usually a well-defined purplish ring with which each scale is surrounded of a diameter considerably larger than that of the scale (see Figure 3 on Plate XII and Figure 2 on Plate XIII).

The Insect.

The male.—As previously stated, the male only becomes winged. It is shown greatly enlarged in Fig. 3 of Plate XIV—its natural size being indicated by the crossed lines within the circle beside it. Examined under a high magnifying power, its wings are seen to be transparent, each with two delicate veins only. It has a well-defined thorax and a rather large head with two large eyes. Its body is of a light amber color with dark brownish markings, and terminates in a slender "stylet" nearly as

long as the body, which is the external organ of reproduction. The antennæ are long and conspicuous, ten-jointed, eight of which are hairy.

The above description of the male will be of no particular interest to others than the entomological student, as but few fruit-growers will ever see it in nature, as it is difficult to obtain and needs a good microscope for its inspection.

The female.— Soon after the leafing of the tree in the spring, when the young have crawled out from beneath the scales, close examination of an infested twig will show them as yellowish objects, scarcely more than points to the unaided eye, moving over the bark (Matthew Cooke has given their size as one seventy-fifth of an inch). They are of an oval form, with the normal number of legs pertaining to insects — three pairs — and a pair of antennæ. In Fig. 1 of Plate XIV, giving an enlarged view of the insect from the under side, its curious long hair-like beak or proboscis which serves it for feeding and for fastening itself to the bark or leaf or fruit, is shown as curled up between the legs.

The mature female can only be seen by taking her from beneath the scale at the proper time. She then appears in a very different form from that when moving over the bark. In a subsequent molting she had lost her legs and antennæ, retaining only for her need her long and delicate proboscis consisting of four hair-like bristles within a two-jointed sheath. Fig. 2 of the same Plate represents this stage of the insect, enlarged from the hair-line at the right-hand side. It is shown from the underside as seen with its transparency in nature, with a number of its young within, for this species, unlike most of the scale-insects, which produce eggs, may bring forth its young alive. Of the several segments into which the body is divided, as indicated in the figure, the last one bears groups of spinnerets, anal and vaginal openings, and upon its border, lobes, incisions, and spines (some of which are shown in enlargement at *d*): from the location, number, and form of these, important and reliable characters are drawn for the separation of the species, which may not be found in the study of the external scale alone, where they closely resemble one another.

Its Life-History.

Most of the Coccidæ are oviparous — that is, they deposit eggs underneath the scale, from which the young are soon thereafter hatched. A few are known to be viviparous, *i. e.*, bringing forth living young, as *Aspidiotus tenebricosus* occurring on maple, and a few species of the genus *Lecanium*.* It would seem that the San José scale, *Aspidiotus perniciosus*,

* As *Lecanium hesperidum*, *L. platycerii*, *L. tulipiferæ*, and two unnamed species on the red-bay and on Acacia. — Riley, in *Proc. Ent. Soc. Wash.*, iii, 1894, pp. 67, 69.

may be both oviparous and viviparous, for while generally regarded as giving out its young alive (the young shown within the body of the parent in Fig. 2 of Plate XIV), it is also recorded as producing eggs. Dr. Riley has stated of it (*loc. cit.*)—"specimens examined in December, 1879, showed that the mature females were hibernating, and that with some of them were found a few eggs and recently hatched larvæ:" on the authority of Professor Comstock (*Rept. Commis. Agricul.* for 1880, p. 305), "the eggs are white:" Matthew Cooke has written (*Inj. Ins. Orchard, Vineyard*, etc., 1883, p. 62)—"each female produces from thirty-five to fifty eggs;" W. G. Klee, State Inspector of Fruit Pests in California, states (*Bien. Rept. St. Bd. Horticul. Cal.* for 1885 and 1886, p. 373)—"eggs, thirty to fifty produced by each female; color yellow; form ovate;" Mr. C. H. T. Townsend, formerly of the New Mexico Agricultural Experiment Station, states of the eggs—"According to Comstock, the eggs are white; but according to my own observation, they turn to an orange-yellow color in the spring. They hatch here about the first or second week in May" (*Bulletin No. 7 New Mexico Agr. Exper. Stat.*, June, 1892, p. 7). Other writers have also mentioned the eggs. As opposed to this, however,—in colonies of the scale carried over on potted pear trees in the Insectary of the Entomological Division at Washington during the winter of 1893–4, although watched with care and subjected to daily observation, in no instance were eggs seen (*Insect Life*, vii, p. 287).

Early in June, ordinarily, in New York and New Jersey, the young escape from underneath the scale, and for a short time may be seen traveling actively over the branches, when they fasten themselves to the bark and commence to secrete a scale. They are not all given out at the same time, even the members of the same family. How long the hibernating female continues to reproduce, is not known. It is thought by Dr. Smith that it may extend over the greater part of the summer, and until "their grand-daughters are already full-grown with nearly full-grown progeny: there may be, therefore, upon a plant at one time, young born of as many as three or even four distinct generations." Certain it is that examination of an infested orchard will show the presence of the young, traveling insects at any one time from early June until nearly the last of autumn. On some pieces of twigs cut in Mr. Morrell's orchard on November 1st, the little yellow young were seen in motion two days thereafter in my office. It is probable that the young will not survive on a twig cut from the tree, for more than four or five days.

Observations made on isolated individuals at Washington showed that "the newly-hatched larvæ after crawling about for a few hours, settle down and commence at once to form a scale, which is white and fibrous. In two days the insect becomes invisible, being covered with a pale, grayish-yellow shield with a projecting white nipple at the center. * * * Twelve days after hatching, the first skin is cast. * * * In 20 to 21 days after hatching, the females cast their second skin. At 24 days the males begin to issue. * * * At 30 days the females are about full grown, and embryonic young can be seen within their bodies; and at from 33 to 40 days the larvæ begin to make their appearance." For additional observations on the development of other broods, see Howard, *Insect Life*, vii, pp. 288, 289.

From the first brood hatching early in June, a second is undoubtedly disclosed in July. How many follow, has not been ascertained. Matthew Cooke has placed the number during the season at three — the first in June, the second in July, and the third in October; but it would seem that the high temperature of summer could hardly fail of developing at least one additional brood intermediate to those of July and October. Four broods were developed at Washington from over-wintered females, and it was thought that there were ordinarily five. They soon became so inextricably mixed that the only importance that could attach to a determination of their number, would be as indicating the rapidity of increase of the insect in different localities and under different seasonal conditions.

The females continue to feed until prevented by the dormancy of the tree in the late autumn. It is thought that most of them pass the winter in about a half-grown stage, and resume their feeding in early spring, as soon as practicable for their entrance upon active life, in June as above stated.

Its Food-plants.

In addition to the food-plants of the San José scale that have been mentioned in the preceding pages, several others have recently been reported to me by Mr. Sirrine, as observed by him on Long Island.

The following is the list as it now stands. It will doubtless be largely extended by future observations:

Tiliaceæ

Linden (*Tilia*).

Celastraceæ

Euonymus.

Leguminosæ

Acacia.

Rosaceæ

Almond.
Peach.
Apricot.

Rosaceæ — (Continued)

Plum.
Cherry.
Spiræa.
Raspberry.
Rose.
Hawthorn (*Cratægus*).
Cotoneaster.
June Berry.
Pear.
Apple.
Quince.
Flowering Quince.

Saxifragaceæ

Gooseberry.
Currant.
Flowering Currant.

Cornaceæ

Dogwood.

Ebenaceæ

Persimmon (*Diospyros*).

Urticaceæ

Elm.
Osage Orange.

Juglandaceæ

English Walnut.
Pecan Nut.

Betulaceæ

Alder? (*Alnus*).

Salicaceæ

Weeping Willow.
Laurel-leaved Willow (from Asia).

It will be seen from the above that the scale is recorded as occurring on plants in eleven of the Orders, although one-half of the food-plants named belong to the Order *Rosaceæ*.

Spread of the Insects.

The natural spread of this scale is not a rapid one. As the female is unprovided with wings, and is unable to change its position after having become fixed and throughout its entire period of reproduction, the insect can only pass from one tree to another during the few hours that it continues in its active larval stage. Although a rather rapid traveler its range of locomotion would hardly ever carry it to neighboring trees in an orchard, unless the branches should interlock, in which case every facility is afforded it for spreading the infestation — almost equal to that existing in nurseries where the young trees are grown so closely together as to form compact masses.

Carried by birds, etc.—It has been found that the young insect may be distributed through the agency of other insects and of birds. When abounding on a tree to the extent that much of the bark is already occupied by the scales, they apparently show a disposition to leave the tree and fasten upon any visiting insect or to the legs of birds. If this is instinctive or in accordance with a purpose, they will leave their hosts as soon as transported to a favorable place for the establishment of a new

colony. It is stated that several of the young have been seen upon the wing-covers of a single lady-bird, that they are often found on ants, and that they show a preference for insects of dark color.

Distribution in Nursery Stock.—The ease with which many of our most serious insect pests may be widely distributed through sales of nursery stock, has been brought to notice so frequently in recent years by studies made of the means by which injurious insects have suddenly made their appearance in new localities, that our economic entomologists have deemed it their duty from time to time to warn fruit-growers of the danger to which they are exposed, and to impress upon them the great importance of a thorough inspection of all the nursery stock purchased by them. Each of the recent occurrences of the San José scale in the Eastern States, has been traced directly, or with a strong probability, to nursery infestation as its source. Of course, the danger of such introduction is the greater when the insect is so inconspicuous as is this scale, or when it is entirely hidden within its burrows in the branches or trunk, as in the case of the flat-headed pear tree borer, *Agrilus sinuatus* Oliv., lately discovered in New Jersey orchards by Dr. Smith, and by him traced to a New Jersey nursery which it was supposed had imported it from Europe about ten years ago.

Protection from Infested Stock.

In view of this danger, the following suggestion made by Dr. Smith (*Entomological News*, v., p. 311) is both timely and important: "No farmer should set out a tree until he has examined it closely and made certain that no scale-insects infest any portion of it. He should also wash at least the trunk and larger branches with a kerosene emulsion, diulted by no more than five parts of water; and he should, finally, trim back to the smallest possible amount of wood, burning or otherwise destroying all the cuttings," thereby facilitating the growth of the tree, and disposing of the eggs of the Aphides or plant-lice and of mites occurring on the smaller twigs.

Dr. Smith also offers the following: "Purchasers of nursery stock could insist on a written guarantee with each lot of stock purchased, that they are clean and free from insect pests, and had not been, in the nursery, affected by any plant disease, nor grown in the vicinity of diseased trees."

It is not probable that the New Jersey or Long Island nurserymen would give such a guarantee, nor does it seem that they could safely do so. Were they, one and all, skilled entomologists they might even then,

with reason, decline to commit themselves so broadly, covering insects of all kinds, both exposed to view and hidden from the eye. But for the present, at least, while the scale infestation of these localities is so generally known, some assurance of protection will be demanded by all to whom the knowledge has come, before further orders are sent to the nurseries involved.

The following form of certificate is offered to the consideration of purchasers and nurserymen, in the belief that it would prove equally beneficial to each party. Without it, or something to the same effect, there is reason to believe, from action about to be taken in another State, that some of the unfortunate nurseries may suffer for a time from a "boycott." Let it be understood — there is no disposition on the part of any entomologist to magnify the danger to important interests from this newly introduced pest, but simply to accept it at its full magnitude: —

I do hereby certify that the stock sent out herewith has been examined by a competent entomologist, and has been pronounced by him, to the best of his knowledge and belief, to be free from living San José scales (*Aspidiotus perniciosus*); and in the event of its being shown that the stock now sent has carried with it the living insects, I do hereby agree to replace it free of cost with uninfested stock.

Proposed Legislation.

No legislation has been had in the State of New York against insect pests. Laws of this character, more or less broad and stringent, have been passed in ten of the States, viz., California, Colorado, Idaho, Kansas, Massachusetts, Minnesota, Missouri, Nebraska, Oregon, and Washington. A compilation of these laws, which will be found convenient for examination and as aids to future legislation, has recently been made in a pamphlet of 46 pages by Mr. L. O. Howard, and issued as *Bulletin No. 33 of the U. S. Department of Agriculture — Division of Entomology*. California, it appears, has taken the lead in resorting to legislation, moved thereto by the urgency of preventing the introduction of species known to be destructive to fruit culture in other parts of the country and from the Old World.

Although the State of New York is subjected each year to losses from insect injuries which would aggregate in amount to several millions of dollars — a large proportion of which is preventable — no effort has hitherto been made toward the removal of so onerous a burden through a resort to legislative aid. An investigation of the insect pests of the State which was commenced forty years ago and continued, with a short inter-

val, up to the present, has given to the people of the State details of the life-histories and habits of all of our more noxious insects, accompanied with methods for their control. These studies are accessible in State reports to all who may desire to consult them. Their recommendations are conceded to be of great value, and if the information they contain be utilized to the extent that it should be, the occasion will seldom arise when aid from legislation is needed.

There may be, however, insect infestation in some other State or country of such a pronounced dangerous character, that its introduction should be guarded against by quarantine laws. Or, an insect may have multiplied to such an extent that its control is entirely beyond individual effort, as in the case of the gypsy moth in Massachusetts. Again, a newly introduced insect pest, known only in a single locality but threatening an almost unlimited range, may call for its extermination while the task is simple and inexpensive.* Still another instance is that of the presence of the San José scale in the State of New York. There is reason to fear that it has been sent into every county of the State. In how many orchards it has found place can not be known, without special examination of suspected localities by a person competent to identify it. Its dangerous character demands its extermination if it can be accomplished. Although it has had a foothold in the State for, probably, five years or more, it is believed that its extermination is practicable if the proper effort can be made at once, under the provisions of a bill which has been drawn up and introduced in the present Legislature, reading as follows:

AN ACT to provide for the extermination of the San José Scale in the State of New York.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Whenever the state entomologist may have knowledge of the existence of the San José scale, or has reason to believe in the probability of its existence in any locality within the State of New York on any trees, plants, vines, or fruit, he shall notify the commissioner of agriculture, who shall thereupon appoint one or more experts who shall be sufficiently familiar with the scale to be able to recognize it, for the prompt inspection of the infested or suspected locality.

§ 2. Such agent shall make thorough inspection of the locality named, and if the existence of the scale is found therein, he shall notify the

* Such an opportunity was lost when the pear-midge was confined to a few orchards in the town of Meriden, Conn.

owner or owners of the orchard, nursery, or grounds in which the insect is found, of its existence therein, and serve a notice containing a statement of all the facts found to exist, upon the owner or owners, with an order that within ten days they shall take such measures as have been proven to be effectual in the destruction of the scale and for prevention of its further distribution, and to continue them until its extermination has been effected.

§ 3. If the owner or owners shall refuse to comply with the order of the agent, as above stated, the agent shall be charged with its execution, and for this purpose, shall employ all necessary assistance; and such agent or his employes may enter upon any or all premises within the town or city for the purpose of the speedy extermination of the scale. Such agent shall be entitled to compensation for his services under this act at the rate of five dollars for each full day spent by him in the discharge of his duties, and the necessary disbursements paid or incurred by him therein.

§ 4. The sum of five thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of the state treasury to carry out the provisions of this act.

§ 5. This act shall take effect immediately.

Remedies.

There is no difficulty in killing this insect at any time and in any form of its existence, if the proper remedies are used and properly applied; but if entire success is demanded — that is, if all of the insects infesting an orchard are to be destroyed, which means extermination, — so far as our present knowledge extends, it can only be accomplished in the winter season. During the many years of its existence in California the experiments there conducted, showed that several of the insecticidal applications tested, were entirely effective — particularly some of the "winter washes" of which the formulas have been frequently published. When it became necessary to contend with the insect in its eastern invasion, it was naturally supposed that the Californian remedies would be equally effective here, but experiments with them proved that they only sufficed to destroy a certain percentage of the hibernating form; and even when used in double strength, a large proportion of the scales was not destroyed. These unexpected results may probably be accounted for by a more perfect dormancy of the insect in the East than in California.

Winter washes. — The experiments that have been conducted under the direction of L. O. Howard, Chief of the Entomological Bureau at

Washington, during the past year (1894), have been so varied and apparently so thorough that it would seem that the results attained might be accepted, without further experimentation, for future guidance in our operations against this scale. During the latter part of the year twenty-nine different washes were tested by experienced entomologists from the Bureau, upon badly infested trees in Charles county, Maryland. In summing up these results, Mr. Howard has stated: "The only perfect results which have been reached have come from the application of two pounds or more of commercial whale-oil soap to a gallon of water, and from the application of a resin wash of six times the normal summer strength. The effects following the application of these washes leave nothing to be desired. In all cases the most careful search over the sprayed trees has failed to show a single living scale."

Unfortunately, both of the above-named washes are somewhat expensive, as the lowest price at which the whale-oil soap can be purchased is four cents a pound by the barrel, making the wash to cost eight cents per gallon. The resin wash is still more expensive. When large orchards are to be treated, the cost is quite an item, but the intelligent fruit-grower will not hesitate when convinced that the choice lies between the expense of the wash and the loss of the trees.

The above are known as "winter washes," since they may only be used without serious injury to the tree during its winter dormancy. Later, it would not be safe to apply them unless in a considerably diluted form, when they would only suffice to destroy a portion of the scales.

Home-made whale-oil soap.— For those who would prefer making the soap for themselves, at a less cost than if purchased by a small quantity in market, Mr. Howard has given the following formula: Potash lye, one pound; fish oil, three pints; soft water, two gallons; dissolve the lye in water and add the oil on bringing the mixture to a boil; boil for about two hours and then add sufficient water to make up for the evaporation. This will make about twenty pounds of soft soap, equivalent to about five pounds of the hard.

The winter resin wash.— The composition and proportions given for this are as follows: Resin, 120 pounds; caustic soda, 30 pounds; fish oil, 15 pints; water sufficient to make 100 gallons. The resin and soda are broken up and, together with the fish oil, are placed in a large kettle, sufficient water being added to cover them. The whole is then boiled for several hours, or "until the compound will mix properly in water without breaking up into yellowish flakes" (*Insect Life*, vii, p. 293).

Potash wash.— Dr. Smith, in his experiments with the scale in New Jersey, has tested to his entire satisfaction the efficacy of a saturated solution of crude or commercial potash, i. e., potash in a sufficient quantity of water to dissolve it, to be used upon trees during their dormancy in the winter season, only. It may be applied either by means of a cloth or stiff brush, or by thorough spraying. The potash eats into or corrodes the scales and kills a large proportion of the insects beneath them. A month later, by which time the scales will have become riddled or loosened, it should be followed with kerosene emulsion made after the usual formula and diluted to a strength of one part to five parts of water. If these applications are thoroughly made, according to Dr. Smith, "not a single insect need escape."

Before using any of the above washes, it is recommended to cut back as freely as may be properly done, the infested trees, and burn the cuttings, as a large part of the scales are to be found on the terminal twigs.

Summer washes.— Experiments thus far made with applications that may be safely used during the summer, have failed to give a wash that will destroy all the scales; a small percentage will escape. The two that have given the best results are the summer resin wash and an ordinary diluted kerosene emulsion. With either of these, "by three applications at intervals through the summer, the insects may be kept from increasing to any serious extent." The unattached insects and those in which the scale is in its incipiency will readily be killed, and if it were possible to reach all of them, the entire destruction of the insect would be effected. But this is impracticable. The young are hatching continually during nearly five months of the year, and are to be found at any time during this period in their active stage upon the tree. The number of sprayings that would be required to reach the young before they are protected by their scale, would render this method altogether too laborious and costly to depend upon it for extermination.

Gas treatment.— The treatment of infested trees with hydrocyanic acid gas, generated within a canvas tent made air-tight through the application of boiled linseed oil, and fastened closely down over the tree to be treated, has been extensively used in California and with entire success against some of the scale-insects of the western coast. The cost of the tents and the labor involved in their management render it altogether too expensive for general use; and further, although it has been hitherto claimed that the gas applied in this manner was absolutely fatal to all animal life, yet late experiments appear to show that it may not be en-

tirely depended upon for the complete destruction of the San José scale when infesting orchards. According to Mr. Howard, an orchard in Charlottesville, Va., which had been treated with the gas in March last, under the skilled supervision of Mr. Coquillett, although "the operation was as thorough as it could be made, a few of the insects survived the treatment, as was shown by the receipt of living specimens late in the fall from Dr. Hedges" (*Insect Life*, vii, p. 286).*

Treatment of Nursery Stock.—It is believed that the hydrocyanic acid gas treatment is reliable for disinfesting nursery stock of infested nurseries previous to its distribution. Of course, all such stock found to have the scale in abundance, should be promptly taken up and burned, but where the scale is sparsely present or even where there is barely a suspicion of its presence, it should, before shipment be subjected to the gas fumigation. This is now being done in New Jersey and Long Island nurseries—in some of them at least, and should be made a condition upon which any further orders may be given or stock received from either of the infested districts or others that may hereafter be discovered.

The manner of treatment is the following: An air-tight box is made of suitable size for the reception of as much stock as may be conveniently treated at one time. The stock is placed therein and subjected for an hour to the gas generated in it by the combination of three ounces of water, a little more than one fluid ounce of commercial sulphuric acid, and one ounce of 60 per cent. cyanide of potassium, to be placed in a glazed earthenware vessel of the capacity of at least a gallon, in the order above named. These amounts are for 150 cubic feet of space. It should be remembered that this gas should not be breathed, as it is exceedingly poisonous.

Bibliography.

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* Mr. Howard has since made personal examination of this orchard, and has found the gas treatment inefficacious. The trees are again badly infested, while one result of the fumigation has been to seriously injure the trees by causing the blackening and cracking of the bark.

and *Insect Life*, vii, p. 167); the varieties of plums and pears more liable to its attack (*Bull.* 106—*ante*, p. 16); and its natural enemies (*id.*, p. 16).

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Myrmeleon sp.

The Ant Lion.

(Ord. NEUROPTERA: Fam. MYRMELEONIDÆ.)

An example of the larva of an ant-lion was received from a correspondent at Falls Church, Va., accompanied with comments on its habit of moving backwards and an inquiry of the name of the creature. As it could not be carried to its final winged stage, its scientific name could not be determined, but it probably belonged to the genus *Myrmeleon* of Linnæus. It differed in its greater hairiness and other features, from the forms that we are accustomed to see in this vicinity among the Helderberg mountains.

Number of Species.

The species are rather numerous, Dr. Hagen, in his *Synopsis of the Neuroptera*, published over thirty years ago, recorded twenty-four United States species. Very little has since been added to our knowledge of them. For a number of years prior to his death Dr. Hagen had been engaged in collecting the material for an extended publication upon the group, but so far as known to me he has only published a Memoir on the Ascalaphid larvæ,* and a series of articles in the *Canadian Entomologist*, vols. 19 and 20, entitled, "Stray Notes on Myrmeleonidæ." In the latter, description of seven new United States species are contained and one new genus is characterized. Mr. Banks, in his *Synopsis, Catalogue and Bibliography of the Neuropteroid Insects of Temperate North America*,† has listed thirty-four species belonging to the *Myrmeleonidæ*.

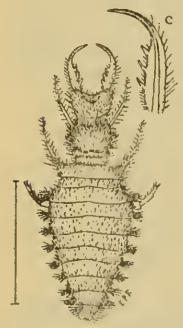

FIG. 17.—An ant-lion; mandible more enlarged at c. (Original.)

Appearance and Habits of Myrmeleon.

It is not strange that the insect excited the curiosity of the sender. for it is one of the most interesting objects of the varied insect tribe. Its name indicates its strength, its ravenous nature, and its chief food. The larva feeds only on living ants and other small insects. It is exceedingly unprepossessing in appearance, with its humped body covered with bristles, and its head armed with a pair of formidable curved mandibles, projecting far in front of its head as shown in Fig. 17. Its

* In *Stettiner Entomologische Zeitung*, Jahrg. 34, 1873, 33.

† In *Trans. Amer. Entomol. Soc.*, xix, 1892, pp. 327–373.

greatest peculiarity is its utter incapability of making the least progress in a forward direction, its legs being so constructed that it can only move backward. How then can the creature, it may be asked, provide itself with its needed supply of food? It can only do so by a resort to a cunning artifice.

Its Pitfall.

It constructs a pitfall in which to entrap its victims. Its home is beneath some overhanging ledge of rocks, the disintegration of which furnishes the material and the shelter needed, such as are offered by the Pentamerus rocks of the Helderberg formation. Depressing the end of its abdomen, it buries its body beneath the sand-like particles of the rocks, and moving around in a circle and throwing outward, with quick and frequent jerks, the sand which falls on its flat head, it marks in a deep furrow the circumference of its pitfall. Within this a slightly smaller and deeper circuit is taken, and successive smaller and deeper ones, all the material from within being meanwhile loaded upon its head, and by it thrown upward and outward, to the distance sometimes of several inches. By this means, by dint of much hard labor, especially when a piece of stone requires to be nicely balanced upon its head for its proper projection, a symmetrical funnel-shaped pit is at length constructed, the walls of which are as steep as the mobility of the material will permit. (See Fig. 18.)

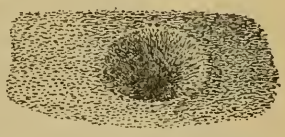

FIG. 18.— Pitfall of Ant-lion. (After Emmons.)

The pitfalls vary in size according to the age of the insect, some being but about half an inch in depth, and the largest perhaps two inches.

How the Prey is Captured.

The pit having been completed, the ant-lion buries itself at the bottom, with only its mandibles exposed, and widely spread apart, ready to grasp its prey. An ant traveling over the surface of the soil, unsuspicious of the trap, would perhaps endeavor to arrest its steps on the very margin, but the crumbling sand at once gives way beneath its struggles, and down it falls into the very jaws of death. If by chance a foothold is obtained on the sloping side, the watching ant-lion at once projects showers of sand which never fail to bring its victim down. It is instantly seized by its long curved mandibles and dragged beneath the sand to prevent its struggles. The mandibles of the larva are peculiarly adapted to the needs of the insect. On the lower side of each, a groove extends to the tip and in this the elongated maxilla is located (Fig. 17*c*). The sharp pointed

mandibles are forced into the body of its prey and the fluids sucked up along their grooves — the slender maxillæ playing back and forth and probably aiding in the operation. After its juices are sucked out, the empty carcass is placed on the shovel head, and thrown out as far as possible from the pitfall. The damage to the pit occasioned by the capture and the struggle is then repaired, and the ant-lion resumes its position and patiently awaits the advent of the next victim.

Transformations.

When the ant-lion has fully matured, it spins itself up in a ball of sand for its pupation—shown at figure 19. In emerging from the cocoon, the thin, transparent pupal case is left projecting from it (see figure). In its perfect state, it is a beautiful and graceful creature, with a slender body and long, narrow, finely reticulated wings. They are very rarely met with, probably because their delicate forms fail to arrest attention, or perhaps. as stated by some writer, from their flying mostly at night, The larvæ can easily be collected in numbers, by going quietly to localities where they occur, and with a piece of bent paper, scooping up the pitfall with its builder at the bottom. The collector, however, must be adroit, for at his first glance into the pitfall he will notice a slide of sand at the bottom, betokening the attempted retreat of the watchful insect from apprehended danger, and its possible escape from capture.

FIG. 19.—Cocoon of ant-lion. (After Emmons.)

FIG. 20.—The spotless ant-lion MYRMELEON IMMACULATUS. (After Emerton.)

Life-History.

The life-histories of the ant-lions (the American species at least), appear not to have been worked out. It seems not to be definitely known whether one or two years are required for attaining their winged stages. Certain it is that their development is very unequal, for their pitfalls of nearly the smallest size and of the largest are often found grouped together under the same overhanging rock. In this uncertainty, some scattered notes of observations of the larvæ and the imago may aid

in the presentation of the desired life-histories hereafter. A few are the following:

Latreille states that the larvæ are produced in the summer or autumn, and become pupæ on the following spring.

Westwood has written: "I have found the larvæ of all sizes in July, one of which became a pupa, and assumed the perfect state; while another, of equal size, remained throughout the winter in the larval state."

Emerton obtained a larva of *Myrmeleon immaculatus* August 29th, at which time it made a pitfall about two inches in diameter. On the 15th of the following May the larva spun its spherical cocoon, and on the 25th of June the perfect insect emerged.

Moody has taken *M. immaculatus* larva in April, which pupated June 4th, and on July 8th gave out the imago.

Mr. Felt found the full-grown larva which is represented in figure 17, at Ithaca, N. Y., on August 15th, at which time pitfalls of about two inches in diameter, were common in certain localities.

The ?Myrmeleon larva, noticed in the Seventh Report Ins. N. Y., was taken at Coeymans, N. Y. (now Ravena), on June 3d, underneath a carpet.

An example of *Dendroleon obsoletum* (Say), imago, was taken at Palenville, N. Y., on August 6th, and another at Coeymans, N. Y., in the month of September.

The following occurs among my notes in 1868: "Sept. 1st. On a ledge beneath the Pentamerus limestones of the Western mountain at Schoharie, N. Y., I captured 16 young ant-lions. When placed in a box of sand, they made their pitfalls, which averaged three-eighths of an inch in diameter. I find difficulty in supplying them with food, as they only venture to seize some of the minute Diptera given them — the house-fly, with which I have usually fed them when more advanced, proving too formidable for them at this stage of growth."

Still another old note is this: "At Glen Onoko, near Mauch Chunk, Pa., in August, 1884, I collected a number of larval ant-lions. Their number was gradually reduced, through feeding upon one another it was believed, and only four buried for hibernation. On April 3d they emerged from the sand and made their small pitfalls. They were not carried beyond their larval stage."

The following note, by E. A. Birge, Williams College, is also transcribed, as containing, in addition to larval presence and pupation, interesting observations on the habits of the insect:

While in the Indian Ladder region, Albany Co., N. Y., in August, 1871, I found a large colony of ant-lions. It is situated near the head of the "Ladder Road," at the base of the cliffs, and extends for several rods along the path to the "Tory House." The cliffs here hang over the paths, so that it is almost impossible for rain to reach the spot. The soil is composed of disintegrated limestone, extremely fine, but mingled with minute fragments of stone as well as larger pebbles.

In August, 1871, the colony numbered rather more than six hundred individuals, but on July 6, 1872, there were scarcely half that number. Perhaps at this last date some were in the chrysalis, as of several specimens then obtained, most of them entered that state in a short time, while those taken in August remained until the following spring.

Food was very scarce in this colony, as it was rare to see more than four or five victims in the lions' dens at one time. On several occasions I noticed a strong and active insect, having ventured over the edge of the pit, run swiftly down and up the other side, leaving the ant-lion wildly snapping its jaws, as the intended victim mounted the steep side of the pitfall.

The ant-lion does not, so far as my observation goes, throw up sand to bring down its prey, but throws it up in every direction in order to keep its jaws free to seize the insect when it reaches the bottom of the den.

In 1871 there was another colony (which I did not visit in 1872) near the "Paint Mine." It consisted of some 300 members. I call it a colony, although, of course, there was no friendly intercourse between the inhabitants of the settlement. On the other hand, in the most crowded portions, the chief employment of the insects was to throw out the dirt which their active neighbors were depositing on their own premises.

Mr. Nathan Banks has kindly furnished me with the following notes:

Myrmeleon immaculatus (DeGeer) pitfalls at Washington, D. C., two inches in diameter, in June and September. Imagoes emerged the following August. *Myrmeleon rusticus* Hagen, imago taken in Texas, in September. *Myrmeleon pumilus* Burm. and *M. ingeniosus* Hagen, imagoes, Florida, during the winter, probably in February. *Brachnemurus abdominalis* (Say), imago, Texas, in September, captured at light. *B. nigrilabris* Hagen, imago, Nebraska, in September. *Dendroleon obsoletum* (Say), imago, Ithaca, N. Y., August 3rd.

From Cornell University, through the kindness of Professor Comstock, we have the following:

Dendroleon obsoletum imagoes were captured at Ithaca on July 10th, July 27th, and August 4th. This species appears to be more abundant than *Myrmeleon immaculatus*. Its larvæ are quite common in a ravine about three miles from the University grounds. *M. immaculatus* imago has been taken on August 19th.

A pitfall of an ant-lion found in the dirt of the basement of the Entomological laboratory, and now in a box of sand, measures at the present time (October 12th) one and one-fourth inches in diameter and five-eighths of an inch in depth.

Habits of Some European Species.

While our common species, as noted above, can travel backward only, others have different habits. The larvæ, as observed by Brauer in Vienna, of a certain species of *Dendroleon*, *D. pantherinus*, has the power of walking forward in the normal manner and apparently captures its prey by lurking in concealment and, when the victim is near, rushing upon it rapidly: the larva of this insect is known to climb trees. Prof. Westwood, in the *Transactions of the Entomological Society of London*, 1888, published some interesting notes, together with two plates, on the life-history of several Ascalaphides, which are quite closely related to the ordinary ant-lions. The eggs of a species of *Ascalaphus* have been observed to the number of 64 to 75 deposited in a double row at the extremity of a small twig, and guarded by certain curious structures designed to protect the eggs and also to prevent the young from rambling beyond their protection until able to care for themselves. These *repagula*, as they are termed, are placed in circles about the eggs and are deposited by the female with as much care as the eggs themselves: they are described as elongate, pedunculate, subhyaline, reddish. Dr. Brauer, of Vienna, has observed the eggs of *Ascalaphus hungaricus* placed in a double row along a blade of grass, from which the young larvæ escaped by cutting an oval lid at one end of the egg. It is stated that *Ascalaphus longicornis* also oviposits in a double row on grass, and that the young larvæ make no pitfall but lie in wait under small stones whence they seize their prey, such as small flies and other insects. The larvæ of a Ceylonese species, *Ascalaphus* [*Helicomitus*] *? insimulans* make no pitfalls; some young ones were found ranged in a single row along the stem of a lily with the abdomen of each covered by the one behind it and with their jaws widely extended: in this manner they waited for prey to literally walk into their jaws. When placed in a box they scarcely ever moved, but lay close to and over each other and awaited their prey. After molting three times, they transformed in a manner similar to our native species.

United States Species of Ascalaphinæ.

Six species of *Ascalaphinæ* are listed by Banks as occurring in the United States; five are southern forms, and one is found as far north as Massachusetts. Possibly it was this species of which a brief notice is given in my Seventh Report (pp. 318, 319), as having been taken beneath a carpet in Albany county, and moving both forward and backward with

almost equal facility, and manifesting no disposition when placed on sand to construct a pitfall.

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WOOD: Insects Abroad, 1874, pp. 365–373, pl. vii, and fig. 179 (popular account).

RAGONOT: in Ann. Soc. Ent. France, 5 sér. xiii, 1878, Bull. Ent., p. cxx (discovery of eggs of *Ascalaphus longicornis*).

LINTNER: in Proc. Albany Institute, 1878, ii, pp. 48, 49 (appearance and habits of larva); in Country Gent., xlviii, 1883, p. 881 (habits of larva, description of imago); 2nd. Rept. Ins. N. Y., 1885, p. 233 (abstract of preceding article); 7th id., 1891, pp. 318–320, figs. 35, 36 (habits of two species), p. 384 (mention); 9th id., 1893, p. 440 (reference).

ASHMEAD: Orange Insects, 1880, p. 73 (under orange trees; larva termed "doodle").

RENNIE: Insect Architecture, 1880, pp. 209–216, 2 figs. (habits of larva).

MOFFAT: in Canad. Entomol., xvi, 1884. pp. 121–122 (notes on habits of larva and imago).

RILEY: 4th Rept. U. S. Ent. Comm., 1885, p. 100, figs. 28, 29 (may feed on army-worm); Pt. F. Bull. 39 U. S. Nat. Museum, 1892, p. 24, figs. 37, 38 (brief notice).

SCUDDER: in Zittel's Handbuch der Palæontol., 1885, p. 777 (fossil species); the same in English, Bull. 31 U. S. Geograph. Surv., 1886, p. 56; Tertiary Ins. in U. S. Geolog. Surv. Terr., xiii, 1890, pp. 92, 147 (fossil American species).

COMSTOCK: Introduct. Entomol., 1888, pp. 225–227, fig. 193 (general account).

HYATT-ARMS: Guides for Science Teaching, No. viii, Insecta, 1890, pp. 173–175, figs. 121, 122 (brief account).

SMITH: Cat. Ins. N. J., in Final Rept. State Geol., ii, 1890, p. 462 (eight species recorded); in Rept. N. J. Agr. Expt. Station for 1893, 1894, pp. 500–501, figs. 35, 36 (brief notice); Econom. Entomol., 1896, pp. 75–76, fig. 41 (brief, *Ascalaphus* the most common).

RITZEMA BOS: Tierische Schädlinge und Nützlinge, 1891, p. 395, fig. 239 (brief notice).

BANKS: in Trans. Amer. Entomol. Soc., xix, 1892, pp. 337–338, 360–361 (synopsis, catalogue, bibliography of American species).

TASCHENBERG: Brehms Tierleben, Insekten, ix, 1892, pp. 525–528, 1 fig.

COMSTOCKS: Man. Study Ins. 1895, pp. 182–183, figs. 221, 222 (brief account).

SHARP: in Cambridge Nat. Hist., v—Insects, 1895, pp. 454–462, figs. 299–304 (larval habits, structure of various species).

Thrips tabaci Lindeman.

Onion Thrips.

(Ord. THYSANOPTERA: Fam. THRIPIDÆ.)

Limothrips tritici Fitch. PACKARD: 2nd Ann. Rept. Ins. Mass., 1872, pp. 5–8, 3 figs. (erroneous reference).

Thrips on onion plants. SHIPLEY: in Bull. 10 Miscellaneous Information, Royal Gardens, 1887, p. 18.

Thrips tabaci LINDEMAN: Schädl. Ins. d. Tabak in Bessarabien, 1888, pp. 51–65 (life-history, habits, description, remedies).

Thrips sp. THAXTER: in Ann. Rept. Conn. Agr. Expt. Stat., 1889, p. 180 (injuries in Conn.).

Thrips sp. RILEY–HOWARD: Insect Life, iii, 1891, p. 301 (reference); id., vi, 1893, pp. 4–5 (reference).

Thrips sp. COQUILLETT: in Insect Life, iv, 1891, p. 79 (seriously injuring potatoes and tumble-weed).

Thrips tabaci Lind. RITZEMA BOS: Tierische Schädlinge und Nützlinge, 1891, pp. 577–578 (description, brief notice).

Thrips sp. LINTNER: in Country Gent., Oct. 27, 1892, lvii, p. 809 (on cabbage); 9th Rept. Ins. N. Y. for 1892, 1893, p. 445 (abstract of notice in Country Gent.).

Limothrips sp. BAKER: in American Florist, 1892, vii, p. 168, fig. occurring in rose-buds).

Thrips striata Osborn. GILLETTE; in Bull. 24 Col. Agr. Expt. Stat., July, 1893, p. 13, figs. 11, 12 (may be n. sp., and suggests *allii*.); in 5th Ann. Rept. Col. Agr. Expt. Stat. for 1892, 1894, p. 36; in 6th do. for 1893, 1894, p. 55 (referred with doubt).

Onion Thrips. SMITH: in Ann. Rept. N. J. Agr. Coll. Expt. Stat. for 1893, 1894, p. 441; in id. for 1894, 1895, p. 447 (abundant); Econom. Entomol., 1896, p. 102 (mention).

Thrips alii [*allii*] Gillette. SIRRINE: in Bull 83 New Ser., N. Y. Agr. Expt. Stat., 1894, pp. 680–683, plate II; the same in 13th Ann. Rept. N. Y. Agr. Expt. Stat., for 1894, 1895, pp. 758–760, plate.

Thrips alii Gillette. OSBORN-MALLY: Bull. 27 Io. Agr. Coll. Expt. Stat., 1895, pp. 139–142.

Thrips tabaci Lind. PERGANDE: in Insect Life, 1895, vii, pp. 392–395 (general account).

Limothrips tritici Pack. WEBSTER: in Bull. 58 Ohio Agr. Expt. Stat., 1895, pp. xxxiii–xxxiv (on onions in Ohio).

Thrips tabaci. SLINGERLAND: in Rural New Yorker, lv, 1896, p. 561 (at Peace Dale, R. I.; brief notice with remedies).

In August of 1892 a severe attack of Thrips on cabbage was brought to my notice in a letter and infested leaves received from Kingston, Pa. The following was the statement made:

I mailed you yesterday a box containing a number of cabbage leaves from the field of a neighbor. To assist in identifying the pest, I mail this morning a box containing cauliflower leaves on which are a number of eggs, worms, lice, etc. Some of our people think the difficulty is a species of fungus, and the lice a result rather than a cause. Late cabbage have failed from this cause for a number of years.

M. G.

The Attack Apparently New.

The result of my examination, published in the *Country Gentleman* for October 27, stated "that the insects present in many hundreds of individuals on the cabbage and cauliflower leaves — minute forms, of which the features are not distinguishable without a lens — and of a green color,

are a *Thrips*, the particular species of which cannot be determined. When received (August 23rd) they were nearly all in their larval stage. In assuming the perfect or winged stage, a few days thereafter, they changed to a dark brown color or black. Examples were sent to the Division of Entomology at Washington, where the *Thripidæ* have been given some special study, but they could not be referred to any known species. As there seems to be no record of thrips attack on cabbage, it may be presumed that this is an unrecognized and undescribed species."

"There can be no reasonable doubt but that the Thrips abounding on the cabbage and cauliflower leaves was directly responsible for their strange appearance and condition — quite unlike injury caused by aphis attack or anything that I had ever seen before. The leaves, although recently plucked, were remarkably dry, their juices almost wholly extracted, leaving them of a grayish color. Their entire surface under a lens showed thousands of minute scars, evidently where the epidermis had been broken or pierced by the mouth-organs of the Thrips in feeding. On one leaf examined with an achromatic triplet, there were counted 65 of these scars in an area of one-tenth of an inch, giving over 6,000 to the square inch. Injury to this extent would seem to account adequately for the peculiar condition of the leaves, and for the failure of late cabbages as reported."

Previously Known as "Onion Thrips."

A study of the insect made during the present year by Mr. Th. Pergande of the Entomological Division of the U. S. Department of Agriculture has brought to light some interesting facts in relation to the insect. It appears that a record of an Onion Thrips had been made by Dr. Packard in 1872 which was erroneously referred to *Limothrips tritici* Fitch. Similar attacks on onions were published by Prof. Shipley, of Cambridge, England, in 1887, and by Dr. Thaxter in Connecticut, in 1889. In 1893, Mr. Gillette reported a great abundance of the insect in Colorado, and, in the event of its proving to be undescribed, proposed the name of *Limothrips allii* for it. In this same year it was observed by Dr. Smith to be extremely abundant upon onions in New Jersey. For other records of its known injuries to onions in various parts of the United States, the careful study of Mr. Pergande, published in *Insect Life*, vii, 1895, pp. 392–395, may be consulted.

Its Probable European Origin.

From specimens received from Dr. K. Lindeman, of Moscow, Russia, Mr. Pergande has been able to identify our onion Thrips with a species

that had been causing much damage to tobacco in Southern Russia, and named by Dr. Lindeman as *Thrips tabaci*. It had probably been brought to this country many years ago, in infested onions or cabbages, and distributed throughout the States by railroad transportation.

Occurs on Many Food-Plants.

This species has been commonly recorded as depredating on the tops of onions, and its injuries have been quite serious at times, as in the instance reported by Dr. Packard, where in 1872, one-tenth of the crops of Essex Co., Mass., was destroyed by it at an estimated loss of $10,000. In some localities it has proved so destructive that the growing of the crop has been abandoned. Next to onions, its preference seems to be for cabbage. It might be thought that this was a recently acquired taste, for during the space of twenty years no record appears of its being found upon this plant—the first such publication being that made by me in 1892, in the *Country Gentleman*, as above cited. It seems, however, that Mr. Pergande has found it recorded in his notes, as occurring in the District of Columbia and in Virginia, during the years 1882 to 1888, on the leaves of cabbages.* In 1894 its operations on cabbage were studied by Messrs Sirrine and Lowe, of the N. Y. Agricultural Experiment Station on Long Island. It was not very harmful to the cabbage, as it attacked and killed mainly the outer leaves, and deserted them the latter part of September for onion fields.

Messrs Osborn and Mally (*loc. cit.*) have named fifteen food-plants on which the insect occurs. Although little special attention has been given to its food-habits, other writers have so largely added to the number that it hardly seems worth the while to publish a list ranging through so many of the orders which presumably rests principally on their accidental detection and identification upon the plant named. The following may be given as a list of the plants on which they have been observed, so far as recorded:

Cabbage.	Sweet clover (*Melilotus alba*).
Kale.	Cinquefoil (*Potentilla*).
Cauliflower.	Stonecrop (*? Sedum*).
Turnip.	Squash.
Candy-tuft (*Iberis*).	Cucumber.
Mignonette (*Reseda odorata*).	Melons.
Nasturtium (*Tropæolum*).	Parsley (*Carum sativum*).

* *Insect Life*, vii, 1895, p. 394.

Blanket-flower (*Gaillardia*).
Cone-flower (*Rudbeckia*).
Catnip (*Nepeta cataria*).
Heal-all (*Brunella vulgaris*).
Four o'clock (*Mirabilis*).
Tomato (*Lycopersicum esculentum*).
Tobacco (*Nicotiana tabacum*).
Jamestown weed (*Datura stramonium*).
Garden leek (*Allium porrum*).
Onion.

Distribution.

The distribution of this Thrips is an extensive one, in both Europe and the United States, but how generally throughout these countries we are unable to state. From Mr. Pergande's paper we have the following localities: Russia, Germany, Bermuda, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Virginia, Ohio, Illinois, Iowa, Colorado, and California.

The Insect Described.

It is a little over 1 mm. long, and varies from a yellowish-green color in the wingless, immature forms to a brownish-yellow and even black in the mature winged insect; in the latter the eyes and the tips of the mouth-parts are a dark-brown color.

The antennæ are composed of seven subequal segments; the terminal one apparently single but under a high power, is seen to be composed of two minute segments, the apical one not sharply separated from the seventh (Plate XV, fig. 1*a*). The lateral aspect of the head is shown in figure 2, on Plate XV, in which are represented the minute palpi and the general form of the conical mouth-parts.

The four wings are semi-transparent, and with an expanse greater than the length of the body (Plate XV, fig. 1); stout bristles occur along the anterior margin and the veins; the outer two-thirds of the posterior margin of the fore wing is thickly fringed with long wavy hairs; in the hind wings the fringe along the posterior margin extends to the anal angle, though that of the inner third is thinner.

The lateral aspect of the tip of the female abdomen is represented in figure 3 of the same plate. On the ventral surface there is a pair of curved saws, which are coarsely serrate along the concave edge and finely serrate on the opposite border.

Described from 30 specimens mounted in balsam.

Life-History of the Insect.

A brief abstract of the life-history of this species based upon the valuable work of Dr. Lindeman, in Russia (*loc. cit.*), is given, as almost nothing concerning it has been published in this country.

The eggs are elliptical, reddish, not more than 0.25 mm. long, and are glued singly along the nerves on the underside of the leaves. At the end of the summer they were found on the upper side also.* The egg stage was found to last ten days.

The larvæ were observed to hatch in large numbers on the 10th of July. They remained on the leaves where they were first seen feeding and growing until August 10th, at which time they suddenly disappeared. They were then found on the stalk and upper side of the leaves as nymphs. A few scattering larvæ were seen after August 10th. Thus the larval period is about 30 days. Of other species studied by Dr. Lindeman, viz., *Thrips secalina* Lindmn., and *Phlœothrips frumentaria* Bel., their larval periods were found to be 28 to 30 and 35 to 40 days respectively. The nymph stage was apparently from five to seven days. On the 27th of August newly hatched larvæ in large numbers again appeared — the life-cycle of which was completed in 47 days. "The imago appears to live but one day."

Number of Generations.

The first generation observed on the tobacco by Dr. Lindeman emerged from eggs laid the last of June, matured, and oviposited about August 17th. From their eggs numerous larvæ hatched on the 27th of the month and matured about 37 days later,— imagoes appearing early in October. The insect hibernates in the adult form, and flies the middle of the following May. Thus there are three generations in a year in Bessarabia — the first flying the middle of May, the second the last of June, and the third the last half of August. The spring brood was not observed personally by Dr. Lindeman, but he was assured by many tobacco growers that the seed beds were commonly infested by large numbers of Thrips early in May.

"The winter is passed in the larval or adult form, very likely in each; both stages being represented during the winter months and the adults beginning the deposition of eggs as early in the season as the vegetation is ready for them" (Osborn–Mally, *loc. cit.*). The above appears to be the only record of how the insect passes the winter in this country.

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* According to Osborn–Mally, *loc. cit.*, p. 140: "The eggs are deposited slightly beneath the surface of the leaf and imbedded in the cell-structure." There is a discrepancy between this and Dr. Lindeman's observations. It certainly appears that the saw (Pl. XV, fig. 3) of the female is well adapted to making punctures for the reception of the eggs The differences in habit noted may possibly be due to the food-plant, Dr. Lindeman having studied the insect on the tobacco, and Osborn–Mally on the onion.

Remedies.

The injury inflicted by this minute insect when occurring in such myriads can be prevented, if, at its first detection, the plants be thoroughly sprayed with fresh pyrethrum in water, in the proportion of one ounce to two gallons of water. See *Insect Life* vii, p. 392. A spraying with kerosene emulsion would also be effective.

Some Characters of the Thripidæ.

The *Thripidæ*, when full study shall be given them, will doubtless be found to embrace numerous species. Those known to us as occurring in the United States have been referred to ten genera, such as *Thrips*, *Phlæothrips*, *Limothrips*, etc.— the names of all terminating in thrips. Their structure places them quite low in the class of insects. They have been included by some authors (as Packard) in the order of Hemiptera. They have also affinities with the Orthoptera and Neuroptera. They may not properly be assigned to any of the old seven orders, and there is therefore a disposition to set them apart in a distinct order, with the name *Thysanoptera* (meaning fringe-wings). *Physopoda* drawn from the bladder-like termination of their feet, has also been proposed for them. They are small, elongate creatures, measuring less than one-tenth (some less than one-twentieth) of an inch in length, with narrow, long-fringed wings lying flat on their backs in repose. They can run rapidly, often turning up the tip of their abdomen after the manner of the rove-beetles, or they leap or take wing when alarmed. The common ox-eye daisy, or a head of red clover, plucked at almost any time, will give examples of these interesting forms.

A few years ago the *Thripidæ* were thought to be harmless insects, nearly all of them possessing carnivorous habits, and living mainly on other insects. More careful study has shown that many are herbivorous, and may be quite injurious to the plants that they infest, their strangely constructed mouth-parts being adapted to both biting and sucking.

Some Literature of the Thripidæ.

An excellent study of the food-habits of the family has been given by Prof. Osborn in *Insect Life*, vol. i, 1888, pp 137–142, in which the food of 26 species is given, consisting of apple, strawberry, olive tree, potato, melon, onions, corn, clover, grasses, timothy, wheat, rye, hops, greenhouse plants, and species of *Compositæ*. See also the following publications for additional information regarding the family.

Westwood: Introduct. Class. Insects, ii, 1840. pp. 1–5, fig. 57 (Thysanoptera, structure, habits, systematic position).

HARRIS: in Hovey's Mag. Hort., July, 1842, viii, pp. 247–248 (on plum); Ins. Inj. Veg., 1862, p. 20 (Thrips referred to Hemiptera), pp. 234–235 (characters of, habits, injuries of *T. cerealium*).

FITCH: in Trans. N. Y. State Agr. Soc. for 1854, xiv, 1855, pp. 806–808 (describes *Phlœothrips mali*, habits); in Count. Gent., vi, Dec. 13, 1855, p. 385 (describes *Thrips tritici*, *Coleothrips trifasciata*); 1st–2nd Repts. Ins. N. Y., 1856, pp. 102–104; (*P. mali*), pp. 304–309 (characters of Thysanoptera; descriptions, habits, *Thrips tritici*, *Coleothrips trifasciata*).

CURTIS: Farm Insects, 1860, pp. 285–289, fig. 38 pl. J., figs. 8, 9, pl. O., figs. 13–17 (characters, injuries to grains of several species), pp. 431–432 (on potato leaves).

OSTEN-SACKEN: in Dipt. North Amer., pt. i, 1862, p. 201 (in *Lasioptera* galls).

WALSH: in Proc. Ent. Soc. Phila., iii, 1864, pp. 611–612 (predaceous habits); Practical Entomol., i, 1865, p. 21 (habits); id., ii, 1866, p. 19 (cannibal), pp. 49–51, fig. (characters, predaceous habits).

PACKARD: Guide Study Insects, 1869, pp. 547–550 (Thripidæ referred to Hemiptera near to Corisiæ and Capsini; habits); 3rd Rept. Ent. Comm., 1883, p. 297 (reference); Entomol. for Beginners, 1888, p. 73, fig. 58 (referred to Thysanoptera); in Psyche, v. 1888, p. 96 (reference).

WALSH–RILEY: Amer. Entomol., i, 1869, p. 227 (Thrips preying on *Phylloxera caryæcaulis*).

RILEY: Amer Entomol., ii, 1870, pp. 134–135 (yellow Thrips destroying Curculio eggs); the same in 2nd. Mo. Rept., 1870, p. 6; reference to preceding in 3rd do., 1871, p. 29; 5th do., 1873, p. 16 (referred to Thysanoptera), p. 118 (destroying *Lasioptera vitis*); 6th do., 1874, pp. 50–51, fig. 9 (destroying Phylloxera in galls); in Insect Life, i, 1889, p. 301 (referred to Thysanoptera by Westwood); in do., v, 1892, p. 18 (undescribed species on orange trees); Pt. F., Bull. 39 Smithson. Institut., 1892, pp. 18–19, fig. 22 (systematic position, characters).

GLOVER: in Rept. Dept. Agr. for 1871, 1872, pp. 86–87, fig. 21 (Thrips injuring grapes; habits).

FIGUIER: The Insect World, revised by Duncan, 1872, pp. 400–401, figs. 381, 382 (brief notice).

COOK: in 3rd Ann. Rept. State Pomolog. Soc. Mich. for 1873, 1874, p. 501 (referred to Hemiptera; brief mention).

WOOD: Insects Abroad, 1874, pp. 347–349, fig. 172 (injuring wheat, greenhouse plants); Insects at Home, 1887, pp. 259–260, fig. xxvii, 1 (brief).

BETHUNE: in 5th Rept. Ent. Soc. Ont., 1875, p. 60 (Thrips preying on Phylloxera).

ASHMEAD: Orange Insects, 1880, p. 72 (on orange); in Insect Life, vii, 1894, p. 27 (species injuring cotton).

HAGEN: in Psyche, iii, 1881, p. 196 (tarsi of Thrips compared with those of Psocids).

BENNETT: in Psyche, iii, 1881, p. 249 (wild pansy adapted to fertilization by Thrips).

DARWIN: in Psyche, iii, 1881, p. 250 (Thrips on flowers of *Primula*).

HART: in Psyche, iii, 1881, p. 254 (Thrips fertilizing wild pansy).

KITCHENER: in Psyche, iii, 1881, p. 256 (Thrips fertilizing wild pansy).

ORMEROD: Man. Inj. Ins, 1881, pp. 86–88, figs. (habits, preventives, remedies, wheat species); 2nd Ed. do., 1890, pp. 97–99, figs. (the same); 8th Rept. Inj. Ins., 1885, pp. 28–31, figs. (on corn); 18th do., 1895, pp. 41, 42 (*Thrips cerealium* injuring corn).

HOWARD: in Rept. Dept. Agr. for 1881, 1882, p. 137 (Thrips on diseased rice plants); in Entomolog. Amer., iv, 1888, p. 152.

LINTNER: 1st Rept. Ins. N. Y., 1882, p. 79 (classification), p. 303 (reference), p. 332 (species on apple); 2nd do., 1885, p. 31 (systematic position, habits); 3rd do., 1887, pp. 97–98 (species injuring grass); in Country Gent. lii, 1887, p. 459 (in strawberry blossoms, characters, habits, etc.); 4th Rept. Ins. N. Y., 1888, p. 66 (Thrips in Lasioptera galls), p. 198 (abstract of C.–G. article); 5th do., 1889, pp. 302, 304 (reference); 7th do., 1891, p. 316 (Thrips sp. attacked by fungus), pp. 366, 384 (reference); 8th do., 1893, pp. 254–255 (systematic position, habits); 9th do., 1893, p. 377 (reference).

OSBORN: in Psyche, iii, 1882, p. 369 (injuring style of fruit blossoms); in Canad. Entomol., xv, 1883, pp. 151–156 (some new species, etc.); in Rept. Dept. Agr. for 1887, 1888, p. 164 (species abundant on clover); in Insect Life, i, 1888, pp. 137–142 (food habits); in Canad. Entomol., xxiii, 1891, pp. 93–96 (cause of silver-top in grass); in Insect Life, v, 1893, pp. 112–113 (*Phlæothrips nigra* on clover); in do., vi, 1892, p. 80 (table of stages of several species).

PERGANDE: in Psyche, iii, 1882, p. 381 (habits; preying on *Tetranychus telarius* and possibly on *Cecidomyia leguminicola*); in Insect Life, vii, 1895, pp. 390–395 (observations on; description of several species).

COOKE: Ins. Orchard, Vineyard, etc., 1883, pp. 122–123, figs. 100–102 (species on pear, peach, and plum).

SAUNDERS: in 13th Rept. Ent. Soc. Ont., 1883, p. 66 (preying on Phylloxera); the same in Ins. Inj. Fruits, 1883, p. 238, fig. 244.

HUBBARD: Insects Affect. Orange, 1885, pp. 164–165, fig. 77 (*Thrips tritici* on orange; remedies).

WEBSTER: in Rept. Dept. Agr. for 1886, 1887, p. 577 (on buckwheat); in Entomolog. Amer., iv, 1888, p. 152 (living on wheat for weeks); in Insect Life, ii, 1890, p. 256 (on salsify); in do., iii, 1891, p. 453 (species abundant in young growing wheat).

LINDEMAN: Die am Getreide Lebenden Thrips-Arten Mittelrusslands, 1886, pp. 1–42, figs. 1–18, in Bull. Soc. imper. natur. Mosc., lxii, 1886, pp. 296–337 (several species treated); in Psyche, v, 1888, p. 23 (*Thrips* sp. injuring grain in Russia).

WEED, C. M.: in Prairie Farmer, v. 59, 1887, p. 343 (severe injury to strawberries); Insects and Insecticides, 1891, p. 95 (*Thrips tritici* on wheat).

COMSTOCK: Introduct. Entomol., 1888, pp. 123–127. figs. 111, 112 (characters and classification as Physopoda); Bull. xi Cornell Agr. Expt. Stat., 1889, 131 (Thrips on wheat).

FLETCHER: in Entomolog. Amer., iv, 1888, p. 152 (injury to grasses); Ann. Rept. for 1888, pp. 59–62 (injuries by species, remedies); in 19th Rept. Ent. Soc. Ont., 1889, p. 11 (injuring grass); in 20th do., 1890, pp. 2–3 (wide-spread injury to grasses); Ann. Rept. for 1892, p. 3 (injuring grass); in Insect Life, v, 1892, pp. 124–125 (injuring grass; in greenhouses).

RILEY–HOWARD: in Insect Life, i, 1889, p. 340 (*Thrips tritici* injuring orange blossoms); id., ii, 1890, p. 338 (wheat Thrips); id., iii, 1891, p. 77 (referred to Thysanoptera), p. 301 (causing rust of oats); id., vi, 1894, p. 343 (injuring carnations).

THAXTER: in Ann. Rept. Conn. Agr. Expt. Stat. for 1889, 1890, p. 180 (*Coleothrips 3-fasciata* causing a rust on oats; onion Thrips).

BRODIE: in 20th Ann. Rept. Ent. Soc. Ont., 1890, pp. 8–9 (Thrips injuring cereals).

EDWARDS: 21st Ann. Rept. Ent. Soc. Ont., 1891, p. 103 (reference to remedies).

GARMAN: in Bull. Essex Institute, xxii, Nos. 1–3, 1890, pp. 1–4, fig. (structure of mouth-parts); in Canad. Entomol., xxii, 1890, pp. 215, 216 (asymmetry of mouth-parts).

FORBES: 16th Rept. Ins. Ill., 1890, p. ix, pl. v, fig. 4; 17th do., 1891, pp. xiii, xv (*Thrips tritici* on strawberries): in Insect Life, v, 1892, pp. 126, 127 (injuring strawberries and grass).

HYATT-ARMS: Guides for Science-Teaching, No. viii, Insecta, 1890, pp. 113–114, fig. 62 (characters of Thysanoptera).

MALLY: Bull. 24 U. S. Dept. Agr. Divis. Entomol., 1891, pp. 30–31 (injuring cotton blossoms).

RITZEMA BOS: Tierische Schädlinge und Nützlinge, 1891, pp. 574–578, fig. 349 (characters, descriptions and habits of several species).

TASCHENBERG: Brehms Tierleben, Insekten, ix, 1892, pp. 609–611, 2 figs

TOWNSEND: in Canad. Entomol., xxiv, 1892, p. 197 (notes on three species)

HOSKINS: in Psyche, vi, 1893, p. 557 (ravages of Thripidæ, reference).

BRUNER: in Rept. Nebr. St. Bd. Agr. for 1893, Ins. Enemies of Small Grains, p. 457, fig. 96 (*T. tritici*, *Coleothrips trifasciata*); Insect Enemies Apple, in Nebr. St. Hort. Rept. for 1894, pp. 163, 214, fig. 82 (*Thrips tritici* on apple).

COMSTOCKS: Manual Study Insects, 1895, pp. 119–120, figs. 137, 138 (characters and habits).

SHARP: in Cambridge Nat. Hist., v, 1895, pp. 173, 175 (systematic position, characters).

COCKERELL: Bull. 15 N. Mex. Agr. Expt. Stat., 1895, p. 71 (*Coleothrips trifasciata* on grass).

HOPKINS-RUMSEY: Bull. 44 W. Va. Agr. Expt. Stat., 1896, pp. 270–271 (injury to grass).

SMITH: Econom. Entomol., 1896, pp. 101–103, fig. 73 (characters, several species mentioned, remedies).

Schoturus nivicola (Fitch).

The Snow Flea.

(Ord. THYSANURA: Fam. PODURIDÆ.)

FITCH: in Amer. Quart. Journ. Agricul. Sci., May, 1847, v, p. 284; in id. for Sept., 1847, vi, p. 152; Winter Ins. N. Y. (sep. from prec.), pp. 10–11 (as *Podura*); the same republished in Lintner's 2nd Rept. Ins. N. Y., 1885, p. 244.

PACKARD: in 5th Ann. Rept. Peabody Acad. Sci., 1873, p. 29–30 (as *Achorutes*).

LINTNER: 2nd Rept. Ins. N. Y., 1885, p. 203–206 (as *Achorutes*).

MACGILLIVRAY: in Canad. Entomol., xxiii, 1891, p. 274 (catalogued as *Achorutes*); in id., xxv, 1893, p. 316 (*Schoturus* proposed, with the *Podura nivicola* of Fitch as type).

In the *Second Report on the Insects of New York*, 1885, pp. 203–207, a notice of some Poduridæ is given, under the heading of *Achorutes nivicola* (Fitch).

Recent studies given to the Poduridæ, by Mr. A. D. MacGillivray* appear to indicate that different species have hastily been referred to this species by authors and accepted as identical with the *Podura nivicola* of Fitch. It is therefore proper to state that the bibliographical references that appear on page 203 *loc. cit.* were merely given on belief, and were not based on actual knowledge of their correctness.

Dr. Packard, in his *Synopsis of the Thysanura of Essex County, Mass.*† referred the *Podura nivicola* Fitch to the genus *Achorutes*. Lately, Mr. MacGillivray, in one of his articles on *North American Thysanura* has proposed to retain for *Achorutes* the species in which the abdomen has no anal spines, and has named as a new genus, *Schoturus*, those allied species having two anal spines, of which *Podura nivicola* Fitch is taken as the type.

Observed at Ghent, N. Y.

While it is not certain that the observations of Poduridæ recorded on pages 204, 205 were those of *S. nivicola*, the following one may be relied upon: In 1893, numerous examples of a Podurid were received from Mr. E. C. Powell of Ghent, N. Y. Critical examination showed that they conform so closely to the

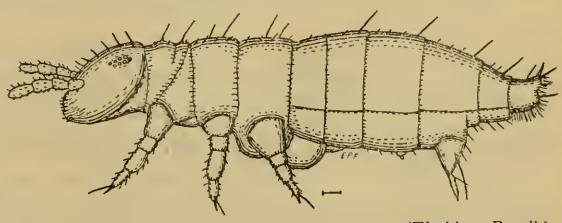

Fig. 21.—The Snow-flea, SCHOTURUS NIVICOLA (Fitch). Possibly unnaturally swollen, greatly enlarged. (Original.)

* In *Canadian Entomologist*, xxv, 1893, pp. 313–318.

† In *Fifth Annual Report of the Peabody Academy of Science*, 1873, pp. 23–51.

general description given by Dr. Fitch and the more detailed one of Dr. Packard, as to leave scarcely a doubt of its identity with this species. The insects were found on April 13th in large numbers on the trunks of pear-trees. They appeared to be working up from the ground toward the larger branches. Mr. Powell was fearful that they might injure the trees, but he was assured that they were harmless and their occurrence on the trees was probably accidental.

Classification and Characteristics.

The *Poduridæ* are among the most degraded forms of insects: indeed, some writers have regarded them as not belonging to the Class of Insects, but as being quite nearly allied to the Myriapoda. Nearly all recent authors agree in referring them to the Order Thysanura, established by Leach in 1796, and in the suborder of Collembola. Dr. Sharp, in his late publication in the "Cambridge Natural History," has revived the old Linnæan Order of Aptera; to include the two suborders, (1) Thysanura, and (2) Collembola. To the former belong the species of Lepisma and allied genera commonly known as "bristle-tails," and to the latter, the *Poduridæ* or "spring-tails."

A distinctive feature of the *Poduridæ*, separating them from all other known insect forms, is a leaping apparatus near the end of the abdomen. The spring, represented in figure 22, consists of a basal part usually of a subtriangular form, bearing a pair of appendages composed each of two distinct joints. During life it is flexed beneath the body directed forward, and held in position by means of a "catch" attached to the under surface of the third abdominal segment. On the sudden release of the spring from the catch, its elasticity projects the insect into the air as if rebounding from a springboard to a distance often of an inch or more. This process is repeated until the insect finds itself in a position of imaginary security.

Another distinctive feature of this family is "the ventral tube" projecting from the first abdominal segment, and appearing as a simple tubercle divided by a central slit. Various opinions have prevailed in regard to its functions. Sir John Lubbock accepts DeGeer's interpretation of it, viz., that it serves as a sucker and is used in case its feet do not sufficiently perform their purpose while ascending a smooth surface — an adhesive fluid being emitted from it.

Fig. 22.—Spring of Schoturus nivicola, lateral aspect, very greatly enlarged. (Original.)

The original description of this species by Dr. Fitch, may be found in my Second Report, 1885, page 265, accompanied with a more detailed one by Dr. Packard.

Achorutes diversiceps n. sp.

(Ord. THYSANURA: Fam. PODURIDÆ.)

Of examples of a Podurid which came under my observation nearly twenty-five years ago, at Center, N. Y., now known as Karner — a station on the N. Y. Central Railroad midway between Albany and Schenectady,— I had written as follows in the *Country Gentleman* for March 22, 1879, at page 327 :

"A species closely allied to the above, [referring to *Lipura fimetaria*, now *Aphorura armata*], but somewhat larger in size and of a black color, once came under my observation at Center, N. Y., in most extraordinary number. Many millions of individuals must have been present, covering a damp tract of sand in a roadway near a swamp, and filling the ruts made by wagon wheels (to the depth of half an inch or more) in places. The species has not been determined. It has been referred to the family *Lipurinæ*, and seems very much like the old European species, *Podura aquatica*, mentioned from Greenland, and may possibly be identical with it, according to Dr. Hagen, who has only seen dried and shriveled specimens of it."

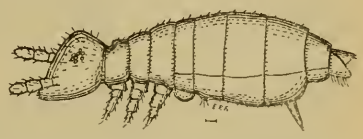

Fig. 23.—ACHORUTES DIVERSICEPS, greatly enlarged; possibly unnaturally swollen. (Original.)

Recent studies of some of the specimens in which the characters were well brought out by treating them with a weak solution of potash lead us to regard it as undescribed, as its characters differ from any description accessible, and it is therefore described as new.

ACHORUTES DIVERSICEPS n. sp. Figures 23, 24, 25.— Color a uniform plumbeous. Head wider than body, dorsal aspect subtriangular, occiput high. Antennæ about two-thirds the length of the head, sparsely setose, stout, four-segmented; segments one and two nearly equal, three and four slightly longer and stouter. Eye-groups high upon the occiput, posterior to insertion of antennæ, each including seven or eight, and possibly ten, ocelli.

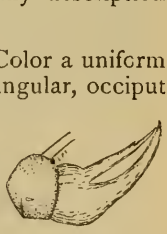

Fig. 24.—Claw of ACHORUTES DIVERSICEPS, very greatly enlarged. (Original.)

Thorax and abdomen sparsely clothed with scattering hairs; body increasing in size to the fourth abdominal segment. Legs four-segmented, with scattering hairs, and bifurcate, curved claws (fig. 24). Ventral sucker prominent, with central papilla, around which are several setæ. Tenaculum or catch apparently composed of a pair of broadly triangular processes as seen from below. Base of spring or elater two-thirds the width of the body and tapering gradually to its apex, which is about one-half as wide in ventral view; the paired processes arising from the base of the spring are

Fig. 25.—Spring of ACHORUTES DIVERSICEPS, very greatly enlarged. (Original.)

about three times longer than wide and are terminated each by a minute segment one-fifth its length; the larger segment of the spring with a few long setæ, posterior margin toothed minutely (fig. 25). Tergite of terminal segment shorter laterally; pleurite produced ventrally, shorter dorsally, and including lateral portions of the tergite. Long setæ occur on the ventral and caudal margins of this segment. Length nearly 0.05 inch.

Described from numerous specimens in the State collection.

The only reference to the above in my Reports is the following incidental one: "I have seen at a glance, in a locality near Albany, within a small extent of roadway, of a single species of a snow-flea—a Podura, more individuals as computed by me, than there are human beings on the entire face of the globe" (*Eighth Report on the Insects of New York*, 1893, page 266).

My original note regarding the occurrence of this insect has recently come to light. It reads as follows:

April 26, 1870. Visited Center for the first time this spring. The day was cold and windy. Took one example of *Thecla arsace* [*Irus*], and two males of a Geometrid, *Aspilates coloraria* (Fabr.), of which several were seen resting on damp ground.

Immense numbers of a very small black Podura were seen in the wagon-ruts of the road near some standing water, extending perhaps some three rods from it. For this distance, the Poduridæ almost blackened the sand, but at several points they were gathered in a dense mass, of six or eight inches in extent, and nearly half an inch in thickness. There were undoubtedly millions of the little insect assembled at this locality. Scarcely any motion was observable in these masses, unless disturbed, when they became quite active, leaping in every direction a distance of about an inch.

Tyroglyphus heteromorphus n. sp.*

A Carnation Mite.

(Ord. Acarina: Fam. Acaridæ.)

A number of carnations in the greenhouse of Samuel Wheeler, Berlin, Mass., were observed to die gradually at the base, and in time the plants perished. The stems usually began to decay just below the surface of the ground. In some cases the whole plant, and in others individual

* Communicated by E. P. Felt.

branches, would show signs of weakness. The number of plants thus affected in December was so large that the trouble was apparently due to some agency other than weakness of the plants, improper conditions of the soil, or similar causes.

The dying of individual carnations is by no means new to the grower of these plants. They are usually reset without further thought, and the loss attributed to the weakness of the plants or some other cause, and nothing more thought of the matter. In some cases it may be due to malnutrition, but in the present instance there appears to be a well-defined cause, and the same may prove true in other places.

An examination of a number of the affected plants showed several large burrows in most of them at or near the surface of the ground, and in these cavities, numerous small white mites, apparently a species of *Tyroglyphus*, were found. In most of the stems examined, the mites were very abundant — in many places they formed a distinct whitish-appearing layer over portions of the affected parts. A limited number of eel-worms, *Anguillulidæ*, were associated with the mites. Several much larger, active, reddish mites were also seen in the course of the examination; these, however, are predaceous, and belong to a species of *Gamasus* — probably undescribed.

Notes on Life-History and Habits.

These mites can live and multiply rapidly on the decaying carnation roots, provided moisture is present. A number of them were placed in tightly corked vials with bits of the roots. The vials were kept moist and in a warm room from the last of December, 1895, till into February, 1896. While the vials were kept moderately moist, the mites multiplied very rapidly. During the latter part of the time that they were under observation, a black, smutty fungus developed upon the decaying carnation roots and the mites were observed feeding upon it; not only were they seen feeding on the fungus, but the black spores were within their semi-transparent bodies. One mite was observed moving slowly through the accumulated moisture in the bottom of the vial, and turning from side to side, apparently seeking to capture the infusoria with which the fluid abounded. From the above it is seen that these mites feed on decaying carnation roots, on fungi, and probably on infusoria. It is also more than likely that they injure the living tissue of the carnation.

The drying up of the carnation roots was followed by many of the mites deserting them and betaking themselves to the sides of the vial, where they became fixed and remained motionless for some time. A few days

after, some mite skins were found, their occupants having disappeared. Many of them had assumed characteristic Hypopus forms, to be described later.

Forms Assumed by the Mite.

This Acarid appears to have at least five well-defined forms through which it passes in the process of development or which it can assume under varying conditions. The mites hatch from eggs as minute six-legged creatures, as is commonly stated,* which resemble the adults in all other ways except that they have one pair of legs less. When first discovered, the mites swarmed on portions of the carnation roots, in the more common immature form closely resembling the male, but with shorter hairs and with all the legs similar; males and females were also present. After the mites had been under observation a few days, a stout form of a size nearly equal to that of the female was seen, and in which most of the head was concealed. It had quite short legs, and between the posterior pair were six ventral suckers. These stout short-legged ones traveled slowly at first—later they became motionless, extended their legs forward, and assumed the typical form of the larger Hypopus (Pl. xvi, fig. 9). Subsequently a female was discovered with one of these nearly developed larger Hypopi within her body, thus showing the connection between the two forms, but transformation to the Hypopus was arrested January 27 by placing the individual in alcohol. The change was probably caused by the poor quality of the food, the mites having fed for a month upon the same bit of decaying root. It would thus appear that this is the Hypopus form of the larger or nearly mature individuals. Possibly this transformation under unfavorable conditions so late in life may be limited to the female.

The last of January the smaller Hypopus was seen (Pl. xvi, fig. 7). Other observers have noted that no Hypopi are to be found until the mites have passed from the six-legged to the eight-legged stage. If such be true, the smaller Hypopi can be developed very shortly after the fourth pair of legs are acquired, as it is usually less than half the size of the other form and smaller than most of the young mites. That the smaller Hypopus is the form assumed by the immature mites is rendered quite certain by the following: January 31st, three of the immature mites were carefully taken—one at a time on a needle point—from the carnation root and placed in a clean vial with a fresh bit of cheese. The vial

* In this species the smallest examples found possessed eight legs. No eggs were seen at any time. It may be viviparous as are *Tyroglyphus longior* and *T. siro* (Howard: in Bull. 4 *New Ser.*, *U. S. Dept. Agr.*, *Div. Ent.*, 1896, p. 101).

was kept tightly corked. The mites did not take kindly to this substance as food. Nine months later the vial was examined and one well developed smaller Hypopus was found, with the other two in a partly transformed condition.

Thus my observations appear to show that there are the larger mites presumably males and females (two of them were observed apparently pairing), the immature and two Hypopal forms to be found in this species.

The Hypopus.

This form has long been a puzzle to naturalists. It was observed by DeGeer as early as 1735 in great numbers on the house fly. It was given the name of *Acarus muscarum*. Similar mites were also found later by others on different insects. Much later, in 1834, Dugès transferred the *Acarus muscarum* to the genus *Hypopus*, which he established for a mite found on *Hister*. The Hypopi are found abundantly at times attached to the chitinous body walls of different insects, and some are even found upon polished fern leaves and other hard surfaces,—places where they could obtain no nourishment. They are attached by means of their ventral suckers with their anterior feet in the air, or, as in the species studied, they may fix themselves by the suckers upon the feet. Later studies of the Hypopus reveal other species. In these studies, M. Dujardin noticed some that were narrower, more transparent, and completely empty; some of these, but more rarely, showed in the interior another form of mite, soft and curled up like an embryo; it occupied the whole internal cavity of the Hypopus as if the latter were a living egg-shell provided with feet. From this he derived the conclusion that the Hypopi were larvæ or rather, "if the phrase were allowable, eggs furnished with feet."

In 1868, M. Claparède announced as the result of his researches that the genus then known as Hypopus was but the male form of certain Tyroglyphidæ. He traced the development of the mite from the egg, and found that it emerged as a six-footed larva, thus disproving the interpretation of this form by M. Dujardin. His explanation of the Hypopus was in turn set aside by the observations of several highly competent men, among whom were Prof. Robin, M. Fumouse and M. Megnin. It will perhaps be enough to cite briefly the work of the latter. He witnessed the transformation to the Hypopus of a species of Tyroglyphus, when the mushrooms, on which they were feeding, were allowed to dry. Upon supplying moist mushrooms, the Hypopi transformed back to Tyroglyphi. Twenty times he witnessed these transformations. It

would thus appear, that the Hypopus is a form assumed by the mite when scarcity of food and moisture threaten its extinction. From the Hypopus having been seen by some within the ordinary mite, this has led them to claim that it is but a parasite of Tyroglyphus.

During my study of this mite, I was so fortunate as to detect in the above-mentioned instance the Hypopus within the body of the female. Numbers have also been seen walking around and finally becoming fixed in their characteristic attitude. The Hypopus appears so evidently to be but another form of the mite, that the idea of its parasitic nature is hardly tenable.

Description of the Mite.

Examples of the mite were submitted to Prof. Herbert Osborn, who pronounced it a species of *Tyroglyphus* apparently near *phylloxeræ* Riley, but with which he could not make it agree in all details. He further added that it might be identical with some of the described European forms. Failing to find a description of a similar species in the limited European literature at my command, it is herewith described as new:

TYROGLYPHUS HETEROMORPHUS n. sp. Plate XVI. *Male.*— Length, about 0.8 mm.; color, pale white; form, elongated, rounded posteriorly. Tarsi, of first two and fourth pairs of legs, with terminal spine beside the curved claw, no sucker visible, last segment elongated, spiny; anterior two pairs with two long terminal bristles and with a clavate appendage near the base (fig. 3); posterior pair with but one long terminal bristle and no clavate appendage; third pair of legs much stouter, tarsi short and bearing several long bristles, terminal hook beak-like and with a short spine opposite (fig. 4). Hairs scattering, equa in length to the abdomen; on posterior margin of cephalo-thorax, two long hairs inclining slightly forward (fig. 2). Posterior to abdominal legs, two suckers may be seen.

Female (fig. 5).— Slightly longer than male, stouter, abdomen usually much more distended. Tarsi of all the legs much elongated, those of the two anterior pair with a clavate appendage as in the male but with no short spine beside it (fig. 6); legs otherwise similar to those of the male, except that the posterior tarsi bear two long terminal bristles, and that the basal segment of each leg is more nearly globose. Hairs much shorter than in the male, scattering.

The immature mite resembles the male in general shape. The hairs of the body are not so long and the legs are all similar. The tarsi are not so greatly elongated proportionately as in the anterior legs of the male.

Hypopus forms. Quite variable not only in size but also in appearance, the latter perhaps due to more or less complete transformation. The smaller Hypopus, assumed by immature forms, is suboval from a dorsal aspect, laterally, it appears much flattened and in some examples even concave beneath (fig. 7). The snout or beak projects anteriorly, with parallel margins and is terminated by two long bristles. The ante-

rior two pairs of legs are extended forward, usually nearly parallel; the first pair are more elongated, especially the tarsal segments which are terminated by oval suckers on long pedicels (fig. 8), and at the base of the suckers a pair of claws. Second pair of legs shorter, similar but without the oval sucker; both pairs with the clavate organ as observed in the mature form. Posterior legs much more slender, shorter; at base of last pair, six ventral suckers arranged in two parallel rows.

Another stouter oval form was also observed. This may be assumed by the larger females and possibly by the males. The head is nearly concealed and the legs extended forward (fig. 9); the anterior pair, however, with no trace of suckers (fig. 10). This form is usually nearly the size of the mature mites, while the smaller Hypopi are less than half the size. Six ventral suckers may easily be seen near the base of the posterior pair of legs.

It is possible that more than one species may be represented by the forms above described. But, as they were all intimately associated during life, and as a direct connection has been shown between two forms and their Hypopi and in all probability between the forms designated as male and female, no other way is open than to group them all under a single species.

An Associated Mite.

Several very active reddish mites were found on the roots of the carnations. One was seen within the cavity with the Tyroglyphus and was probably preying upon it. Specimens of these were submitted to Prof. Osborn, who pronounced them a species of *Gamasus* related to those grouped with *G. crassipes* (Herm.). As no description of this mite is accessible to me, it is figured and described; in the event of its being new it may be known as *Gamasus longipalpoides*.

This mite (Pl. XVI, fig. 1) is about 1 mm. long of a broadly ovate outline and of a pale red color. Anterior legs much elongated, palpiform, terminal segment about twice the length of the preceding one; second pair of legs very stout, much shorter and acutely bent, terminal segment, spiny, chelate, and with a delicate double claw (Pl. XVI, fig. 1*a*); posterior legs, spiny and with minute claws.

Remedies.

The trouble at Mr. Wheeler's was confined largely, if not entirely, to plants which had been set in the greenhouse on soil left in from the preceding year. Very few plants were affected that had been set on soil brought into the greenhouse the autumn before. Hence, much of the trouble from these mites can be avoided by changing the soil, on which the plants are grown, each season.

It would be well to remove infected plants from the greenhouse as soon as they exhibit signs of weakness. Their prompt destruction would tend to prevent the spreading of the mites from one plant to another.

Kainit, or other potash salt, has been recommended by Dr. Smith, of the N. J. Agricultural Experiment Station, as an insecticide of value against wireworms in the soil, and also as a substance that will destroy the pear-midge after it has buried for pupation. If effective against these insects, a heavy dressing of it would be of value in the greenhouse. Not only would it destroy the mites in the soil, but it would also stimulate the carnations to more vigorous growth.

APPENDIX

(A)

LIST OF INJURIOUS APPLE-TREE INSECTS.

In the "First Report on the Injurious and Other Insects of the State of New York," in 1882, a list was given of the apple insects known in the United States, numbering 176 species. It was then stated:—"The list will, without doubt, be largely extended; it is published at this time to serve as a basis for future additions. An entire exploration of our entomological literature might add nearly or quite fifty species, and careful observation would unquestionably give us no inconsiderable number which have not yet been recognized as apple insects." In 1894 with the above as a basis, a list was published by Professor Lawrence Bruner, of the Nebraska State University, entitled.—"Insect Enemies of the Apple Tree and its Fruit," in which were enumerated 280 species.

From the time of publication of the list of 1882, it has been steadily growing by additions in MS., until as now presented it has more than doubled its original extent—the number of known species being now given as 356.

It is hardly necessary to state that not all the species herein recorded, are to be regarded as specially injurious to the apple-tree and its fruit but as each one is known to make it, at times, its food-plant from choice (many others will feed upon it in confinement), the least harmful among them may at any time, through such sudden and inexplicable multiplication as is often witnessed in the insect world, become a serious pest.

The authority for including the species in the list is given in each instance. For convenience of those who may be willing to scrutinize the list with a view of supplying omissions, the species have been arranged under their several Orders in systematic arrangement. Additions to the list would be gladly received as adding to its interest and value.

Hymenoptera.

Tremex columba LINN. *Pigeon Tremex*..... Riley: Amer. Ent., ii, 128.
Formica Noveboracensis FITCH.* *New York ant*..... Fitch: N. Y. Repts., i ii, 62.
Solenopsis geminata (FABR.)..... McCarthy, *in lit.*
Polistes fuscatus (FABR.) [pallipes ST. FARG.]..... Authors.
Vespa maculata LINN. *White-faced hornet*..... Id.
Vespa vulgaris LINN. *Yellow jacket*..... Id.

Lepidoptera.

(*Diurnals*).

Papilio Turnus LINN. *Turnus swallow tail*..... Harris: Ins. Inj. Veg., 268.
Limenitis Ursula (FABR.). *Ursula butterfly*..... Riley: Amer. Ent., ii, 276.
Limenitis Arthemis (DRURY). *Arthemis butterfly*..... Fletcher: *in lit.*
Limenitis disippus (GODT.). *Disippus butterfly*..... Scudder: Bull. Buff. Soc., ii, 250.
Thecla calanus (HÜBN.). *Banded hair-streak*..... Id., Psyche, 1889, 276.
Thecla strigosa HARRIS. *Streaked Thecla*..... Id., Bull. Buff. Soc., iii, 111.

Sphingidæ.

Deilephila lineata (FABR.). *White-lined Sphinx*..... Riley: Amer. Ent., i, 206.
Sphinx drupiferarum (SM.-ABB.). *Plum Sphinx*..... Lintner: Proc. E. S. Ph., iii, 568.
Sphinx Gordius CRAM. *Apple Sphinx*..... Harris: Ins. Inj. Veg., 328.
Smerinthus geminatus SAY..... Pack: 5th Rept. Ent. Comm., 257.
Smerinthus excæcatus (SM.-ABB.). *Blind-eyed Sphinx*..... Harris: Ins. Inj Veg., 327.
Sesia pyri (HARRIS)..... Riley: Proc. E. S. Wash., i, 85.

Bombycidæ.

Callimorpha Lecontei BDV..... Saunders: Fruit Ins., 198.
Callimorpha fulvicosta CLEM..... Riley: Mo. Rept., iii, 132.
Spilosoma virginica (FABR.). *Virginia ermine moth*..... Walsh: Pract. Ent., ii, 103.
Hyphantria cunea (DRURY). *The weaver*..... Fitch: N. Y. Rept., iii, 19.
Hyphantria sp.?..... Riley: Ins. Life, v, 17.
Halisidota caryæ (HARRIS). *Hickory tussock moth*..... Fitch: N. Y. Rept., iii, 19.
Halisidota maculata (HARRIS). *Spotted tussock moth*..... Thaxter: *in lit.*
Orgyia nova FITCH [antiqua (LINN.)]..... Fitch: 8th Rept. Ins. N. Y., 193.
Orgyia leucostigma (SM.-ABB.). *White-marked tussock moth*. Harris: Ins. Inj. Veg., 366.
Parorgyia parallela GR.-ROB..... Coquillett: Ill. Rept., x, 166.
Ocneria dispar (LINN.). *Gypsy moth*..... Fernald: Hatch Bull. 19, 109.
Lagoa crispata PACKARD..... Saunders: Fruit Ins., 176.
Lagoa opercularis (SM.-ABB.)..... Walsh: Amer. Ent., ii, 29.
Parasa chloris (HER.-SCH.). *Green hag-moth*..... Riley: Amer. Ent., ii, 307.
Euclea querceti HER.-SCH..... Thaxter: *in lit.*
Empretia stimulea CLEM. *Saddle-back caterpillar*..... Riley: Amer. Ent., i, 40.
Phobetron pithecium (SM.-ABB.). *Hag-moth*..... Id., ib., ii, 340.
Limacodes scapha HARRIS. *Skiff Limacodes*..... Thaxter: *in lit.*
Lithacodes fasciola HER.-SCH. *Banded Lithacodes*..... Id., ib.
Heterogenea textula HER.-SCH [flexuosa GROTE]..... Bent.: Ann. N. Y. Ac. Sci., v, 207.
Thyridopteryx ephemeræformis (HAW.). *Bag-worm*..... Riley: Amer. Ent., ii, 38.
Oiketicus Townsendi RILEY MS. *Townsend's bag-worm*..... Townsend: Canad. Ent., xxiv. 199.
Chalia Rileyi HEYLÆRTS..... Riley: Bul. S. E. Belg., 1884, ccviii.
Datana ministra (DRURY). *Yellow-necked apple-tree worm*... Fitch: N. Y. Repts., i-ii, 235.
Datana integerrima GR.-ROB..... Gr.-Rob.: Proc. E. S. Ph., vi. 13.
Datana contracta WALK..... Forbes: Ill. Rept. xiv, 95.

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* Camponotus herculaneus (*Linn.*).

Œdemasia concinna (Sm.-Abb.). ..... Harris: Ins. Inj. Veg., 425.
Œdemasia eximia Grote ..... Thaxter: *in lit.*
Œdemasia salicis Hy. Edw. ..... Dyar: Psyche, vi, 325.
Schizura unicornis (Sm.-Abb.). *Unicorn prominent* ..... Harris: Ins. Inj. Veg., 424.
Heterocampa manteo (Walker) ..... Pack.: 1st Mem. Bomb. Moths, 229.
Heterocampa guttivitta (Walker) ..... Packard: id., 235.
Attacus Promethea (Linn.). *Promethea moth* ..... Minot: Canad. Ent., ii, 100.
Attacus Cecropia (Linn.). *Cecropia Emperor moth* ..... Harris: Ins. Inj Veg., 388.
Telea Polyphemus (Linn.). *American Silk worm* ..... Marten: Ill. Rept., x, 125.
Hyperchiria Io (Fabr.). *Io Emperor moth* ..... Saunders: Ins. Inj. Fr., 139.
Hemileuca Maia (Drury). *Maia moth* ..... Marten: Ill. Rept., x, 128.
Clisiocampa Californica Packard ..... H. Edw.: 5th Rep. U. S. Com., 119.
Clisiocampa pluvialis Dyar ..... Dyar: Canad. Ent., xxv. 43.
Clisiocampa ambisimilis Dyar ..... Id., ib., 43.
Clisiocampa erosa Stretch ..... Id., Psyche, vi, 365.
Clisiocampa thoracica Stretch ..... Koebele: Bull. Div. Ent., 23, 42.
Clisiocampa Americana Harris. *Apple-tree tent caterpillar* ..... Harris: Ins. Inj. Veg., 373.
Clisiocampa disstria Hübn.* *Forest tent-caterpillar* ..... Id., ib., 375.
Tolype velleda (Stoll). *Velleda lappet-moth* ..... Id., ib., 377.
Gastropacha Americana Harris *American lappet-moth* ..... Packard: Rep Rk. M. Locust 379.
Gastropacha Californica Pack. *California lappet moth* ..... Id., ib., 807.
Xyleutes [Cossus] robiniæ (Peck) ..... French: Ill Rept., vii, 279.
Zeuzera pyrina (Fabr.). Leopard moth ..... Graef: Ent. Amer., iv, 163.

Noctuidæ.

Acronycta occidentalis Gr.-Rob. ..... Lintner: Ent. Contrib., i, 62.
Acronycta morula Gr.-Rob. ..... Lintner: Ent. Contrib., ii, 137.
Acronycta Radcliffei Harvey ..... Thaxter: Papilio, iii, 17.
Acronycta spinigera Guen. ..... French: Canad. Ent., xxvii, 332.
Acronycta luteicoma Gr.-Rob. ..... Thaxter: Papilio, iii, 17.
Acronycta brumosa Guen. ..... Beutenmüller: *loc. cit.*, 211.
Acronycta clarescens Guen. [is A. pruni *Harris*] ..... Thaxter: Papilio, iii, 17.
Acronycta oblinita (Sm.-Abb.) ..... Thomas: 7th Ill. Rept., 201.
Agrotis placida Grote. *Red cut-worm* ..... Davis: Bull 132 Mich., A. E. S., 7.
Agrotis saucia (Hübn.). *Variegated cut-worm* ..... Riley: Mo. Rept., i, 72.
Agrotis clandestina Harris. *W-marked cut-worm* ..... Id., ib., 79
Agrotis scandens Riley. *Climbing cut-worm* ..... Id., ib., 77.
Agrotis messoria Harris. *Dark-sided cut-worm* ..... Id., ib., 75.
Agrotis Cochrani Riley. *Cochran's cut-worm* ..... Id., ib., 75.
Agrotis tessellata Harris. *Checkered cut-worm* ..... Gillette: Bul. 12 Io. A. E. S., 539.
Mamestra subjuncta Gr.-Rob. *Speckled cut worm* ..... Davis: Bul. 132 Mich. A. E. S., 17.
Mamestra picta Harris. *Zebra caterpillar* ..... Coquillett: Ins. Life, v, 287.
Mamestra assimilis Morr ..... Thaxter: *in lit.*
Laphygma frugiperda Guen. *Fall army-worm* ..... Riley: Amer. Ent., ii, 364.
Nolophana malana (Fitch). *Many-dotted ap.-tr. worm* ..... Fitch: N. Y. Repts., i–ii, 241.
Amphipyra pyramidoides (Guen.) ..... Guenée: Noct., iii, 398.
Tæniocampa rufula (Grote) ..... Coquillett: Bul. Div. Ent., 32, 25.
Tæniocampa pacifica Harvey ..... Koebele: Bul. Div. Ent., 23, 43.
Tæniocampa alia Guen. *Unstable drab-moth* ..... Fitch: N. Y. Rept., iii, 26.
Scopelosoma sidus Guen. ..... Riley: 5th Rept. Ent. Comm., 116.
Xylina Bethunei Gr.-Rob. *Bethune's Xylina* ..... Thaxter: *in lit.*
Xylina antennata Walk. *Ash-grey pinion* ..... Riley: Mo. Rept., iii, 135.
Morrisonia confusa (Hübn.) ..... Dyar: Ins. Life, iii, 63

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* *Clisiocampa sylvatica* Harris.

Aletia argillacea HÜBN. *Cotton-moth*..... Riley: Amer. Ent., iii, 68.
Heliothus sp..... Id., Ins. Life, v, 18.
Chamyris cerintha (TREITS.)..... Coquillett: Papilio, i, 56.
Catocala grynea (CRAMER)..... Id., Ill. Rept., x, 184.
Catocala nuptialis WALK..... Hoy: Tr. Wis. Hort., Soc. ix, 233.
Catocala ultronia (HÜBN.)..... Beutenmüller: *loc. cit.*, 217.
Palthis angulalis (HÜBN.)..... Murtfeldt: ?

Geometridæ.

Prochœrodes nubilata (PACK.)..... (Reference lost.)
Ennomos magnaria GUEN..... Crane: Ent. Amer., iv, 13.
Ennomos subsignaria HÜBN. *Snow-white linden moth*..... Dodge: Canad. Ent., xiv, 30.
Nematocampa filamentaria GUEN..... Beutenmüller: *loc cit.*, 220.
Plagodis Kentzingaria GROTE..... Thaxter: *in lit.*
Corycia vestaliata GUEN. *Vestal Corycia*..... Perkins: *in lit.*
Eumacaria brunneariaPACK..... Goodell: Canad. Ent., x, 66.
Boarmia plumigeraria HULST..... Coquillett: Bull. 30 Div. Ent., 28.
Boarmia pampinaria GUEN..... Beutenmüller: *loc. cit.*, 222.
Boarmia crepuscularia TREITS..... Id., ib., 222.
Biston ypsilon FORBES..... Forbes: Ill. Rept., xiv, 95.
Amphidasys cognataria GUEN..... Goodell: Canad. Ent., x, 67.
Hybernia tiliaria HARRIS. *Lime-tree winter-moth*..... Harris: Ins. Inj. Veg., 472.
Hybernia defoliaria (CLERCK)..... Fletcher: Rept. Ent., 1893, 24.
Phigalia? cinctaria FRENCH. *Banded Phigalia*..... French: Ill. Rept., vii, 241.
Anisopteryx vernata PECK. *Spring canker-worm*..... Harris: Ins. Inj. Veg., 463.
Anisopteryx pometaria HARRIS. *Autumn canker-worm*..... Id., ib., 462.
Operophtera boreata WALKER..... Bruce: Ent Amer., iii. 49.
Petrophora diversilineata HÜBN..... Riley: 5th Rept. Ent. Comm., 189.

Pyralidæ.

Eurycreon rantalis GUEN. *Pyralid web-caterpillar*..... Popenoe: Kan. R. B. A., 1880, 100.
Phycis [Mineola] indigenella (ZELL.). *Leaf-crumpler*..... Riley: Mo. Rept., iv, 39.
Pempelia Hammondi RILEY. *Apple leaf skeletonizer*..... Id., ib., 44.

Tortricidæ.

Teras oxycoccana (PACK.)..... Riley: Papilio, iv, 71.
Teras Cinderella (RILEY). *Green apple-leaf tyer*..... Riley: Mo. Rept., iv, 46.
Teras malivorana (LEBARON). [T. minuta ROB.]..... LeBaron: Ill. Rept., 1, 20.
Cacœcia rosaceana (HARRIS). *Oblique-banded leaf-roller*..... Harris: Ins. Inj. Veg., 480.
Cacœcia rosana (LINN.)..... Fernald: Cat. Tort., 11.
Cacœcia argyrospila (WALK.)..... Riley: Trans. Am. E. S., x, 12.
Lophoderus triferana (WALK.)..... Murtfeldt: Fern's Cat. Tort, 15.
Eccopsis permundana (CLEM.). *Neat strawberry-leaf roller*.. Coquillett: Papilio, iii, 102.
Eccopsis malana FERN. *Apple-bud worm*..... Coquillett: Fern's Cat. Tort., 72.
Penthina chionosema ZELLER..... Murtfeldt: Bull. 23 Div. Ent., 51.
Semasia sp..... Riley: Tr. Mass. Hor. Soc., 1, 39.
Proteopteryx spoliana (CLEM.)..... Murtfeldt: Bull. 23 Div. Ent., 51.
Steganoptycha pyricolana RILEY..... Id., ib., 52.
Tmetocera ocellana (SCHIFF.). *Eye-spotted bud-moth*..... Harris: Ins. Inj. Veg., 482.
Phoxopteris nubeculana (CLEM.). *Apple-leaf folder*..... Riley: Agr Rept. for 1878, 239.
Grapholitha prunivora (WALSH). *Plum moth*..... Id., Amer. Ent., iii, 131.
Carpocapsa pomonella (LINN.). *Codling moth*..... Linnæus: Syst. Nat., x, 538.

Tineidæ.

Ephestia interpunctella HÜBN. *Indian meal moth*..... Lintner MS. (in dried fruit).
Argyresthia andereggiella F. v. R..... Beutenmüller: *loc. cit.*, 228.
Gelechia intermediella CHAMBERS..... Murtfeldt: Bull. 23 Div. Ent., 53.
Ypsolophus contubernalellus (FITCH)..... Fitch: N. Y. Repts., i-ii, 231.
Ypsolophus malifoliellus (FITCH). *Striped palmer-worm*. Id., ib., 231.
Ypsolophus pometellus (HARRIS). *Palmer-worm*..... Id., ib., 221.
Anarsia lineatella ZELL. *Peach-twig moth*..... Lintner: Inj. Ins. N. Y., i, 154.
Ornix cratægifoliella CLEM..... Chambers: Canad. Ent., v, 50.
Lithocolletis [Ornix] geminatella PACK..... Packard: Guide Stud. Ins., 353.
Lithocolletis pomifoliella ZELL. *Thorn-apple leaf-miner*..... Clem.: Pr. A. N. Sc. Ph., 1860, 208.
Coleophora malivorella RILEY. *Apple-tree case-bearer*..... Riley: Agr. Rept. for 1878, 253.
Coleophora Fletcherella FERN..... Fernald: Canad. Ent., xxiv, 122.
Tischeria malifoliella CLEM. *Apple-leaf miner*..... Stainton: Tineida N. A., 141.
Bucculatrix pomifoliella CLEM. *Apple-leaf Bucculatrix*..... Id., ib., 145.
Aspidisca splendoriferella CLEM. *Resplendent shield-bearer*. Comstock: Ag. Rep. for 1879, 210.
Micropteryx pomivorella PACK. *Apple Micropteryx*..... Packard: Inj. Ins. etc., 1870, 6.

Diptera.

Trichocera regelationis (LINN.)..... Billups: Ent. Mo. Mag., xxii, 284.
Euxesta notata (WIED.)..... Riley: Ins. Life, vi, 270.
Sciara mali (FITCH). *The apple midge*..... Fitch: N. Y. Repts., i-ii, 252.
Trypeta [Rhagolites] pomonella WALSH. *Apple maggot*..... Walsh: Ill. Rept., i, 29.
Drosophila amœna LOEW. *Pretty pomace fly*..... Comstock: Ag. Rept. for 1881. 199.
Drosophila ampelophila LOEW. *Pickled-maggot fruit-fly*..... Id., ib., 201.

Coleoptera.

Cucujidæ.

Silvanus Surinamensis (LINN.). *Grain Silvanus*..... Glover: Agr. Rept. for 1870, 66.

Nitidulidæ.

Ips fasciatus OLIV. [quadriguttatus FABR.]. *Banded Ips*.... Thomas: Ill. Rept., vi, 91.

Trogositidæ.

Trogosita [Tenebriodes] nana (MELSH.). *Dwarf Tenebrioides*. Riley: Mo. Rept., iii, 6.
Tenebrioides corticalis (MELSH.)..... Hopkins: Bull 32 W. Va. Ag. St., 180.

Elateridæ.

Alaus oculatus (LINN.). *Eyed Alaus*..... Fitch: N. Y. Rept., iii, 11.
Alaus myops (FABR.). *Blind Alaus*..... Id., ib., 12.
Melanotus incertus LEC. [decumanus ER.]..... Riley: Mo. Rept., iii. 6.
Melanotus communis (GYLL.). *Common snapping beetle*.... Id., ib.
Corymbites caricinus (GERM.)..... Fletcher: Rept. Expt. Farm, 1892, 146.

Buprestidæ.

Dicerca divaricata (SAY). *Divaricated Buprestis*..... Glover: Agr. Rept. for 1868, 91.
Chrysobothris femorata (FABR.). *Fl.-head. Apple tree borer*. Fitch: N. Y. Rept., i, 25.
Chrysobothris semisculpta LEC. [contigua LEC.]..... Blaisdell: Ins. Life, v, 33.
Chrysobothris Californica LEC..... Id., ib.

Malachidæ.

Attalus scincetus (SAY)..... Hopkins: *loc. cit.*, 185.

Ptinidæ.

Sinoxylon basilare (Say). *Red-shouldered Sinoxylon*..... Riley: Mo. Rept., iv, 54.
Bostrychus bicornis (Web.)..... Hopkins: *loc cit.*, 185.
Amphicerus bicaudatus (Say). *Apple-twig-borer*..... Fitch: N. Y. Rept., iv. 12.
Polycaon confertus Lec. *Twig-borer*..... Riley: Amer. Nat., xvi, 747.
Psoa maculata Lec..... Coquillett: Ins. Life, iv, 261.

Lucanidæ.

Lucanus dama Thunb. *Stag beetle*..... Harris: Ins Inj. Veg., 45.

Scarabæidæ.

Serica iricolor (Say). *Iridescent Serica*..... Glover: Agr. Rept. for 1868, 87.
Serica valida Harold. *Robust Serica*..... Cooke: Inj. Ins. O. V., etc., 101.
Macrodactylus subspinosus (Fabr.) *Rose beetle*..... Harris: Ins. Inj. Veg., 36.
Macrodactylus uniformis Horn..... Riley: Ins. Life, ii, 115.
Lachnosterna fusca (Fröhl.). *May Beetle*..... Glover: Agr. Rept. for 1868, 104.
Lachnosterna micans (Knoch.)..... Id., ib.
Lachnosterna fraterna Harris. *June beetle*..... Harris: Ins. Inj. Veg., 32.
Lachnosterna prunina Lec..... Townsend: Ins. Life, ii, 43.
Lachnosterna rugosa Melsh..... Bruner: Neb. Hort. Rept., '94, 159.
Lachnosterna affinis Lec..... Id., ib.
Lachnosterna hirticula (Knoch). *Hairy May beetle*..... Glover: Agr. Rept. for 1868, 88.
Lachnosterna crenulata Fröhl..... Id., ib.
Lachnosterna tristis [pilisocollis] Fabr..... Harris: Ins. Inj. Veg., 33.
Polyphylla variolosa Hentz. *Scarred Polyphilla*..... Id., ib.
Polyphylla decemlineata Say. *Ten-lined leaf-eater*..... Cooke: Inj. Ins. O. V., etc., 100.
Anomala varians (Fabr.). [undulata Melsh.]..... Thomas: 6th Rept. Ins. Ill., i.
Anomala marginata (Fabr.). *Margined Anomala*..... Lintner: Inj. Ins. N. Y., 412.
Pelidnota punctata (Linn.). *Spotted Pelidnota*..... Bruner: *loc. cit.*, 1894, 159.
Cotalpa lanigera (Linn.). *Goldsmith-beetle*..... Id. ib.
Allorhina nitida (Linn.). *Green June beetle*..... Townsend: Bull. 5 N.Me.Ag.St.,10.
Allorhina sobrina..... Id., ib.
Euphoria melancholica Gory. *Melancholy chafer*..... Walsh-Riley: Amer. Ent., ii, 61.
Euphoria Inda (Linn.). *Indian Euphoria*..... Riley: Mo. Rept., iii, 6.
Osmoderma eremicola (Knoch). *Hermit Osmoderma*..... Harris: Ins. Inj. Veg., 42
Osmoderma scabra (Beauv.). *Rough Osmoderma*..... Glover: Agr. Rept. for 1886, 90.
Trichius sp. ?[Valgus canaliculatus, Fabr.]..... Harris: Ent. Corr., 82.

Spondylidæ.

Parandra brunnea (Fabr.)..... Sherman: *in lit.*

Cerambycidæ.

Orthosoma brunneum Forst. *Brown Prionus*..... Riley-Howard: Ins. Life, iv, 270.
Prionus laticollis (Drury). *Broad-necked Prionus*..... Riley: Amer. Ent., 1, 233.
Prionus imbricornis (Linn.). *Tile horned Prionus*..... Riley: Mo. Rept., iii, 6.
Chion cinctus (Drury). *Banded Chion*..... Fitch: N. Y. Rept., iii, 8.
Chion garganicus (Fabr.)..... Id., ib.
Elaphidion ocellata (Hald.). [*auct.* Riley]..... Murtfeldt: Rept. Agr. 1888, 137.
Elaphidion villosum (Fabr.). *Apple-tree pruner*..... Riley: Amer. Ent., iii, 239.
Elaphidion parallelum Newm. *Parallel Elaphidion*..... Id., ib.
Neoclytus erythrocephalus (Fabr.)..... Chittendon: Pr. E S. Wash., iii. 97.
Distenia undata (Oliv.)..... Lugger: Psyche, iv, 204.
Ipochus fasciatus Lec..... Coquillett: Ins. Life, iv, 262.
Psenocerus supernotatus (Say)..... Packard: Guide Stud. Ins., 500.
Leptostylus aculiferus (Say). *Prickly Leptostylus*..... Fitch: N. Y. Rept., iii, 8.

Leptostylus macula (SAY). *Spotted Leptostylus*..... Brackett: Pract. Ent., i, 19.
Sternidius [Liopus] alpha (SAY)..... Riley: Am. Ent., iii, 270.
Liopus [Lepturges] facetus (SAY)..... Fitch: N. Y. Rept., iv, 65.
Hyperplatys maculatus HALD. ..... Riley: Amer. Ent., iii, 271.
Eupogonius tomentosus HALD..... Smith: Ins. Life, iv, 43.
Oncideres cingulata (SAY). *Twig-girdler*..... Riley: Amer. Ent., iii, 271.
Saperda calcarata SAY. *Poplar borer*..... Riley: Prairie Farm., 1867, 397.
Saperda candida FABR. *Round-headed apple-tree borer*..... Harris: Ins. Inj. Veg., 107.
Saperda cretata NEWM..... Osborn: Amer. Nat., xv, 244.
Saperda vestita SAY..... Zabriskie: Jo. N. Y. E. Soc., iv, 96.
Oberea sp..... Riley: Amer. Ent., iii, 181.

Chrysomelidae.

Syneta albida LEC..... Lewelling: Ins. Life, iv, 396.
Coscinoptera dominicana (FABR.). *Dominican case-bearer*... Riley: Mo. Rept., vi, 127.
Xanthonia 10-notata SAY. *Spotted Xanthonia*..... Id., Bull. 31 Dept. Ent., 17.
Glyptoscelis crypticus (SAY). *Cloaked Chrysomela*..... Fitch: N. Y. Rept., iii, 18.
Colaspidea smaragdula (LEC.)..... Riley-Howard: Ins. Life, vi, 373.
Diabrotica 12-punctata (OLIV.)..... Id., ib., i, 58.
Diabrotica vittata (FABR.). *Striped Cucumber-beetle*..... Riley: Mo. Rept., iii, 6.
Diabrotica longicornis (SAY)..... Forbes; 12th Ill. Rept., 23.
Disonycha Pennsylvanica ILLIGER..... Id., 18th Ill. Rept., xi.
Graptodera [Haltica] chalybea ILLIGER. *Grapevine flea-beetle*. McMillan: Bull. 2 Neb. Ex. St., 43.
Haltica foliacea LEC. *Apple flea-beetle*..... Cook: Rural N. Yorker, lxiv, 530.
Haltica punctipennis LEC..... Riley: Sci. Amer., lvi, 384.
Crepidodera rufipes (LINN.). *Red-footed flea-beetle*..... Lintner: 4th N. Y. Rept, 102.
Crepidodera Helxines (LINN.). *Violaceus flea-beetle*..... Forbes: 14th Ill. Rept., 98.
Epitrix cucumeris (HARR.). *Cucumber flea-beetle*..... Id., ib.
Odontota scutellaris OLIV. [dorsalis THUNB.]..... Riley: Amer. Ent., iii, 151.
Odontota nervosa PANZ..... Harris: Ins Inj. Veg., 120.
Odontota rubra WEBER..... Dimmock: N. E. Homestead, v. 73.

Tenebrionidae.

Helops micans FABR..... Riley: Prairie Farm., 1867, 397.

Cistelidae.

Hymenorus obscurus (SAY)..... Lintner; Count.-Gent, 1882, 605.

Melandryidae.

Synchroa punctata (NEWMAN)..... Hamilton: Can. Ent., xvii, 48.

Anthricidae.

Notoxus calcaratus HORN..... Jones: Ins. Life, v, 197.
Notoxus monodon (FABR.)..... Woodworth: Rep. Cal. A. E. S., 1894-5, 248.

Meloidae.

Macrobasis unicolor (KIRBY). *Ash-grey blister-beetle*..... Glover: Agr. Rept. for 1868, 105
Pomphopœa ænea (SAY). *Pear-tree blister-beetle*..... Riley: Mo. Rept., iii, 6.

Otiorhynchidae.

Epicærus imbricatus (SAY). *Imbricated snout-beetle*..... Glover: Agr. Rept. for 1870, 71.
Anametis grisea HORN [granulatus SAY] ..... Riley: Amer. Nat., xvi, 916.
Otiorhynchus sulcatus (FABR.)..... Quin: Gard.-Field, xxii, 1896, 25.
Otiorhynchus picipes (FABR.) [singularis LINN.]..... Packard: Rep. Geo. Sur, 1875, 757.
Thricolepis simulator HORN. *Grey bark-eating weevil*..... Cooke: Inj. Ins. O. V., etc., 71.

Curculionidæ.

Ithycerus Noveboracensis (Forst.). *New York weevil* ..... Fitch: N. Y. Rept., iii, 13.
Magdalis ænescens Lec..... Fletcher: Farm. Adv., 1896, 480.
Coccotorus prunicida Walsh. *Plum-gouger*..... Bruner: Neb. Hor. Rept., 1894, 161.
Tachypterus quadrigibbus Say. *Apple curculio*..... Walsh: Amer. Ent., i, 36.
Pseudanthonomus cratægi Walsh. *Thorn curculio*..... Riley: Amer. Ent., ii, 308.
Anthonomus pomorum (Linn.). *Apple-blossom weevil*..... Dietz: Tr. Am. Ent. S., xviii, 204.
Conotrachelus nenuphar (Herbst). *Plum curculio*..... Harris: Ins. Inj. Veg., 76.

Scolytidæ.

Monarthrum mali (Fitch). *Apple bark-beetle*..... Fitch: N. Y. Rept., iii, 8.
Hypothenemus eruditus Westw..... Hopkins: Bul. 31 W. V. E. S., 132.
Hypothenemus erectus Lec..... Id., ib., 133.
Hypothenemus dissimilis Zimm..... Marten: Prairie Farm., lxi, 204.
Xyleborus pyri (Peck) [dispar Fabr.]. *Pear-blight beetle*.... Harris: Ins. Inj. Veg., 90.
Xyleborus obesus Lec..... Riley: N. Y. Tribune, 1877, 234.
Xyleborus xylographus Say. *Wood-engraver bark-beetle*..... Hopkins: *loc. cit.*, 136.
Pityophthorus sp. "h." [Xylocleptes decipiens Lec.]..... Id., ib., 132.
Scolytus rugulosus Ratz. *Wrinkled Scolytus*..... Lintner: 4th. Rept. Ins. N. Y., 104.
Phlœotribus limiuaris (Harris) var..... Cockerell: Ins. Life, vii, 210.

Hemiptera.

(*Heteroptera.*)

Brochymena annulata (Fabr.) ..... Walsh-Riley: Amer. Ent., i, 227.
Brochymena Carolinensis Westwood..... Bruner: *loc. cit.*, 162.
Leptocoris trivittatus (Say). *Box-elder plant bug*..... Riley: Bull. 12 Div. Ent., 41.
Nysius angustatus Uhler. *False chinch-bug* ..... Id., Mo. Rept, v, 114.
Crophius disconotus (Say)..... Gill.-Baker: Hemipt. Col., 24.
Trapezonotus sp..... Bruner: *loc. cit.*, 162.
Lygus pratensis (Linn.). *Little-lined plant-bug*..... Riley: Mo. Rept., ii, 114.
Corythuca arcuata Say ..... Slingerland: Rur. N. Y., liv, 425.
Corythuca sp..... Washburn: Bul. 31 Or Ag. St., 87.
Sinea diadema (Fabr.)..... Dodge: Forest & Field, ii, 67.

(*Homoptera.*)

Cicadidæ.

Cicada septendecim Linn. *Seventeen-year locust*..... Fitch: N. Y. Rept., i, 45.
Cicada tredecim Riley. *Thirteen-year locust*..... Riley: Mo. Rept, iii, 6.
Cicada Novæboracensis [rimosa Say] Emmons..... Cooke: Inj. Ins. O. V. etc., 74.
Cicada tibicen Linn. *Dog-day Cicada*..... Uhler: *in lit.*

Membracidæ.

Ceresa bubalus (Fabr.). *Buffalo tree-hopper*..... Riley: Mo. Rept., v, 122.
Ceresa taurina Fitch. *Calf tree-hopper*..... Fitch: N. Y. Rept., iii, 17.
Thelia cratægi Fitch. *Thorn-bush tree-hopper* ..... Saunders: Fruit Ins., 46.
Enchenopa binotata Say. *Two-spotted tree-hopper* ..... Goding: Ins. Life, v, 93.

Jassidæ. ?

Jassus irroratus Say..... Uhler: *in lit.*
Eutettix seminuda (Say)..... Gill.-Baker: Hemipt. Col., 102.
Empoasca albopicta (Forbes). *Green apple-leaf hopper* ..... Forbes: Ill. Rept., xiii, 181.
Empoasca Birdii Goding..... Goding: Ent. News, i, 123.
Empoasca obtusa (Walsh)..... Walsh: Prairie Farm., xxvi, 147.

Empoasca viridescens WALSH..... Id., ib.
Typhlocyba rosæ (HARRIS). *Rose-leaf hopper*..... Riley: Ins. Life, v, 18.
Typhlocyba mali PROV. *Apple-tree leaf-hopper*..... Provancher: Can. Hemipt., 298.

Psyllidæ.

Psylla pyricola (FOERST.). *Pear-tree Psylla*..... Glover: Agr. Rept. for 1876, 33.

Aphididæ.

Schizoneura lanigera HAUS. *Apple-root plant-louse*..... Fitch: N. Y. Rept., i, 5.
Lachnus dentatus LEBARON..... LeBaron: Ill. Rept., ii, 138.
Callipterus mucidus FITCH. *Mouldy Aphis*..... Fitch: N. Y. Rept., iii, 16.
Aphis mali FABR. *Apple-tree Aphis*..... Id., ib., i, 49.
Aphis malifoliæ FITCH..... Id., ib., 56.

Aleurodidæ.

Aleurodes sp..... Walsh: Pract. Ent., ii, 58.

Coccidæ.

Icerya purchasi MASKELL. *Cottony-cushion scale*..... Cooke: Fruit Ins. Cal., 38.
Lecanium pruinosum COQUILL. *Powdered Lecanium*..... Coquillett: Ins. Life, iii, 384.
Lecanium pyri SCHR..... Cockerell: Canad. Ent., xxvi, 35.
Lecanium oleæ BERNARD. *Black scale of California*..... Comstock: Ag. Rept. for 1880, 336.
Lecanium juglandis BOUCHÉ. *Plum scale*..... Slingerland: Bul. 83 C. E. S., 687.
Lecanium sp..... Coquillett: Bull. 26 Ent. Div., 34.
Ceroplastes Floridensis COMST. *Barnacle scale*..... Riley: Ins. Life, i, 326.
Aspidiotus perniciosus COMST. *The pernicious scale*..... Comstock: Ag. Rept. for 1880, 305.
Aspidiotus ancylus PUTNAM..... Sirrine: *in lit.*
Aspidiotus Forbesi JOHNSON. *Cherry scale*..... Johnson: Entomo. News, vii, 151.
Aspidiotus juglans-regiæ COMST..... Cockerell: Canad. Ent., xxvii, 260.
Aspidiotus ostreæformis CURTIS..... Douglas: Ent. Mo. M., xxiii, 239.
Aspidiotus rapax COMST. *Greedy scale*..... Wood.: Rep. Cal. E. S. 1892, 456.
Aspidiotus camelliæ (BOISD.). *Camellia Aspidiotus*..... Howard: Year Book Agr '94, 262.
Mytilaspis pomorum BOUCHÉ. *Apple bark-louse*..... Harris: Ins. Inj. Veg., 252.
Chionaspis furfurus (FITCH). *Scurfy bark-louse*..... Walsh: Pract. Ent., ii, 31.
Diaspis ostreæformis SIGNORET. *Pear-tree oyster-scale*..... Comstock: Ag. Rept. for 1880, 312.

Thysanoptera.

Heliothrips hæmorrhoidalis BOUCHÉ..... Pergande: Psyche, iii, 381.
Phlæothrips mali FITCH. *Apple thrips*..... Fitch: N. Y. Rept., i, 102.
Thrips tritici FITCH. *Wheat thrips*..... Osborn: Ins. Life, i, 141.

Orthoptera.

Œcanthus niveus HARRIS. *White flower-cricket*..... Riley: Mo. Rept., v, 120.
Orchelimum glaberrimum (BURM.)..... Bruner: *loc. cit.*, 163.
Microcentrum retinervis (BURM.). *Angular-winged katydid*. Riley: Mo. Rept., vi, 158.
Chortophaga viridifasciata (DE GEER). *Green striped locust*.. Saunders: Fruit Ins., 139.
Camnula pellucida SCUDD. *Pellucid locust*..... Riley: U. S. Ent. Com. Rept., i, 445.
Schistocera Americana (DRURY). *American locust*..... Thomas: Amer. Ent., iii, 250.
Schistocera Shoshone THOMAS. *Shoshone locust*..... Bruner: *in lit.*
Melanoplus femur-rubrum (HARRIS). *Red legged locust*..... Riley: Rept. Ent. Com., i, 445.
Melanoplus spretus (UHLER). *Rocky Mountain locust*..... Id., ib., 253.
Melanoplus atlanis (RILEY). *Lesser migratory locust*..... Id., ib., 445.
Melanoplus differentialis (THOMAS). *Differential locust*..... Bruner: *in lit.*

Melanoplus bivittatus (Say). *Two-striped locust* ..... Bruner: *in lit.*
Melanoplus herbaceus Bruner ..... Id., ib.
Melonoplus cinereus Scudder..... Id., *loc. cit.*, 163.
Melanoplus cyaneipes Bruner MS.. ..... Id., *loc. cit.*, 163.
Melanoplus devastator Scudder. *Devastating locust*..... Coquillett: Bull. 27 Div. Ent. 36.
Pezotettix chenopodii Bruner..... Bruner: *loc. cit.*, 163.
Forficula auricularia Linn. *Earwig*..... Cooke: Inj. Ins. O. V., etc., 111.

Neuroptera.

Termes flavipes Kollar. *White ant*..... Riley-Howard: Ins. Life, v, 201.

Thysanura.

Symnthurus arvalis Fitch. *Field flea*..... Fitch: N. Y. Repts., vi–ix, 191.

Arachnida.

Bryobia pratensis Garman. *Clover mite*..... Cockerell: Ins. Life, vii, 210.
Bryobia speciosa (Koch)..... Webster: Ins. Life, i, 363.

(B)

PUBLICATIONS OF THE ENTOMOLOGIST.

The following is a list of the principal publications of the Entomologist during the year of 1895: 50 are named, giving title, place and time of publication, and a summary of contents.

Ants in a Lawn. (Country Gentleman, for January 3, 1895, lx, p. 9, cols. 1, 2 — 34 cm.)

A remedy requested for an infestation of ants in a lawn which was formerly dense woods, at East Williston, N. Y., can not be given without a knowledge of the species. If the yellow ant, *Formica rufa*, it may be destroyed in its mound by introducing bisulphide of carbon. If the ants can not be traced to their mounds or nests, then, at a time when the lawn "is alive" with them, they may be killed with kerosene emulsion. Lime or kainit, used as directed, may also prove effective against them.

[Published in pages 115, 116 of this Report (xi).]

The Apple-Tree Aphis. (Country Gentleman, for January 10, 1895, lx, p. 27, cols. 1, 2 — 40 cm.)

For an unusually severe attack of aphis in an orchard at George's Harbor, British Columbia, kerosene and lime applied to the trunks of the trees had been recommended. This would not be effective, and why not. The proper remedy is spraying with kerosene emulsion as the young are hatching.

Can the blackening of the trunks and branches and stickiness of the leaves result from Psylla attack on pear trees? It is unusual with aphis but common with Psylla. But the Psylla has not been reported from British Columbia, while the apple-tree aphis was quite destructive there (as quoted) in 1893, and its eggs have been received, fairly blackening apple twigs from Oregon. Reply to question — the Bordeaux mixture may follow the application of kerosene, or be combined with the emulsion.

The Apple-Tree Bark-Louse. (Country Gentleman, for January 10, 1895, lx, p. 27, cols. 2, 3 — 45 cm.)

In answer to inquiries with specimens from Pleasant Plains, N. Y., the above-named insect, *Mytilaspis pomorum*, is identified. Instead of cutting down badly infested trees, as in years ago, we can now kill the insect and save the trees. The young can be killed by kerosene emulsion spraying at the proper time. Few persons seem willing to devote the time to fight insect pests, yet the future of fruit-growing depends upon its being done. The winter months are favorable for

destroying scale insects by the whale-oil soap wash. Directions are given for its use and its economical home manufacture.

The many food-plants of *M. pomorum* are given.

Colorado Beetles. (Country Gentleman, for January 10, 1895, lx, p. 30, c. 2 — 5 cm.)

To the inquiry when the potato bug first came to Albany, reply is made: — its occurrence may safely be given as in 1873. It is recorded as having entered the western limits of the State in 1871; in 1872 as in Cattaraugus Co.; in 1873 as having reached the extreme eastern boundary of the State; in 1874 it was seen in Chenango Co.; in 1875 it was present in several of the New England States. In August of 1876 it was so abundant in Albany, that on some of the streets, in walking a block a number would be crushed under foot.

Attacking Scale Insects. (Country Gentleman, for February 7, 1895, lx, p. 108, c. 2 — 21 cm.)

The suggestion is made by a correspondent from St. Lawrence Co., that the remedies for the ravages of the apple-tree scale be published at the present time. We have now a sure remedy for this, and most other of our fruit-tree scales, in the winter application of the whale-oil soap solutions, the formula for which and the manner of use may be found in the *Country Gentleman* of January 10th. The formula as there given will make about 20 lbs. of the soap—not 25 as stated. Mr. Howard's testimony to the value of this wash is quoted.

Garden Slugs. (Country Gentleman, for February 21, 1895, lx, p. 147, c. 1 — 9 cm.)

The best remedy is freshly slacked lime applied to them while feeding during the morning or evening. As they are able to throw off their slimy coating when obnoxious substances are applied, the application should be renewed at short intervals until they are no longer able to excrete a new coating. Lime water is used by English gardeners. They may also be killed by sprinkling them with salt. Ducks are serviceable in gardens for hunting the slugs for food.

Rhinoceros Beetle. (Country Gentleman, for March 21, 1895, lx, p. 230, cols. 1, 2 — 10 cm.)

Two "horned bugs" taken alive from a chestnut stump at Harmony Grove, Ga., and thought to have killed chestnut trees, are the rhinoceros beetle, *Dynastes Tityus*. The larva feeds and transforms in decaying cavities in old trees and stumps, and not being a borer, is not injurious. The beetle may be harmful in plowing off the bark to feed on the sap-wood. It is said, also, to be a sap feeder. It has not previously been recorded in chestnut.

Bounty on the English Sparrow. (Albany Evening Journal, for March 21, 1895, p. 8, c. 4 — 23 cm., Scientific American, April 27, 1895.)

In remarks made upon a Bill offering a bounty on English sparrows killed, under consideration by a Legislative Committee, it was urged,

that although the bird was "an unmitigated nuisance" (among other reasons for the protection it gave to the Orgyia caterpillars), a bounty was inexpedient: its reduction could be better reached by other means indicated. Its extermination or great reduction through a bounty was impracticable, as shown where bounties had been paid. A bounty would be detrimental to the agriculturist in driving the sparrows from cities into the country, and giving it more general distribution. Many insectivorous song sparrows would be mistaken for it and killed. Careless shooting by boys would endanger lives.

Vermicides [Insecticides for Vermin.]. (Country Gentleman, for April 4, 1895, lx, p. 266, c. 4 — 8 cm.)

An inquiry for a carbolic acid solution that will kill vermin on cattle, sheep, and lambs, is answered by recommending Buchan's Carbolic soap and Little's Chemical Fluid. Directions as to preparation and method of use are given on the packages.

The English Sparrow. (Country Gentleman, for April 11, 1895, lx, p. 285, cols. 2, 3 — 19 cm.)

Substantially the same as in the *Albany Evening Journal* of March 21, 1895, of which an abstract is given above.

Some Destructive Shade-Tree Pests. (State of New York — Department of Public Instruction, Arbor Day Manual, May 3, 1895, Albany, April 6, 1895, pp. 13–17, figs. 6.)

Importance of protecting shade-trees from insect depredations. The elm is particulary subject to insect attack. Notice and figures of the elm-leaf beetle, *Galerucella xanthomelæna* [*luteola*], and how to destroy it; the Orgyia tussock caterpillar — its beauty, abundance, and control by destruction of eggs; the ravages of the leopard-moth, *Zeuzera pyrina*; operations of scale insects, illustrated by maple-tree scale, *Pulvinaria innumerabilis*; increase of insect pests and number of species infesting different trees, and the importance of the study by young people for their control.

A Bad Scale on Currant Bushes. (Gardening, for May 15, 1895, iii p. 263, c. 2 — 9 cm.)

Currant bushes in St. Louis are "completely covered with scales," which from examples sent, are identified as *Aspidiotus ancylus* Putnam —a scale that closely resembles the San José scale, *Aspidiotus perniciosus*, recently introduced into the Atlantic States.

If badly infested, they should be cut down and burned. If but moderately infested, spraying with kerosene emulsion early in June will kill the young. All the insects can be killed by a wash in winter with two pounds of whale-oil soap in one gallon of water.

The Currant Aphis. (Gardening, for May 15, 1895, iii, p. 263, c. 3 — 12 cm.)

The plant-louse reported from Oshkosh, Wis., as curling and blistering the leaves of the red currant, is the currant aphis, *Myzus ribis*

(Linn.). It can be destroyed by kerosene emulsion or a whale-oil soap solution if applied at the hatching of the eggs and prior to the curling of the leaves.

Repelling the attack by mulching the plant with tobacco stems, as reported, would be a valuable preventive if it should prove, on further trial, effective.

The Bean Weevil. (Country Gentleman, for May 16, 1895, lx, p. 389, cols. 1, 2 — 17 cm.)

To an inquiry from Butler Co., O., of the construction of kilns for killing the bean weevil, reply is made that any excess of heat used in killing the weevil in stored beans would endanger their germination. Professor C. E. Weed's experiments in killing the pea weevil in an oven exposure of 146° Fahr. for an hour, are referred to. Exposure of infested beans to the vapor of bisulphide of carbon is preferable to heat. Where description of the "Tracy House" for killing the weevil with bisulphide of carbon, may be found.

The Bean Weevil. (Country Gentleman, for May 23, 1895, lx, p. 408, c. 3 — 6 cm.)

Answer is made to a correspondent from Binghamton, N. Y., that the weevil comes from eggs deposited upon the pods, and no means are known for preventing the deposit. As it is a rather local insect, all bean growers in an infested locality should combine in killing the insect soon after the gathering of the crop, by the bisulphide of carbon treatment or some other efficient remedy.

Millepedes and Wire-Worms. (Country Gentleman, for May 30, 1895, lx, p. 423, cols. 1, 2 — 23 cm.)

From 40 to 60 "black wire-worms" reported as occurring in single hills of melons, in Pattersonville, N. Y., are millepedes or "thousand-legged worms." What may be done to prevent them infesting crops, as in not using manure in which their eggs occur, applying soot, lime-water, trapping with baskets of damp moss, slices of potato, and cabbage leaves. Figures of wire-worms and of millepedes are given to show their difference.

Carpet-Eating Insects. (Country Gentleman, for May 30, 1895, lx, p. 423, c. 3 — 16 cm.)

Insects sent from Louisville, N. Y., from underneath carpets, are the larvæ of *Tinea pellionella* (one of the three species of clothes-moths) and of *Attagenus piceus*, the black-carpet beetle. An account of each is given and how they may be destroyed. The supposed clothes-moths attracted to light in the evening are not clothes-moths, but are species that enter through open windows and are harmless within doors.

Plum-Tree Aphis. (Gardening, for June 1, 1895, iii, p. 281, c. 3 — 16 cm.)

The aphides sent from Eaton, O., had all been devoured by the larval Syrphus flies and a *Coccinella 9-notata* inclosed with them, but

they are undoubtedly, from the statement of their operations, *Aphis prunifolii*. To prevent its injury, the tree should be sprayed with kerosene emulsion, soap suds or whale-oil soap solution when the leaves begin to open and the insect appears. Later, they are sheltered by the curling of the leaves.

Cutworms. (Country Gentleman, for June 6, 1895, lx, p. 440, c. 3 — 10 cm.)

As there are fifty or more species of cut worms, the habits and operations of which are largely influenced by the crops attacked, soil and seasonal conditions, etc., no general remedy can be given for them. The preventives and remedies contained in Bulletin No. 6 of the New York State Museum of Natural History, on "Cut-worms," are named— twelve in number.

A Manual for the Study of Insects. (The Nation, for June 6, 1895, Vol. 60, No. 1562, p. 451, cols. 1, 2, 3 — 42 cm.)

Notice of the above-named volume by Prof. J. H. Comstock and Anna Botsford Comstock, 8 vo., 701 pp., 6 plates, and 797 figures: refers to its new system of classification in Lepidoptera, its tables for the determination of families in all orders, the numerous figures for the identification of species, the large number of orders (19) designated, the syllabication and accentuation of the scientific names, etc.

The San José Scale, Aspidiotus perniciosus, and Some Other Destructive Scale Insects of the State of New York. (Bulletin of the New York State Museum, Vol. 3, No. 13, April, 1895. Published June 11, 1895, 44 pp., 7 plates.)

As introductory, what scale insects are, is told. The destructive New York scale insects noticed are: Apple-tree Bark-louse; Scurfy Bark-louse; Pine-leaf Scale-insect; White Scale; Maple-tree Scale-insect; and Plum-tree Scale-insect. Of the San José Scale is given: Introduction and Spread; Occurrence in the Eastern United States; Investigations by the U. S. Department of Agriculture; The San José Scale in New York; The San José Scale on Long Island; The San José Scale in New Jersey; The Two Infested New Jersey Nurseries; The San José Scale in Ohio; Description of the Scale; Description of the Insect; Its Life-history; Its Food Plants; Spread of the Insect; Protection from Infested Stock; Proposed Legislation; Remedies; Bibliography; Plates and their Explanations.

[Published in pages 200–233 of this Report (xi).]

The Asparagus Beetle Goes North. (Country Gentleman, for June 13, 1895, lx, p. 455, cols. 1, 2 — 47 cm.)

This insect is detected for the first time as abundant and destructive to asparagus in Magnolia, Mass. The localities where it had previously appeared are named, as tending to indicate that the northward distribution will be confined to the "Upper Austral life-zone." Mag-

nolia and other northern localities named have not hitherto been embraced within the zone as mapped, but they in all probability should be. This zone limitation, if it be established, will allay the fear of several of the more injurious insect pests becoming destructive over a large portion of the State of New York. Its limitation of the San José scale spread is stated, and it may finally control the Gypsy Moth. The air-slacked lime remedy for the beetle is given.

[See pages 177–181 of this Report (xi).]

The Pear Midge. (Country Gentleman, for June 13, 1895, lx, p. 456, cols. 2, 3 — 16 cm.)

Pears infested with the larvæ of *Diplosis pyrivora* are received from Millbrook, N. Y., where the attack is said to be new. The nature of the attack, and the history of the pest in this country, are given. No method is known for preventing the infestation of the fruit. The remedies are, destroying the infested fruit, or killing the insect after it has entered the ground, as given in detail in the 8th Report on the Insects of New York.

Pear Midge Again. (Country Gentleman, for June 20, 1895, lx, p. 472, cols. 1, 2 — 10 cm.)

An attack on young pears from Poughkeepsie, N. Y., is recognized as that of the pear-midge. The larvæ at this time have left the fruit and entered the ground. The remedies for this insect and other particulars are given on page 456 of this volume of the *Country Gentleman*.

A New Maple-Tree Insect. (Country Gentleman, for June 27, 1895, lx, pp. 484-5, cols. 4, 1 — 21 cm.)

The stems of maple leaves sent from Concordville, Pa., are found to be burrowed by the larva of a Tortricid moth, named *Steganoptycha Claypoliana*. The history of the species, its life-history in brief, and a preventive of the attack, are given. It does not promise to prove a serious pest, as it does not spread rapidly.

Plum Tree Scale. (Country Gentleman, for June 27, 1895, lx, p. 485, c. 1 — 11 cm.)

A scale on six-year old plum trees in East Hartford, N. Y., is what is now regarded (with some doubt) as *Lecanium juglandifex* Fitch. It was first noticed, in Western New York, last year. The remedies are, scraping off the scales on sheets early in the year, and spraying with an insecticide at the hatching of the eggs in June.

The Elm-Leaf Beetle. (Albany Evening Journal, for July 20, 1895, p. 3, c. 1 — 23 cm.)

The insect has invaded Albany in force. Large numbers of the pupæ were found, July 15th, at the base of elms on Hawk street, with larvæ ready for pupation, and beetles already emerged. Features for recog-

nizing each are given. As the proper remedy — thorough arsenical spraying will not be generally resorted to, it is urged that every effort be made to destroy the pupæ, which transform upon the pavement and in crevices where they are easily reached, by kerosene, hot water or strong soapsuds. Importance of fighting this insect, which is far more destructive to elms than the *Orgyia leucostigma*.

Elm-Leaf Beetle. (Country Gentleman, for August 1, 1895, lx, p. 568, c. 1 — 10 cm.)

"Small worms about half an inch long that in a short time eat all the leaves of an elm shade tree" in Oceanport, N. J., are those of the elm-leaf beetle, *Galerucella xanthomelæna* [*luteola*]. The best remedy for them is spraying the foliage with 1 lb. of Paris green to 200 gallons of water at the time that the eggs are hatching in early spring. If the tree is large, a hose 50 to 100 feet long should be carried into the tree and the spray thoroughly distributed therefrom. When the larvæ descend the trunk about the middle of July and change to small yellow pupæ, they should be killed with hot-water, kerosene, strong soapsuds or tobacco water.

Horn-Tail Borer. (Country Gentleman, for August 1, 1895, lx, p. 568, cols. 1, 2 — 12 cm.)

An example of the insect is sent from Fort Wayne, Ind., for name and remedy. *Tremex columba* is not regarded as particularly injurious, for although its larva runs broad burrows in the trunks of trees, it usually selects for oviposition such as are already diseased. Fortunately it has effective parasites in the two species of "long stings" — *Thalessa atrata* and *Th. lunator* which are drawn to the infested trees, and by the aid of their long ovipositor insert their eggs deeply therein. The larvæ burrow in search of the Tremex, to which when found, they attach themselves and eventually consume it. The "long stings" usually control Tremex attack.

Orchard Insects. (Country Gentleman, for August 1, 1895, lx, p. 568, c. 2 — 15 cm.)

A remedy is asked, from Augusta, Ga., for "plum and peach trees of which the fruit is full of worms." From an inquiry so general the attacking insects cannot be named, and consequently no remedy can be suggested. The fruit of each harbors the larvæ of the plum curculio and the codling moth, and the peach, that of *Xylina cinerea*.

The Black Peach Aphis. (Country Gentleman, for August 8, 1895, lx, p. 583, c. 2 — 17 cm.)

This aphis, the *Aphis persicae-niger*, is reported as occurring on the roots of trees in an orchard, attacking tree after tree in the rows. In a Maryland nursery one hundred thousand trees were killed in three weeks' time. Its life-history is briefly given and how its increase may be prevented.

The Sugar Maple Borer. (Country Gentleman, for August 8, 1895, lx, p. 583, c. 2 — 14 cm.)

Insects injuring sugar maples and a linden tree are probably the maple-tree borer, *Glycobiusus* [*Plagionotus*] *speciosus*, and ants in the latter. A preventive of attack by the former is a coating of soapsuds and carbolic acid to protect from the egg deposit; the remedy is cutting out as stated. The ants in a cavity of the linden may be killed by injecting gasoline.

New Scale Insect. (Country Gentleman, for August 8, 1895, lx, p. 585, c. 2 — 4 cm.)

The scale from Loudenville, N. Y., noticed on page 425 of this volume of the C.-G., as probably an undetermined species of *Eriococcus*, proves, on reception of mature forms of the same on the Camperdown elm sent from the same locality, to be *Gossyparia ulmi*, which has the present year occurred in several places in Albany.

The Harlequin Cabbage Bug. (Country Gentleman, for August 15, 1895, lx, p. 599, c. 2 — 17 cm.)

An insect reported from Forestville, Md., as having nearly ruined a crop of nearly fifteen thousand cabbages, is identified as *Murgantia histrionica*. It is steadily extending northward, and has appeared in New Jersey [and on Long Island, N. Y.]. Of the remedies named the best is believed to be — drawing the first brood in the spring to rows of mustard and killing them there with kerosene.

The Carpet Beetle. (Country Gentleman, for August 15, 1895, lx, p. 599, c. 3 — 32 cm.)

The impropriety of calling this beetle (*Anthrenus scrophulariæ*) the "Buffalo moth," as in the inquiry of it made from Plymouth, Conn.; how to destroy the insect and guard against reinfestation; the food of the beetle; how it may enter or be brought into houses. There is no reason why it should be confounded with the two-spotted lady-bug, as in this inquiry. It is possible to free a house from the pest.

A Pugnacious Caterpillar. (Gardening, for August 15, 1895, iii, p. 364, c. 3 — 10 cm.)

A large caterpillar, which was "pugnacious" when taken from its voracious feeding upon a fuchsia, is that of the humming-bird moth, *Thyreus Abbotii*. Its principal features are given and its peculiar threatening movements when handled or disturbed which serve as a means of protection from its enemies.

An Insect Attack on Maples. (Gardening, for August 15, 1895, iii, p. 364, c. 3 — 3 cm.)

An attack reported from Wisconsin, observed for two years past, causing the center-shoots of cut-leaved maples to fall over and wither,

can not be referred to any insect known to operate in this manner on this variety of maple. If the infested or injured tips can be submitted for examination, probably the insect can be ascertained.

An Insect Gall. (Gardening, for August 15, 1895, iii, p. 366, c. 1 — 8 cm.)

A "tiny green burr" taken from a sweet-brier in Georgetown, Ky., is a gall made by one of the gall-flies of the genus *Rhodites*. It is not of frequent occurrence and no remedy is needed for it. If found abundant, they should be destroyed before the insect has emerged.

Another Note of Warning [against the Elm-leaf Beetle]. (Albany Evening Journal, for August 20, 1895, p. 8, c. 5 — 39 cm.)

A second brood of the insect is discovered in Albany and is now undergoing its last transformations. It is more abundant and destructive than the first: its numbers and ravages are stated. Killing the larvæ and pupæ at the present time is important, if the elms of the city are to be saved from destruction. *Ulmus Americana* has not been attacked, nor has the insect invaded the city parks.

Caterpillars and Borers. (Country Gentleman, for August 29, 1895, lx, p. 632, c. 2 — 8 cm.)

Inquiry from Springer, N. M., for protection from orchard caterpillars and borers, is answered by recommending the cutting off and burning the nests with assembled larvæ of the fall tent-caterpillar — destroying the egg-belts and the new nests of the orchard tent-caterpillar — and application of carbolic acid soap-wash to prevent egg deposit by the borers.

Black Blister Beetle. (Country Gentleman, for August 29, 1895, lx, p. 632, c. 3 — 7 cm.)

A beetle destroying the petals of china asters in South Montrose, Pa., is the black blister-beetle, *Epicauta Pennsylvanica* (DeGeer). They can either be controlled by frequent handpicking or by shaking them two or three times a day into vessels of water and kerosene. They also quickly yield to pyrethrum or insect powder.

A Scale Insect on Osage Orange Hedge. (Gardening, for September 15, 1895, iv, p. 11, c. 3 — 15 cm.)

This scale was originally described as *Pulvinaria macluræ*, but is now referred by most writers to *P. innumerabilis*. When the cottony mass secreted by the female contains the eggs, they may be crushed by going over the infested plants with a thick, soft mitten. Later, the young scales may be killed by kerosene emulsion spraying, or in winter, with a strong wash of whale-oil soap.

To Kill Red Ants in the House. (Gardening, for September 15, 1895, iv, p. 12, c. 1 — 15 cm.)

The insect can not be routed from the house in Rochester, even in winter, through use of corrosive sublimate or any other method tried.

If they can be traced to their nests in the ground they can be destroyed by bisulphide of carbon, but if located within the walls, they may be baited with some poisonous substance, or attracted to a sugared sponge to be dropped in hot water when the ants gather on it. How chalk lines may be used as barriers against them.

[Extended in pages 109–114 of this Report (xi).]

A Friend, not a Foe. (Country Gentleman, for September 19, 1895, lx, p. 685, c. 1 — 8 cm.)

A supposed hop vine pest, from Port Kent, N. Y., is the larva of a lady-bug, *Hippodamia convergens*. It is one of the best friends of the hop-growers. Importance of knowing our insect friends, so as to protect them as far as possible. Lady-bugs may be so abundant in hop-yards as to render spraying for the aphis unnecessary.

A Humbug Insect Cure. (Country Gentleman, for September 19, 1895, lx, p. 687, c. 1 — 18 cm.)

Reply to an experience related with the Elm Inoculation Company, for protecting trees from the elm-leaf beetle.

The absurdity of the method employed by the company is commented upon. The uselessness of the "remedy" is shown. Reference is made to former exposures, and to the statements regarding the inefficiency of the material used by the company, made at the recent meeting of the American Association of Economic Entomologists at Springfield, Mass.

The Squash Bug. (Country Gentleman, for September 19, 1895, lx, p. 687, cols. 2, 3 — 24 cm.)

In reply to inquiries from Athens, Pa., relating to the injuries of *Anasa tristis*, the two best remedies, viz., trapping the hibernated bugs and destroying the eggs, are named, and directions for the same given; also, its egg-laying habit and period of oviposition. The seriousness of the injury to the plant is explained as due to the poison injected through the proboscis of the insect.

Squash Bugs — Squash-vine Borers. (Country Gentleman, for October 3, 1895, lx, p. 719, cols. 1, 2, 3 — 31 cm.)

Gives the comparative injury to crops from the two insects; the general distribution of the eggs of the squash-vine moth over the plant, and the large number of larvæ that may occur on a single plant; the greater desirability of preventing attack than applying a remedy; the importance of collecting and killing the moths before egg-laying.

Frail Children of the Air: Excursions into the World of Butterflies: by S. H. Scudder. (The Nation, for October 17, 1895, No. 1581, pp. 280–281, cols. 3, 1 — 10 cm.)

The thirty or more chapters of this volume are drawn from the series of "Excurses" contained in the costly volume of "Butterflies of

the Eastern United States." As reproduced, they will be enjoyed by many to whom they were previously inaccessible. They can not fail of proving delightful popular reading, as may appear from the titles of some of the chapters cited — "Butterflies as Botanists" (four others given).

The Natural History of Aquatic Insects: by Prof. L. C. Mial, F. R. S. (The Nation, for October 31, 1895, No. 1583, pp. 317–318, cols. 3, 1 — 23 cm.)

In a brief notice of this volume it is commended as a contribution of more than ordinary value to the knowledge of life-histories and habits of aquatic insects. While purporting to draw much from writings of Réaumur and other "old zoölogists," several of the studies are new, as that, for example, of *Simulium*, in which the strange manner of the escape of the imago from the water is given. That nearly all the orders of insects are represented in aquatic forms will be a surprise to many. The author maintains that all insects were originally terrestrial and that they have gradually invaded both fresh and salt waters, and cites the Tipulidæ larvæ as showing successive stages of this progress.

The Box Elder Plant Bug. (Country Gentleman for October 31, 1895, lx, p. 786, cols. 1, 2 — 11 cm.)

Insects sent from McGregor, Io., as annoying from their abundance, are the above-named plant-bug, *Leptocoris trivittatus* (Say). Its habits, history, etc., have been given in the *Country Gentleman* for September 27, 1894, and in the *Fourth Report of the State Entomologist*, 1888. The insect has not been reported from east of the Mississippi river, but its occurrence on the west shore of that river would indicate that it may have already extended into Wisconsin and Indiana.

(C)

CONTRIBUTIONS TO THE DEPARTMENT IN 1894.

Miscellaneous Insects.

Bombus Pennsylvanicus DeGeer.
Megachile sp.
Xylocopa Virginica (Drury) 2.
Chalybion cæruleum (Linn.).
Pelopœus cæmentarius (Drury) 4.
Clisiocampa disstria (Hübner).
Hadena sp.
Gortyna cataphracta Grote.
Eutrapela transversata (Drury).
Eurycreon chortalis Grote.
Pseudaglossa lubricalis (Geyer).
Endropia bilinearia (Pack.).
Syrphus arcuatus (Fallen).
Eristalis tenax (Linn.).
Dytiscus fasciventris Say.
Photurus Pennsylvanica (DeGeer).
Lucanus dama Thung.
Osmoderma scabra (Beauv.) 3.
Elaphidion incertum Newm. 2.
Epicauta Pennsylvanica (DeGeer).
Lema trilineata (Oliv.).
Pœcilocapsus goniphorus Say 2.
Pœcilocapsus lineatus (Fabr.).
Cicada septendecim Linn., pupa.
Phylloptera oblongifolia Burm.
Œcanthus fasciatus (DeGeer).
Œcanthus niveus (DeGeer).
Cyrtophyllus concavus (Harris).
Melanoplus femur–rubrum (DeG.).
Æschna constricta Say.
From Mrs. E. B. Smith, Coeymans, N. Y.

Hymenoptera.

Polistes pallipes (Say). 7 examples. From Mrs. E. C. Anthony, Gouverneur, N. Y.

Thalessa atrata (Fabr.). From John D. Collins, Utica, N. Y.

The currant-stem girdler, *Phyllœcus flaviventris* (Fitch), 2 examples, in currant canes, the imago, May 11th. From Thomas Tupper, Corning, N. Y.

Larva of *Cimbex Americana* Leach, from a maple. From L. Bower, Camden, N. J.

Larvæ of *Lophyrus Lecontii* Fitch, feeding on *Pinus strobus*, October 16th. From Selwyn E. Russell, M. D., Poughkeepsie, N. Y.

Lepidoptera.

Grapta Progne (Cramer) and *Grapta comma* (Harris). Dr. C. E. Webster, Binghamton, N. Y.

Eggs of *Orgyia vetusta* Boisd. and *O. antiqua* (Linn.) of Europe. From H. G. Dyar, New York.

Larva of the hag-moth, *Phobetron pithecium* (Sm.-Abb.) from pear, August 29th. From N. J. Van Hoesen, Gayhead, N. Y.

Cocoons and larvæ of *Thyridopteryx ephemeræformis* (Haworth) from quince trees, July 25th. From James Shealy, New Oxford, Pa.

Young larvæ of *Datana ministra* (Drury), July 15th. From Dwight Stone, Lansing, N. Y. Eggs and larvæ of the same, July 18th, from G. T. Lyman, Bellport, N. Y.

Cocoon of *Telea Polyphemus* (Cramer). From A. H. Stratton, Arlington, N. J.

Larvæ of *Steganoptycha Claypoliana* Riley, burrowing in leaf-stalks of maple, *Acer saccharinum*, May 27th. From William Trimble, Concordville, Pa.

Diptera.

Pears containing larvæ of the pear midge, *Diplosis pyrivora* Riley, May 28th. From George F. Dobreche, Mountainville, N. Y. The same, from Samuel Thorn, Millbrook, N. Y., June 6th. The same, from Henry L. Young, Poughkeepsie, N. Y., June 11th.

Tabanus atrata Fabr. From George R. Howell, State Library, Albany.

Examples of the raspberry-stem maggot, *Anthomyia* sp., in tips of raspberries, June 7th. From D. F. Harris, Adams, N. Y.

Larvæ of *Drosophila ampelophila* Loew, in grapes, September 16th. From Prof. C. H. Peck, Menands, N. Y.

Coleoptera.

Cicindela vulgaris Say. From Dr. C. E. Fairman, Lyndonville, N. Y.

Silpha Americana Linn., flew into a drug store, May 3d. From S. C. Bradt, Albany, N. Y. The same, from a stink-horn fungus, *Mutinus Ravenalii* Fisch., at Selkirk, August 16th, from Hon. W. L. Learned, Albany, N. Y.

Stelidota geminata (Say), feeding on injured grapes, September 16th. From Prof. C. H. Peck, Menands, N. Y.

Limonius agonus (Say) from grapevines, May 9th. From Ellwanger & Barry, Rochester, N. Y.

Chalcophora liberta (Germ.), May 13th. From S. C. Bradt, Albany, N. Y.

The red-necked Agrilus, *Agrilus ruficollis* (Fabr.), May 7th. From Esby Winne, Delmar, N. Y.

Burrows of *Agrilus sinuatus* Olivier, in young pear trees. From Dr. JOHN B. SMITH, Rutgers College, New Brunswick, N. J.

Examples of *Dinoderus bifoveolatus* Woll., feeding in bamboo, February 4th. From N. POMROY, Lockport, N. Y.

Lachnosterna sp., eating the leaves of strawberry plants, June 13th. From AUGUSTUS FLOYD, New York City.

Larvæ of *Lachnosterna* sp., destructive to lawns, August 8th. From Prof. D. P. PENHALLOW, McGill University, Montreal, Canada.

Pelidnota punctata (Linn.) from grapevines, August 5th. From MARIA N. GREENE, Adams, N. Y.

Larvæ of *Allorhina nitida* (Linn.), September 28th. From WILLIAM FALCONER, Glen Cove, N. Y.

Plagionotus speciosus (Say), 2 examples. From MARY J. LEIGH, Argyle, N. Y.

Numerous examples of the asparagus beetle, *Crioceris asparagi* (Linn.), and its eggs — abundant at Magnolia, June 31st. From T. JEFFERSON COOLIDGE, Magnolia, Mass.

Larvæ of the three-lined leaf-beetle, *Lema trilineata* (Oliv.), on potato leaves. From JEROME HOLMES, South Hamilton, N. Y.

The elm-leaf beetle, *Galerucella luteola* Müll., taken within doors May 11th, and mistaken for the carpet beetle. From G. L. COOPER, Meriden, Conn. The same, April 18th: From W. R. STRONG, Golden Bridge, Westchester Co., N. Y.

Galerucella cavicollis Leconte, injuries to foliage of cherry trees, June 10th. From Mrs. H. D. GRAVES, Ausable Forks, N. Y.

The grapevine flea-beetle, *Graptodera chalybea* (Ill.). From G. E. BROWN, Mountainville, N. Y., May 9th. The same from J. F. KARRAKER, Dongala, Ill.

The bean weevil, *Bruchus obtectus* Say. From O. Q. FLINT, Athens, N. Y.

The oil-beetle, *Meloe angusticollis* Say. From Mrs. EMILIA C. ANTHONY, Gouverneur, N. Y.

Examples (6) of *Macrobasis unicolor* (Kirby), July 12th. From GEORGE T. POWELL, Ghent, N. Y.

Epicauta Pennsylvanica (DeGeer) on asters, August 18th. From J. L. BUTTERFIELD, Montrose, Pa. The same, from asters and potatoes, from W. C. PIERCE, Richford, N. Y. The same, from asters, from J. D. LYONS, Monticello, N. Y.

Eggs of *Xyleborus dispar* (Fabr.) within its burrows in pear. From NORMAN POMROY, Lockport, N. Y.

Scolytus rugulosus (Ratz.), infesting an apple tree at Ripley, O. From D. S. Kellicott, Columbus, O.

Hemiptera.

Larvæ and imagoes of the squash-bug, *Anasa tristis* (DeGeer), August 20th. From L. Morse, Athens, Pa.

The Harlequin cabbage-bug. *Murgantia histrionica* (Hahn.), from Olympus, Texas. From P. C. Lewis, Catskill, N. Y. The same, from J. N. Young, Forestville, Md.

Examples (188) of the box-elder bug, *Leptocoris trivittatus* (Say) occurring in Topeka, Kans. From S. C. Bradt, Albany, N. Y.

Benacus griseus (Say). From Prof. W. M. Chester, Hamilton, N. Y.

The hickory stem gall-louse, *Phylloxera caryæcaulis* (Fitch) crowding numerous galls in stems of hickory, June 3d. From Theo. A. Cole, Catskill, N. Y.

Larvæ of *Gossyparia ulmi* Geoff., on elm, May 28th. From Dr. E. Moore, Loudonville, Albany Co., N. Y.

Mature scale of *Gossyparia ulmi*, on elm, June 10th. The same, from H. D. Cunningham, 1 Sprague place, Albany, N. Y. The same, June 13th, from W. F. Aspinwall, Loudonville, N. Y. The same, June 27th, from W. R. Faulker, Catskill, N. Y.

The maple-leaf louse, *Pseudococcus aceris* (Geoff.), August 27th. From Dr. Selwyn A. Russell, Poughkeepsie, N. Y.

The barnacle scale, *Ceroplastes cirripediformis* Comst., abounding on the China-tree, *Melia Azedarach*, March 11th. From H. A. Morgan, Baton Rouge, La.

Lecanium hesperidum (Linn.) on a fern from California — *Nephlodepsis*. From W. C. Coleman, Albany, N.Y.

The white scale, *Aspidiotus nerii* Bouché, on Cyperus. From Miss Betteridge, Albany, N. Y.

Aspidiotus ancylus Putnam, on red currant, at St. Louis, Mo. From William Falconer, Glen Cove, N. Y.

The San José scale, *Aspidiotus perniciosus* Comstock, on the following food-plants: Spiræa, Japan quince, *Cratægus*, cherry, and peach. Also *A. ancylus*, on olive. From F. A. Sirrine, Jamaica, L. I.

Aspidiotus perniciosus on apple, from Abel Dauce, New York city. The same, from L. L. Morrell, on apple, November 9th, Kinderhook, N. Y.

The apple tree scale, *Mytilaspis pomorum* (Bouché), on lilac, *Syringa vulgaris*. From A. H. Straiton, Arlington, N. J. The same, from

Dr. E. Moore, Loudonville, N. Y. The same, from C. F. Goodman, Fort Ann, N. Y.

The Euonymus scale, *Chionaspis euonymi* Comstock. From A. H. Stratton, Arlington, N. J.

The scurfy bark-louse, *Chionaspis furfurus* (Fitch), on apple twig. From R. D. Van Buren, Stockport, N. Y. The same, on pear, from Mr. Van Slyke, New Baltimore, N. Y.

Orthoptera.

Eggs of the white flower cricket, *Œcanthus niveus* (DeGeer), in grape-vine. From Joseph Strong, Urbana, N. Y.

The oblong-winged katydid, *Amblycorypha oblongifolia* (DeGeer), September 7th. From George H. Ellwanger, Rochester, N. Y.

Eggs of *Microcentrum retinervis* (Burm.), on *Cydonia Japonica*. From A. H. Stratton, Arlington, N. J.

Neuroptera.

The Hellgrammite fly, *Corydalis cornuta* (Linn.), July 9th. From R. F. Gale, Karner, N. Y.

Pseudoneuroptera.

Examples of the small snow-fly, *Capnia pygmæa* (Burm.), occurring abundantly on the snow and on windows, March 6th, at Canaan, N. Y. From Mrs. H. H. Ballard, Pittsfield, Mass.

Examples of *Ischnura verticalis* (Say) taken at Annandale, N. Y., June 19th. From Mrs. C. W. Throop, Albany, N. Y.

Epitheca princeps Hagen, taken within doors, July 5th. From Mrs. Abram Lansing, Albany, N. Y.

Arachnida.

Eggs of *Bryobia pratensis* Garman, on peach twigs. From M. J. Conallen, Tarrytown, N. Y.

Uropoda Americana Riley infesting the Colorado potato beetle. From T. Jefferson Coolidge, Magnolia, Mass.

Crustacea.

Gammarus fasciatus Say, from the water supply of Albany. From F. H. Wentworth, Albany, N. Y.

(D)

CLASSIFIED LIST OF INSECTS, ETC., NOTICED IN THIS REPORT.

Hymenoptera.

Pimpla conquisitor (*Say*).
Sigalphus tibialis (*Hald.*).
Microdus laticinctus *Cresson.*
Chalcis fulvipes [flavipes] *Fabr.*
Chalcid parasites of Cecidomyia betulæ.
Camponotus herculaneus (*Linn.*), the large black ant.
Formica rufa *Linn.*, the fallow ant.
Monomorium Pharaonis (*Linn.*), the little red ant.
Honey bees.

Lepidoptera.

Orgyia leucostigma (*Sm.-Abb.*), the white-marked tussock-moth.
Eudioptis nitidalis (*Cramer*), the pickle caterpillar.
Eudioptis hyalinata (*Linn.*), the melon caterpillar.
Pyrausta futilalis *Lederer*, a dogbane caterpillar.
Mecyna reversalis *Guenée.*, the genista caterpillar.
Pyralis costalis (*Fabr.*), the clover-hay caterpillar: gold-fringe moth.
Grapholitha interstinctana (*Clemens*), the clover-seed caterpillar.
Antispila nyssæfoliella *Clemens*, the sour gum case-cutter.
Tischeria malifoliella *Clemens*, the apple-leaf miner.

Diptera.

Cecidomyia betulæ *Winnertz*, the birch-seed midge.
Diplosis cucumeris *Lintner*, the melon-vine midge.
Diplosis pyrivora *Riley*, the pear midge.
Diplosis setigera *Lintner*, the hairy melon-vine midge.
Anthomyia sp., the raspberry-cane maggot.

Coleoptera.

Anthrenus scrophulariæ (*Linn.*), the carpet beetle.
Pyrophorus noctilucus (*Linn.*), the cucuyo.

Chauliognathus marginatus (*Fabr.*), the margined soldier beetle.
Crioceris asparagi (*Linn.*), the asparagus beetle.
Lina scripta (*Fabr.*), the cottonwood-leaf beetle.
Galerucella luteola *Mull.*, the elm-leaf beetle.
Galerucella cavicollis *Lec.*, a cherry-leaf beetle.

Hemiptera.

Blissus leucopterus (*Say*), the chinch bug.
Pulvinaria innumerabilis (*Rathv.*), the maple-tree scale-insect.
Lecanium juglandis *Bouché*, the plum-tree scale-insect.
Aspidiotus nerii *Bouché*, the white scale.
Aspidiotus perniciosus *Comst.*, the San José scale.
Mytilaspis pomorum (*Bouché*), the apple-tree bark-louse.
Chionaspis furfurus (*Fitch*), the scurfy bark-louse.

Physopoda.

Thrips tabaci *Lindeman*, the onion Thrips.

Neuroptera.

Dendroleon obsoletum (*Say*).
Myrmeleon immaculatus *DeGeer.*
Myrmeleon species.
Ascalaphus species.

Thysanura.

Achorutes diversiceps *Lintner.*
Schoturus nivicola (*Fitch*), the snow flea.

Arachnida.

Gamasus longipalpoides *Felt.*
Tyroglyphus heteromorphus *Felt.*, a carnation mite.

(E)

EXPLANATIONS OF PLATES.

Plate I.

Cecidomyia betulæ.

The Birch-seed Midge.

Fig. 1.— Birch seeds : *a*, showing cavity from which the insect emerged ; *b*, galled seed showing window-like spot; *c*, ditto with two window-like spots ; *d*, normal seed (x 2).

Fig. 2.— Lateral aspect of female midge, greatly enlarged.

Fig. 3.— Tip of male antenna, very greatly enlarged.

Fig. 4.— Ditto of female.

Fig. 5.— Ventral aspect of empodium and claws of tarsus, very greatly enlarged.

Fig. 6.— Lateral aspect of last tarsal segment, very greatly enlarged.

Fig. 7.— Dorsal aspect of male genitalia, very greatly enlarged.

Plate II.

Diplosis cucumeris.

The Melon-vine Midge.

Fig. 1.— Lateral aspect of female, greatly enlarged.

Fig. 2.— Antenna of male; drawn to same scale as the preceding.

Fig. 3.— Two segments of female antenna, very greatly enlarged.

Fig. 4.— A single segment of male antenna drawn to the same scale as the preceding; *a*, *b*, portions of dorsal setæ; *c*, *d*, portions of dorsal arched filaments; *e*, *f*, *g*, arched filaments.

Fig. 5.— Tip of last tarsal segment, very greatly enlarged.

Fig. 6.— Penis very greatly enlarged.

Fig. 7.— Dorsal aspect of terminal abdominal segment of male showing the large claspers crossed and the tip of the intromittent organ, very greatly enlarged.

PLATE III.

Diplosis setigera.

The Hairy Melon-vine Midge.

Fig. 1.— Normal segment of male antenna; *a*, *a*, arched filaments, "filets arques;" *s*, *s*, ordinary setæ.

Fig. 2.— Two normal segments of female antenna showing the arrangement of the setæ and special sense organs, two of which are shown in projection at *y*, *y*.

Fig. 3.— Extruded ovipositor; *c*, tip much more enlarged.

Fig. 4.— Lateral aspect of empodium and claws.

All figures greatly enlarged.

PLATE IV.

Map, showing the Upper Austral Life-Zone in the State of New York.

PLATE V.

Cottonwood beetle collecting machine, to be drawn by a horse.

PLATE VI.

Cottonwood beetle collecting machines, to be propelled by hand.

PLATE VII.

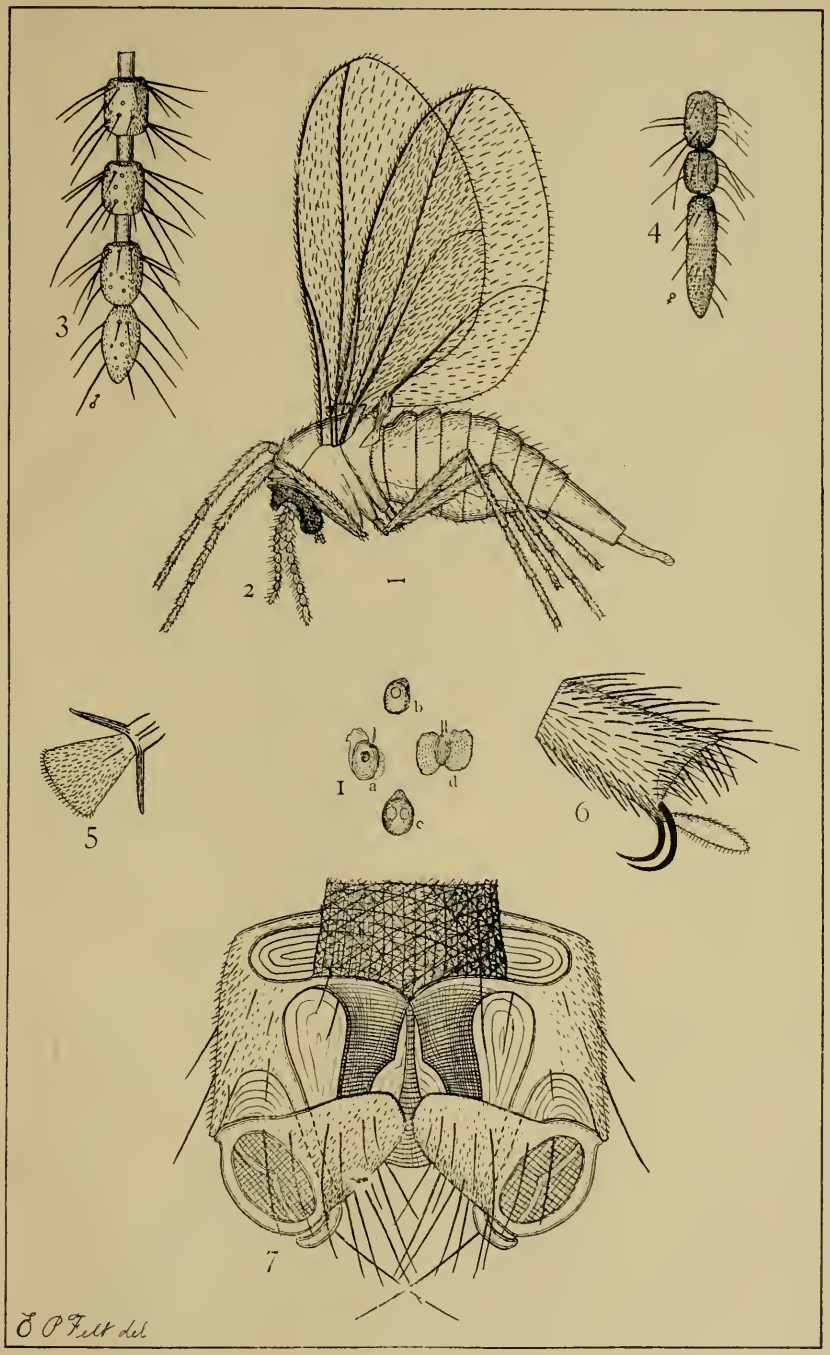
Collecting the cottonwood beetle from a field of willows.

PLATE VIII.

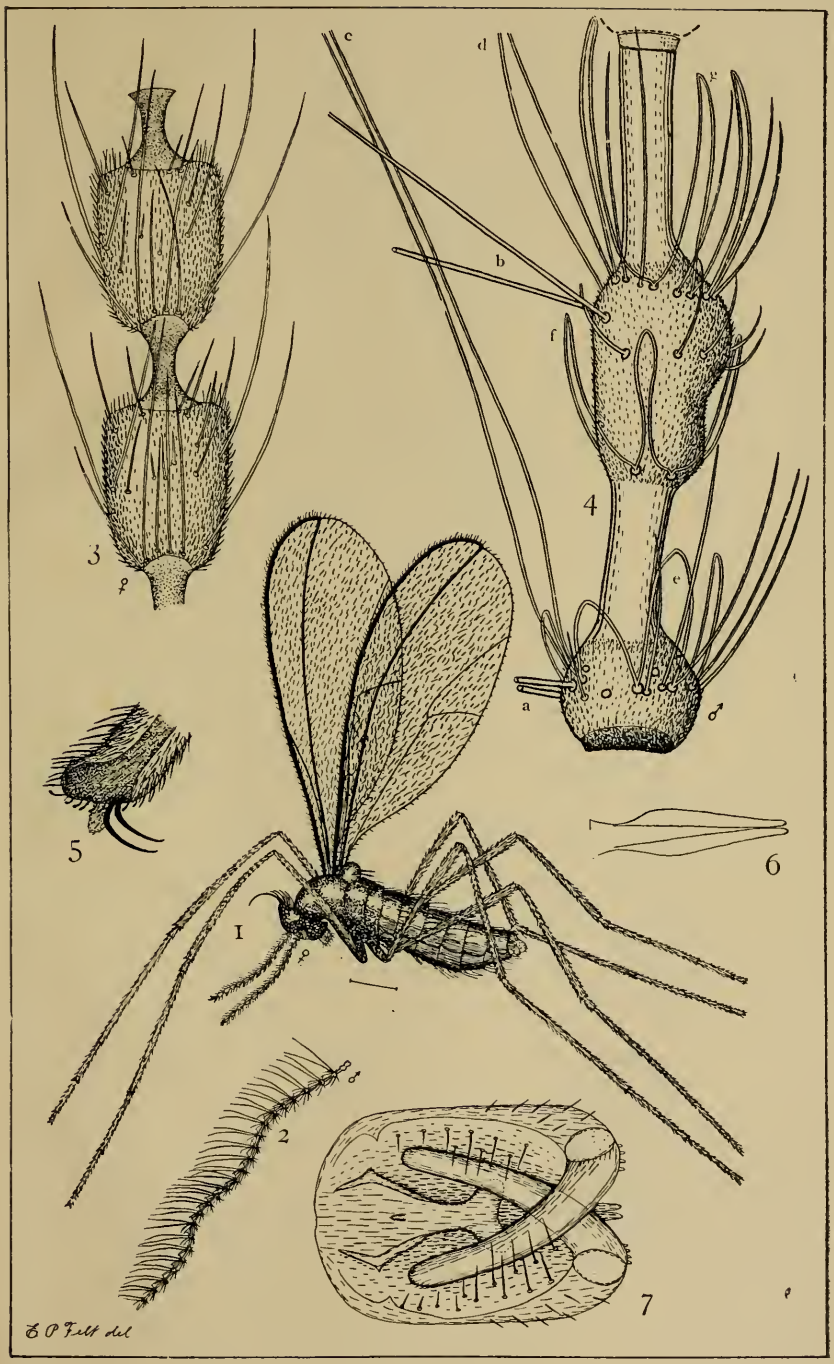
Fig. 1.— The apple-tree bark-louse, *Mytilapsis pomorum* (Bouché), on apple bark. (After Comstock.)

Fig. 2.— The scurfy bark-louse, *Chionaspsis furfurus* (Fitch): *a*, the female scales, and *b*, the male scales, in natural size on twigs; *c*, the female scale, enlarged; *d*, the male scale, enlarged. (From the Division of Entomology, U. S. Dept. Agr. at Washington.)

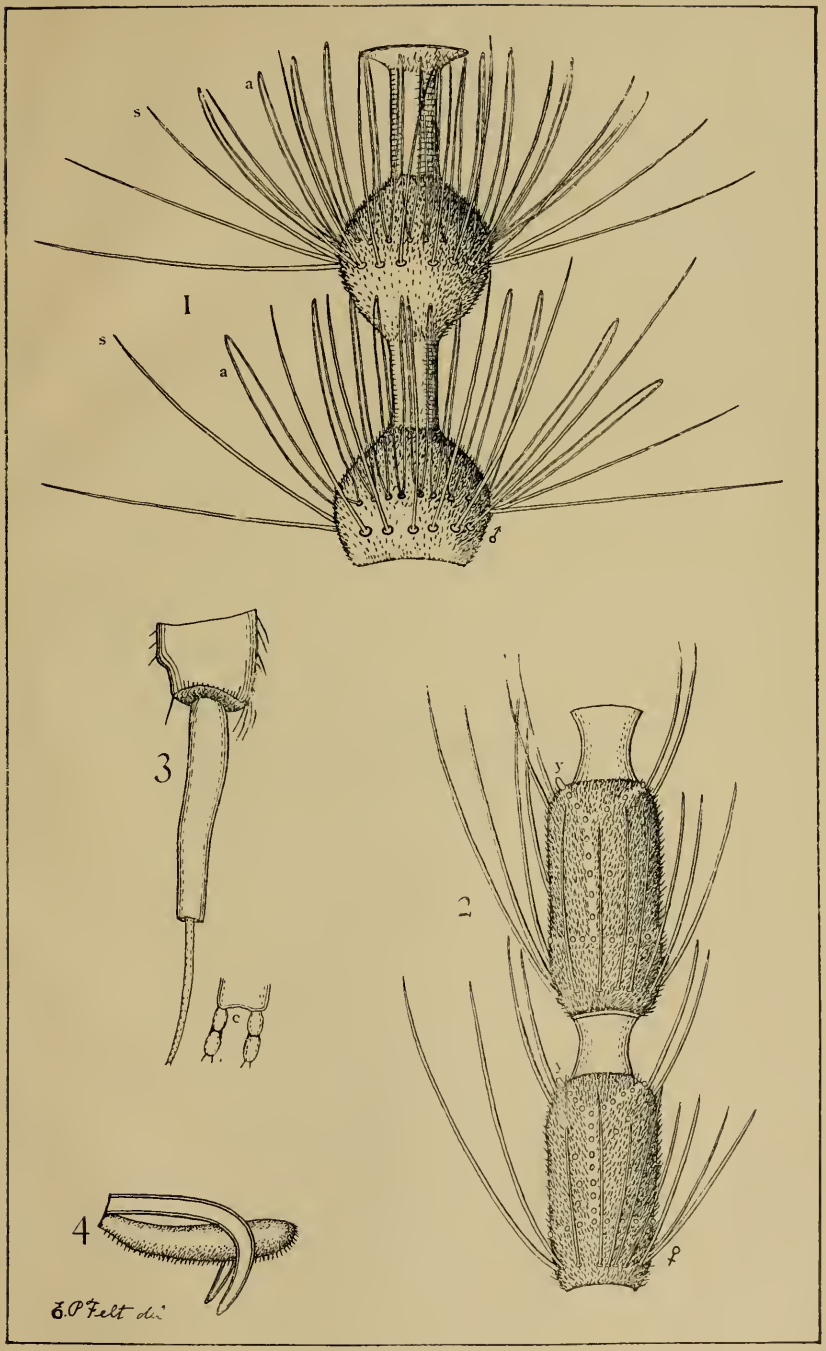
Fig. 3.— The scurfy bark-louse: [*a*], the male; *c*, the young larva; *f*, the male pupa; *g*, the female, from beneath — all enlarged; *b*, *d*, *e*, *h*, structural details of legs and antenna, in greater enlargement. (From the Division of Entomology, Washington, D. C.)



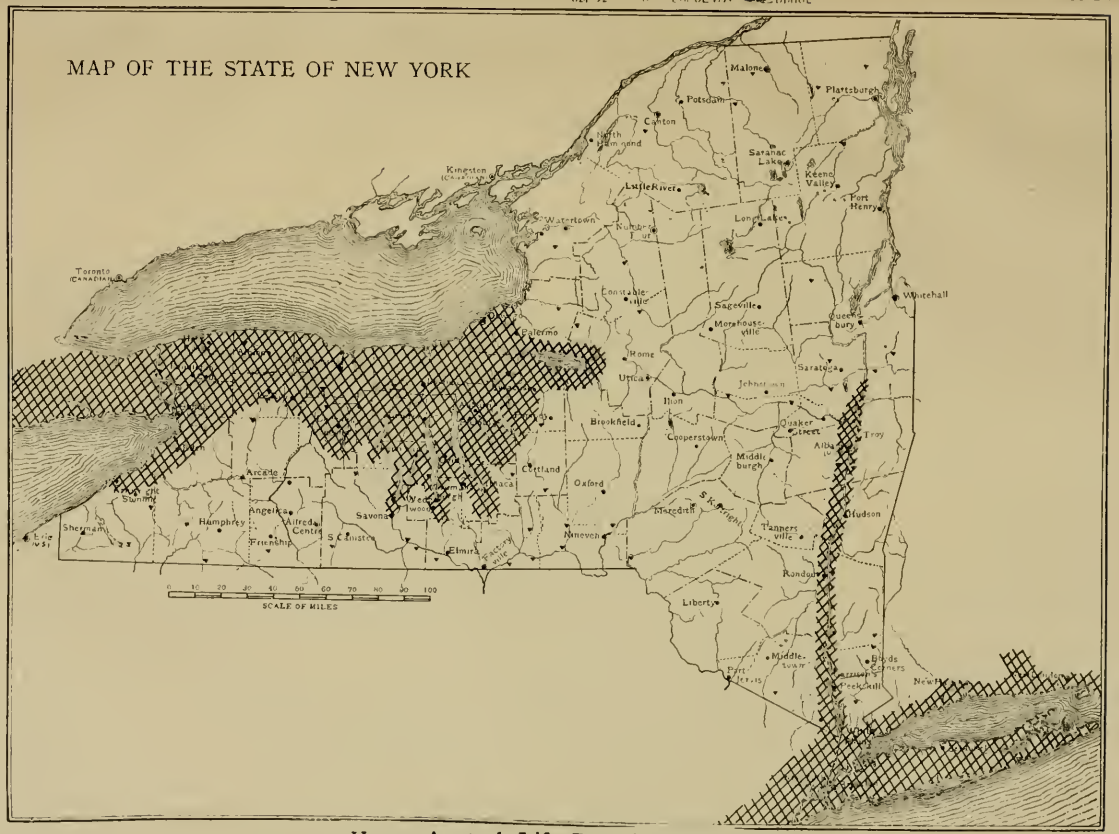
Cecidomyia betulæ.



Diplosis cucumeris.



Diplosis setigera.



Upper Austral Life-Zone in New York.

Cottonwood-beetle Collecting Machine.

Cottonwood-beetle Collecting Machines.

Collecting the Cottoonwod-beetle.

Fig. 1.

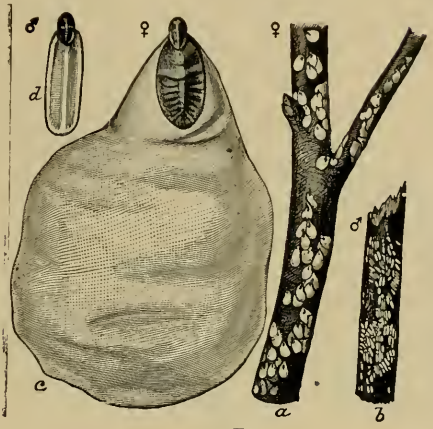


Fig. 2.

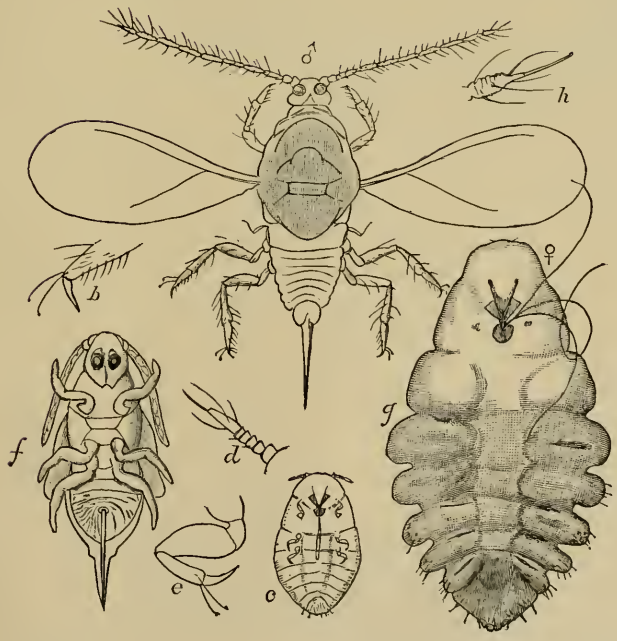


Fig. 3.

Apple Tree Bark Louse — Scurfy Bark Louse.

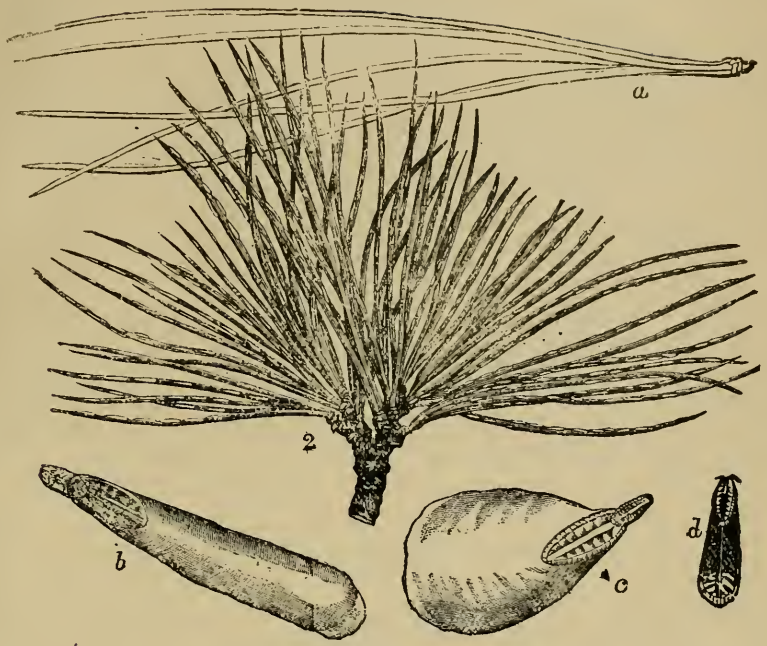


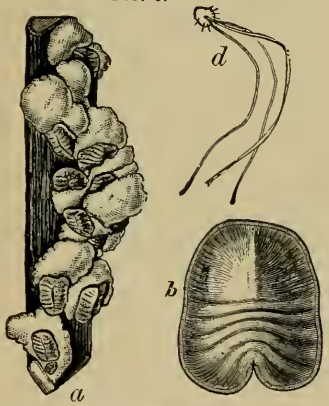
Fig. 1.

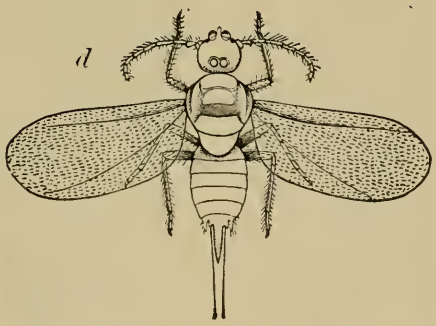
Fig. 2.

Pine Leaf Scale Insect — White Scale Insect.

Fig. 1.

Fig. 2.





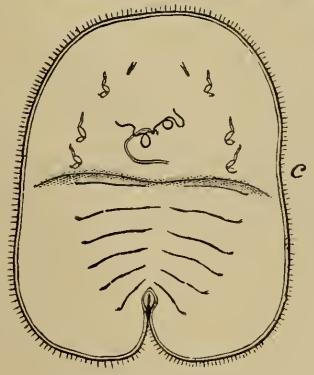


Fig. 3.

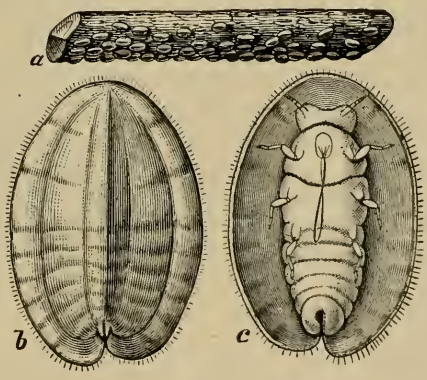
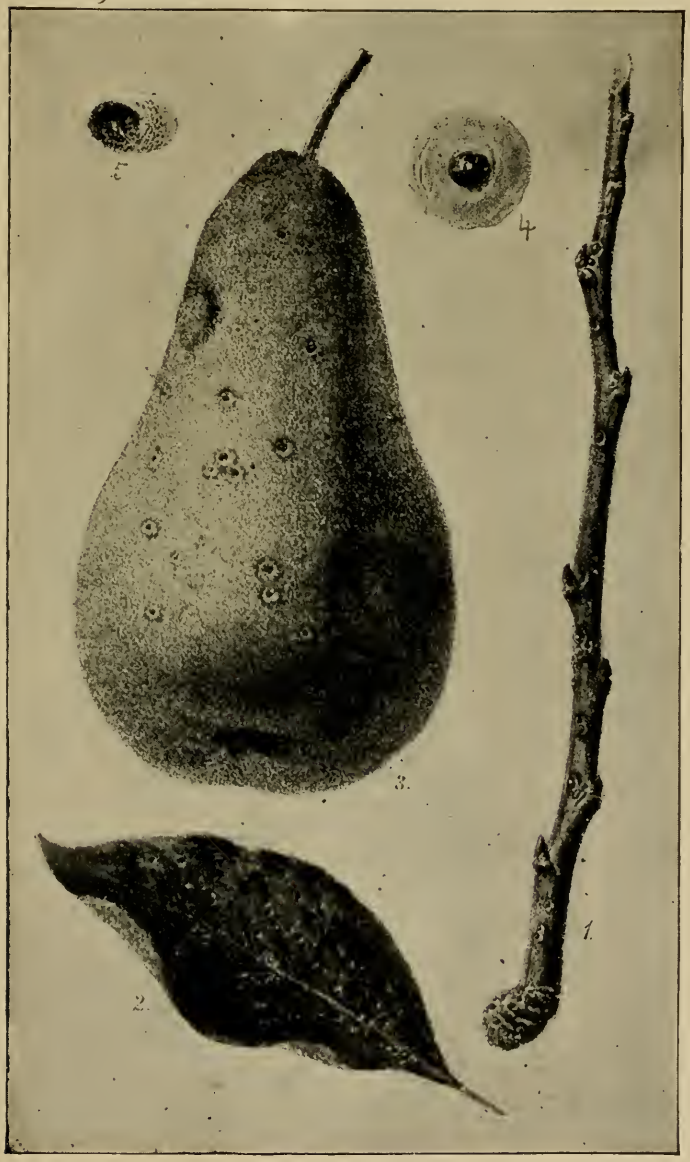


Fig. 4.

Maple Tree Scale Insect.

Plum Tree Scale Insect.



San José Scale.

FIG. 1.

FIG. 2.

San Jose´Scale.

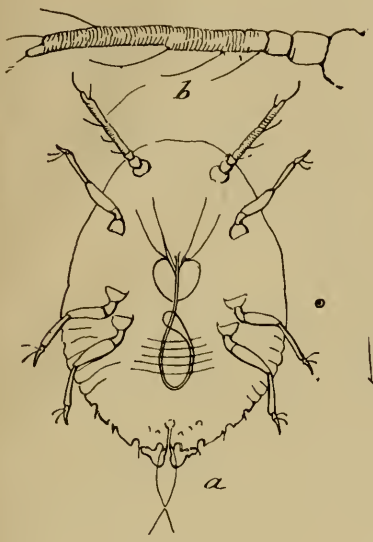


FIG. 1.

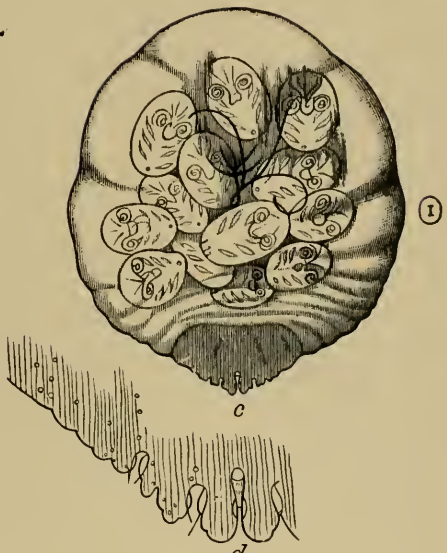


FIG. 2.

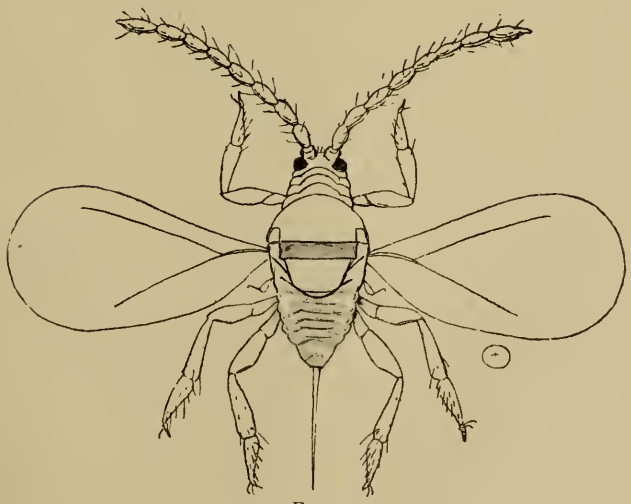
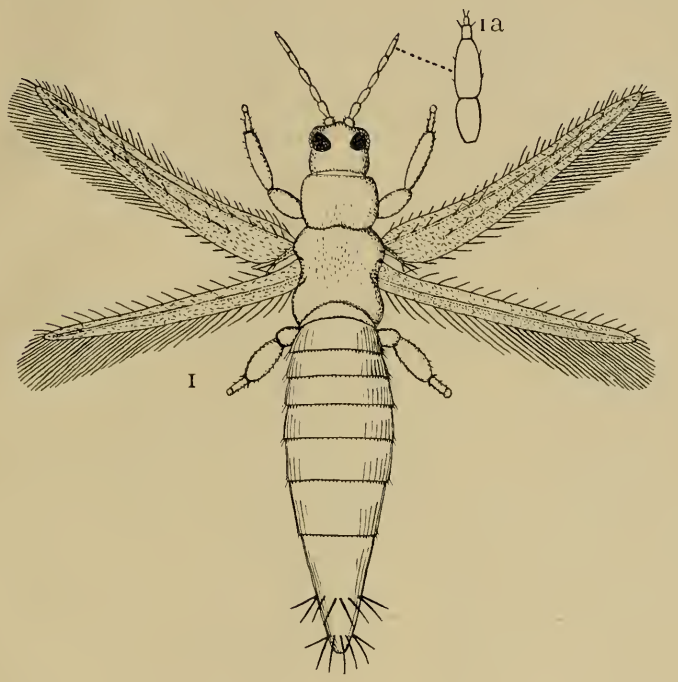
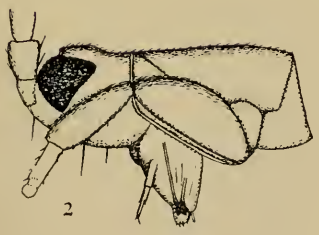
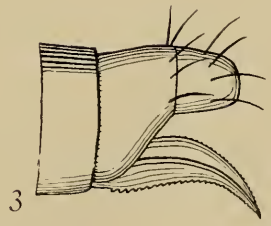


FIG. 3.

San Jose Scale Insect.







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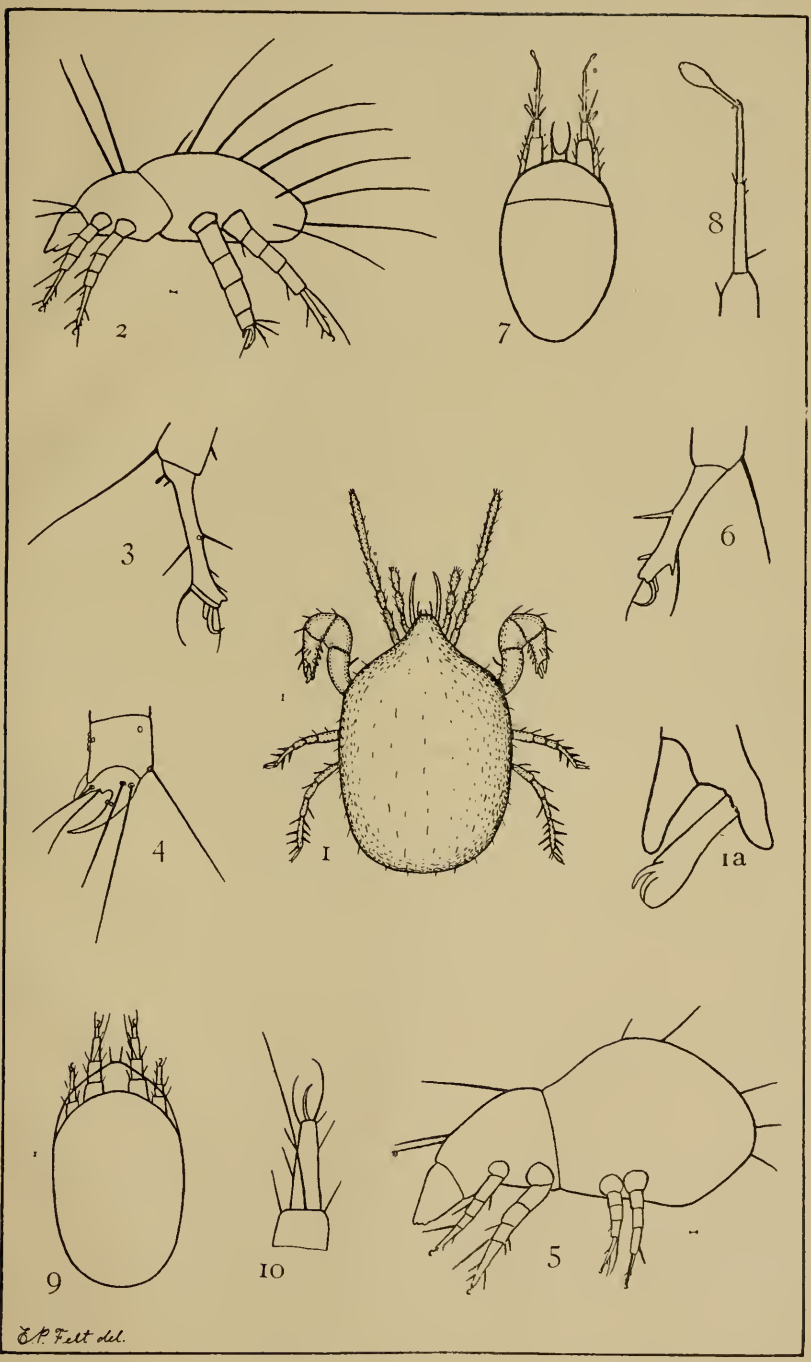
Onion Thrips.



Tyroglyphus and Gamasus.

Plate IX.

Fig. 1.— The pine-leaf scale-insect, *Chionaspis pinifolii* (Fitch): *2*, the scales on the leaves in natural size: *a*, leaves not stunted by the presence of the scales; *b*, scale of female of usual form, enlarged; *c*, wide form of the same, enlarged; *d*, a male scale enlarged. (After Comstock.)

Fig. 2.— The white scale, *Aspidiotus nerii* Bouché, on an Acacia twig, in natural size: *a*, the male insect, enlarged; *b* and *c*, the male and female scales, enlarged. (After Comstock.)

Plate X.

Fig. 1.— The maple-tree scale-insect, *Pulvinaria innumerabilis* (Rathvon), with extruded egg-masses, on grape, natural size. (After Comstock.)

Fig. 2.— The same, on osage orange and on maple. (After Walsh and Riley.)

Fig. 3.— The same: *a*, a twig with mature female scales and egg-masses, natural size; *b*, mature female scale from above, enlarged; *c*, female scale from below, more enlarged; *d*, the thread-like setæ of the proboscis. (From the Seventh Report on the Insects of Illinois.)

Fig. 4.— The same: *a*, a twig with half-grown female scales, in natural size; *b*, autumnal female scale from above, enlarged; *c*, the same from beneath; *d*, the male insect enlarged. (From the Seventh and Thirteenth Illinois Reports.)

Plate XI.

The plum-tree scale-insect, *Lecanium ?juglandis* Bouché in natural size, on plum. (From Garden and Forest.)

Plate XII.

Fig. *1*, the San José scale, *Aspidiotus perniciosus* Comstock, infesting a pear twig; *2*, the scales on a leaf; *3*, scattered scales on a pear; *4*, a female scale, enlarged; *5*, a male scale, enlarged. (From the Cornell University Agr. Exper. Station, and by permission of the California State Board of Horticulture.)

PLATE XIII.

Fig. 1.— The San José scales, in natural size on an apple branch; scales somewhat enlarged on apple bark at above on the left.

Fig. 2.— San José scales on a pear showing the surrounding ring; the female scale, enlarged.

PLATE XIV.

Fig. 1.— Enlarged view of the young larva of the San José scale-insect, seen from beneath, with a greater enlargement of an antenna at *b*.

Fig. 2.— An enlarged view of an adult female of the San José scale-insect, containing young; at *d*, a still greater enlargement of a portion of its anal fringe.

Fig. 3.— A greatly enlarged view of the adult male of the San José scale-insect; its natural size shown in the inclosed crossed-lines at right-hand side.

(The figures of this Plate and the preceding one are from the U. S. Dept. Agriculture — Division of Entomology.)

PLATE XV.

Thrips tabaci.

Onion Thrips.

Fig. 1.— Female very greatly enlarged.

Fig. 1*a*.— Terminal segments of antenna of do., more enlarged.

Fig. 2.— Lateral aspect of head and prothorax of do., more enlarged.

Fig. 3.— Lateral aspect of terminal segments of abdomen of do., more enlarged.

PLATE XVI.

Fig. 1.— *Gamasus longipalpoides*, greatly enlarged.

Fig. 1*a*.— Chelate claw of second foot of same, more enlarged.

Fig. 2.— *Tyroglyphus heteromorphus*, male, greatly enlarged.

Fig. 3.— Anterior tarsus of same, more enlarged.

Fig. 4.— Third tarsus of same, more enlarged.

Fig. 5.— *Tyroglyphus heteromorphus*, female, greatly enlarged.

Fig. 6.— Third tarsus of same, more enlarged.

Fig. 7.— Smaller Hypopus of *T. heteromorphus*, very greatly enlarged.

Fig. 8.— Anterior tarsus of same more enlarged.

Fig. 9.— Larger Hypopus of *T. heteromorphus*, greatly enlarged.

Fig. 10.— Distal segments of anterior leg of same, more enlarged.

GENERAL INDEX.

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ERRATA.

Page 121, bottom line, for fifty-six read sixty.
Page 132, bottom line, for *fulvipes* (Fabr.), read *ovata* Say.
Page 142, line 7, for (Guen.). read Guenée.
Page 157, line 1, for (Clem.). read Clem.
Page 162, line 19, for (Winnertz). read Winnertz.
Page 263, line 16, for 356 read 360 (See Addenda below).
Page 266, line 5 from bottom, for pyricclana read pyricolana.
Page 267, line 24, *dele maggot–*, and read *Pickled-fruit fly*.
Page 267, line 15 from bottom, for Tenebriodes read Tenebrioides.
Page 268, line 22, for [pilisocollis] read (*pilosicollis* Kn.).
Page 268, line 8 from bottom, before ocellata insert [Oberea].
Page 270, line 6 from bottom, after Jassidæ *dele* the interrogation.
Page 272, line 11, for Symnthurus read Smynthurus.
Page 284, line 5 from bottom, for Lecontii read Lecontei.
Page 289, line 8, for fulvipes [flavipes] *Fabr.* read ovata *Say.*

ADDENDA.

In List of Injurious Apple-Tree Insects,—on page 269, after lines 4, 12 and 17, insert the following: Graphisurus fasciatus (DeGeer), Orsodachna atra (Ahr.), and Typophorus canellus (Fabr.),—on the authority of Dr. John Hamilton.

On page 270 of the same list, after line 9, insert, Monarthrum fasciatum (Say).....Davis: Mich. Hort. Rept, 1895, 17.