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FIRST ANNUAL REPORT

ON THE

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Z. P. METCALF

INJURIOUS AND OTHER INSECTS

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1882

OF THE

STATE OF NEW YORK.

MADE TO THE STATE LEGISLATURE, PURSUANT TO CHAPTER 377 OF THE
LAWS OF 1881.

By J. A. LINTNER,

STATE ENTOMOLOGIST.

ISSUED OCTOBER 1882.

ALBANY:

WEED, PARSONS AND COMPANY, PRINTERS

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IN SENATE,

JANUARY 13, 1882.

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STATE ENTOMOLOGIST.

Hon. GEORGE G. HOSKINS,

Lieutenant-Governor, and President of the Senate :

SIR — I have the honor to present to the Legislature of the State of New York, the First Annual Report of the State Entomologist, made in accordance with the requirements of Chapter 377 of the Laws of 1881.

Very respectfully,

J. A. LINTNER.

ALBANY, N. Y., Jan. 12, 1882.

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REPORT.

To the Legislature of the State of New York:

The Entomologist, in accordance with the requirement of the act establishing the office of State Entomologist, would respectfully present the following report:—

In assuming the duties with which he is specially charged — “the study of insects injurious to agriculture and of methods for controlling and preventing their depredations,” — he has done so in earnest devotion to his department of study — with a sense of responsibility arising from the magnitude of the field of his investigations and its consequent demands — a conviction of the great importance of such studies — a determination that, to the extent of his ability, they shall be made to promote the interests of the State, and the hope that they will contribute to the obligations under which other States and countries have already been placed to the State of New York, by their valuable contributions to applied science.

IMPORTANCE OF ENTOMOLOGICAL STUDY.

It should not be necessary in this enlightened age, marked by so great advance in every department of science, to urge the importance of the study of the Insect world. A century ago, when Entomology and many of the allied sciences were in their infancy, it was popular, and perhaps excusable, to ridicule the study, which frequently extended no further than the gratification afforded by the possession of a cabinet of insects properly labeled and systematically arranged. Those devoted to the pursuit were looked upon as occupied with trifles. Such views are still held at the present day by those who are ignorant of the great change that a century has wrought, and of the practical purposes which this preliminary work of collecting, naming, and describing have meantime been made to serve. The study of insects has

assumed an importance in its direct application to advancement in agriculture, horticulture and sylviculture, second to no other department of natural history. It has called to its furtherance some of the best intellect in this country and in Europe. The literature of entomology has become extensive and assumed honorable rank. Five monthly publications exclusively devoted to the science are ably sustained. A list of American entomologists lately compiled contains nearly a thousand names. Several of our States are employing State entomologists, and others, in compliance with demands made upon them by agriculturists and others, are moving for their appointment. The Department of Agriculture at Washington is earnestly engaged in entomological work, through its Entomologist and corps of assistants; and the General Government has for several years been sustaining a Special Commission, through liberal appropriations, charged with the investigation of a few of our more injurious insects whose excessive ravages and wide-spread distribution have given to them a national importance.

The importance of entomological study may be more fully shown by some further considerations which I beg leave to present:

1. **Extent of Insect Depredations.**

It has been truthfully said that insects have established a kind of universal empire over the earth and its inhabitants. Minute as many of them are, and insignificant in size to other than naturalists, yet, in combination, they have desolated countries and brought famine and pestilence in their train. If unrestrained power could be given them, all counter-checks removed, and they were left free to attack us in our persons, food, clothing, houses and domestic animals, the consequent disease, poverty, exposure, and want, would, in the end, remove the human race from the face of the earth. Air, earth and water teem with them; there may be claimed for them almost an omnipresence; they swarm in the tropics, and find a suitable home in the Arctic regions. They abound in our homes, our gardens, orchards, fields, vineyards, and forests. In the vegetable kingdom they are found in the seed, the root, the stalk or trunk, the pith, the bark, the twig, the bud, the leaf, the blossom, and the fruit — within or upon every portion of the vegetable organism. They are parasitic on our persons and upon or within all of our domestic animals. They attack and destroy fishes and birds. They have their natural home in many of our articles of food. By their disgusting presence and annoyance they may render our homes untenable. They burrow within our household and agricultural implements. They occasionally take possession of our books.

No asylum is so secure that they may not intrude; no condition in life is exempt from their presence and attack.

From this general diffusion there necessarily results extensive losses. Provided often with wonderful means for self-preservation and for the perpetuation of the species, they are ever ready in the exercise of their powers to dispute with man his claim of exclusive right in property. Never without the imposition of a heavy tax upon the products of his labor, they often manifest a determination to wrest from him the entire results of a season's toil. Many of the more injurious species living solely upon such vegetable productions as man regards as essential to his welfare and almost indispensable to his existence, there follows as the consequence of the "struggle for life," continual collision and antagonism. Have the study and labor of a long series of years at length brought the products of his garden and his orchard to such a degree of perfection that only traditionary lore can trace therein specific identity with the wild, uncultivated parent-plant, it would seem, at times, as if all this improvement served no other end than to provide more sumptuous repasts to augmented hordes of insects with greatly increased powers of destructiveness.

To the vegetable world, insects are mainly indebted for their sustenance, and a vegetable growth entirely free from insect attack would be an anomaly in nature. From careful and extended observations, it has been estimated that there are, upon an average, six species of insects attacking each species of plant. Upon most of our cultivated plants, such as garden vegetables, shrubs, trees, grasses, cereals, etc., they have become quite numerous, for the qualities resulting from careful culture which have made them more valuable to us, have, at the same time, rendered them more attractive to insects. Ten years ago (since which time great progress has been made in economic entomology), Dr. Packard stated*: "I could enumerate upwards of fifty species of insects which prey upon cereals and grasses, and as many which infest our field crops. Some thirty well-known species ravage our garden vegetables. There are nearly fifty species which attack the grape-vine, and their number is rapidly increasing. About seventy-five species make their annual onset upon the apple-tree, and nearly as many may be found upon the plum, pear, peach, and cherry. Among our shade trees, over fifty species infest the oak; twenty-five the elm; seventy-five the walnut, and over one hundred species prey upon the pine."

The above stated numbers have already been found to be much below the truth. Several, if not all of them, may be safely doubled, for

* *First Ann. Rep. Ins. Mass.*, 1871, p. 5.

on the apple tree above one hundred and sixty species are now known to occur.* Fifty-two species of *Tineidæ* alone are recorded upon the oak, by far the larger number of which are leaf-miners.†

Perhaps the extent to which the depredations of a single insect may extend cannot be better illustrated than by reference to the grape phylloxera — *Phylloxera vitifolia* (Fitch), a minute insect, belonging to the family of *Aphididæ*, or plant-lice. The earliest notice of this species was that given by Dr. Fitch, in the year 1853, who briefly noticed it under the name of *Pemphigus vitifolia*, as forming small galls on the margin of the leaves of some grape-vines, in Washington county, N. Y.‡ By some means the species was carried to Europe, and it was detected in France, in 1868, by Prof. Planchon, infesting the roots of grape-vines. Believing it to be an undescribed species, it was

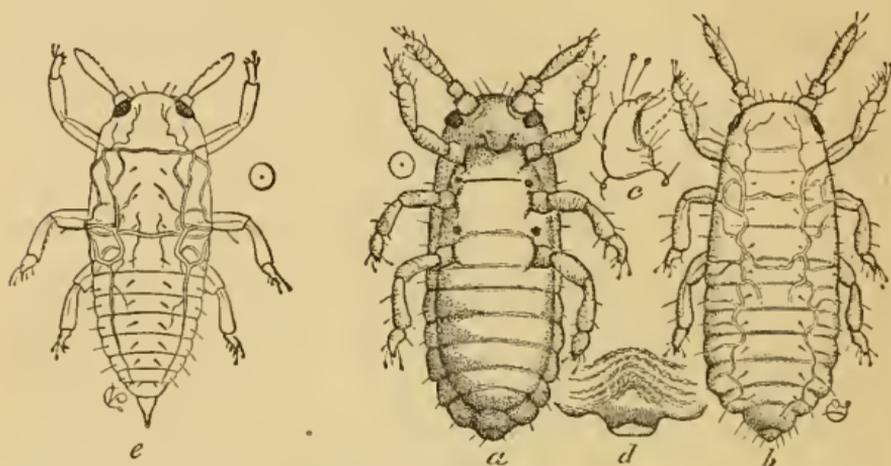


FIG. 1.—SEXED PHYLLOXERÆ:—*a*, female *vitifolia*, ventral view, showing egg through transparent skin; *b*, dorsal view; *c*, greatly enlarged tarsus; *d*, shrunken anal joints, as they appear after oviposition; *e*, male *P. caryocaulis*, dorsal view. The dots in circles indicate the natural size.

*In the Appendix (B.) will be found a list of the apple-tree insects of the United States as far as I have noted them. It contains one hundred and seventy-six species. Although quite incomplete, it is published at this time in order to invite additions by those who may discover omitted species. I purpose, as soon as practicable, to present a report on our apple-tree insects, which shall contain notices of all of our known species, with figures illustrating them as far as possible, together with the most effectual methods for preventing their injuries.

†Chambers' *Food-plants of Tineina*—*Bull. U. S. Geolog.-Geograph. Surv. Terr.*, iv, 1878, pp. 119, 120.

‡*Transactions of the New York State Agricultural Society* for 1854, vol. xiv, 1855, p. 862.

subsequently published by him as *Phylloxera vastatrix*. Later, through comparison and study of the different forms, the identity of the root-inhabiting and the leaf-inhabiting forms was established. Since that time, notwithstanding the most earnest efforts to arrest its spread, aided by legislation, munificent grants, and the learning of the most distinguished scientists, it has continued to extend its area and increase its ravages, until it has invaded every vineyard in France, and threatens the entire destruction of the cultivation of the vine. The female, greatly enlarged, is shown in Fig. 1 with a dot beside it indicating its natural size. The male of a very similar species is also shown.

It is just announced that almost everywhere in the French wine districts, windlasses are at work tearing up blackened vines killed by the phylloxera, and it is estimated that nearly 1,000,000 acres of vineyards have been cleared and the land turned to other uses. The interest and the alarm caused by these ravages are shown by the reward of 300,000 francs (\$60,000), which has been offered by the French Government, for the discovery of a method of destroying the insect; and the large grants which have, for several preceding years, been placed at the disposal of the French Minister of Agriculture and Commerce, for the purpose of encouraging research and experiments as to the best way of dealing with the phylloxera, have, during the present year, been increased to the amount of 969,750 francs (nearly \$200,000).

The insect has also made its appearance in Australia, and such are the apprehensions that its introduction has excited, that Victoria, New South Wales, and South Australia are to contribute \$100,000 toward the expense of exterminating it.*

The minute size of this insect, scarcely more than a microscopic dot in several of its stages, and in its winged state less than one-tenth of an inch in length, always needing a microscope for its observation, exemplifies the apparent paradox often met with in the insect world — the smaller the creature the greater its power of injury.

2. Losses from Insect Depredations.

Could approximate estimates be had of the pecuniary losses resulting from these depredations on our principal crops, the figures obtained would be the only arguments needed to enforce the importance of investiga-

* *Psyche*, iii, 1881, p. 215.

tions to arrest them. There is probably not a single crop cultivated which the infesting insects do not diminish by at least one-tenth — an amount of injury which would hardly be noticed. They often injure crops to the extent of one-fourth or one-half, and occasionally entirely destroy them, as during the ravages of the wheat-midge — *Diplosis tritici* (Kirby) in this State, in 1854–1857, when entire fields were left unharvested.* One of our ex-Governors, in his agricultural addresses, has frequently urged that insect depredations upon crops of one-fourth or one-half their value should be regarded as a direct tax of twenty-five per cent or fifty per cent levied upon their full value, and collected, perhaps, year after year, without a show of resistance; but which each farmer could, and therefore should, resist, and thereby relieve himself from at least a portion of the burden.

Among the estimates made of these losses occurring throughout the United States are the following:

The loss to the wheat crop in the State of New York, in the year 1854 from the wheat-midge, was estimated, from carefully collected data, by the Secretary of the State Agricultural Society, at above fifteen millions of dollars.† The amount would be a third larger if estimated at the price to which wheat afterward arose that winter. (The insect in its natural size and as it appears when magnified is shown in Fig. 2, together with its eggs and larvæ).

From estimates made by the Secretary of the Ohio State Board of

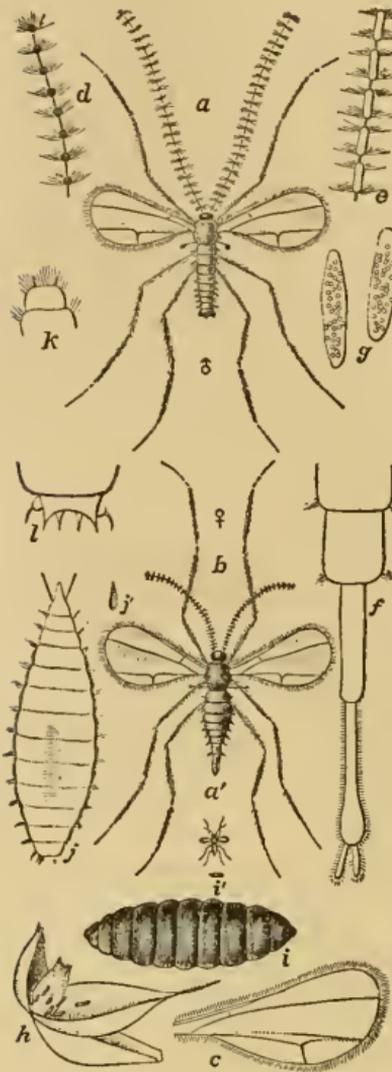


FIG. 2.— THE WHEAT-MIDGE (after Fitch): *a*, male midge; *b*, female do.; *a'*, its natural size; *c*, wing much enlarged; *d*, antennal joints of male; *e*, ditto, of female; *f*, ovipositor, with its two sliding-tubes and terminal finger-like appendages, for guiding the eggs; *g*, eggs, greatly magnified; *h*, a flower of wheat showing the larvæ upon the kernel; *i*, larva in repose; *i'*, its natural size; *j*, larva crawling with its horns extended; *j'*, its natural size; *k*, greatly enlarged view of anterior end when moving on a dry surface with its horns but partially extended; *l*, posterior end with teeth protruded to aid in motion.

*In 1856, in Livingston county, N. Y., 2,000 acres, on flats which would have yielded thirty bushels an acre, were not harvested.

† Fitch's Sixth Report (p. 12), *Transactions New York State Agricultural Society*, xx, 1860, p. 754.

Agriculture, the loss to the wheat crop from the same insect during the same year in that State was even greater than in New York.

In 1857, the insect having extended its ravages over a larger portion of the State of New York, the loss exceeded that of 1854. In Canada, the same year, it destroyed about *eight millions of bushels*.

The cash value of the wheat and corn destroyed in the year 1864, in the State of Illinois, by the chinch-bug — *Blissus leucopterus* (Say), is estimated at *seventy-three millions of dollars*.*

The same insect injured the wheat, oats, and corn in the State of Missouri in 1874, as appears from estimates made in the larger number of counties in the State, to the amount of *nineteen millions of dollars*.†

The loss to corn, potatoes and other crops in the States of Kansas, Nebraska, Iowa, and Missouri in 1874, from the ravages of the Rocky Mountain locust — *Caloptenus spretus* Uhler, is computed by the United States Entomological Commission at nearly *fifty-six millions of dollars*, and the actual loss to the four States is estimated at one hundred millions of dollars.‡ The insect is shown in Fig. 3, at a, in



FIG. 3.—THE ROCKY MOUNTAIN LOCUST *a*, compared with the Red-legged locust (*Caloptenus femur-rubrum* *b*).

comparison with the shorter winged red-legged grasshopper (*Caloptenus femur-rubrum*), at *b*, common in the State of New York and in most of the Northern United States east of the Mississippi river.

For the same insect, from county returns of loss upon grain alone in the western portion of Missouri, in 1875 (omitting several counties that made no returns), Professor Riley figures an aggregate in twenty-six counties of *fifteen millions of dollars*.§ Single counties suffered to the extent of *two millions of dollars*.

Careful estimates of damage sustained from the cotton-worm — *Aletia argillacea* Hübner (the moth of which is represented in Fig. 4), upon an assumed value of \$50 per bale on the number of bales less than an average crop, give, as the annual loss for the fourteen years prior to 1878, in several of the cotton States, the following amounts: Georgia, \$3,912,000; Louisiana, \$4,487,000; Alabama, \$4,789,000; Mississippi, \$6,150,000; Texas, \$7,406,000; and in nine of the principal cotton States, the following result :



FIG. 4.—THE MOTH OF THE COTTON WORM (*Aletia argillacea* Hübn.)

* Riley's *Second Rep. Ins. Mo.*, 1870, p. 28.

† *Seventh Report Ins. Mo.*, 1875, p. 25.

‡ *First Ann. Rep. U. S. Ent. Commis.*, 1878, p. 121.

§ Riley's *Eighth Rep. Ins. Mo.*, 1876, p. 90.

a possible loss of *thirty millions of dollars* in years of general prevalence of the caterpillar.*

From the census returns of the value of the agricultural products of the United States, and estimates of injuries inflicted by certain insects in several of the States, it has been computed that the aggregate annual losses from injurious insects throughout the Union equals *two hundred millions of dollars*.†

B. D. Walsh, who was one of the most able of our economic entomologists, gave it as his opinion that the United States suffer from the depredations of noxious insects to the annual amount of *three hundred millions of dollars*.‡

3. Excessive Insect Depredations in the United States.

The study of insects assumes an importance in this country far greater than in any part of the world. Nowhere else are insect injuries so serious as in the United States. Our several crops are attacked by a larger number of insect pests, and the losses that they inflict upon each are almost invariably in excess of those occurring in the countries of Europe. Three causes have concurred and are mainly instrumental in producing this condition :

I. The Importation of Injurious Insects.—Very few of our various agricultural products are native to our soil. Nearly all of our fruits, grasses, cereals, garden vegetables, and probably three-quarters of our weeds are of foreign importation — mainly from Europe. With their introduction very many of their attacking insects were also introduced or subsequently brought hither, as, for example, the wheat-midge (*Diplosis tritici*), the currant-worm (*Nematus ventricosus*), the oyster-shell bark-louse (*Mytilaspis pomicorticis*), the apple-tree plant-louse (*Aphis mali*), the hop-louse (*Aphis humuli*), the grain-Aphis (*Siphonophora avenæ*), several other species of plant-lice, the codling-moth of the apple (*Carpocapsa pomonella*), the cabbage-moth (*Ephestia interpunctella*), the cabbage-butterfly (*Pieris rapæ*), the currant-borer (*Egeria tipuliformis*), the asparagus-beetle (*Crioceris asparagi*), the clover-root borer (*Hylastes trifolii*), the onion-fly (*Anthomyia ceparum*) and several other root-flies, the boll-worm or the corn-worm (*Heliothis armiger*), and a number of destructive cut-worms (*Agrotis c-nigrum*, *A. baja*, *A. prasina*, *A. pleeta*, *A. saucia*, *A. ypsilon*, *Mamestra trifolii*, *Hadena Arctica*), etc.

Comparatively few of our native injurious species have been introduced in Europe, consequently the number of those imported to this

*Comstock's *Report upon Cotton Insects*, 1879, p. 70.

†Packard, in *Hayden's 9th Annual Report U. S. G.-G. Surv. Terr.*, 1877, p. 591.

‡*American Entomologist*, i, 1868, p. 2.

country so greatly exceed those exported, that the preponderance, added to our native forms, seems to warrant the assertion that "America is the home of insects."

2. **The Increased Destructiveness of Introduced Insects.**—It is well known to entomologists that those of our insect pests which are of European origin have become far more injurious here than they were ever known to be in their native homes. This may be illustrated by a reference to a few of our injurious species. The wheat-midge, introduced to this country about the year 1820, and first observed in Northern Vermont,* has never, throughout its entire European history, extending over nearly a century and a half, displayed an approach to the destructiveness which it has shown since its advent here. Its injuries have indeed, at times, created alarm and entailed serious losses in portions of England and Scotland, but on the Continent its existence was hardly known for a century after its discovery, and subsequent to that time it had not been very prevalent. Curtis, in writing of the species, calls it the *British wheat-midge* (indicating a restricted European range), and states that M. Herpin is of the opinion that it is an inhabitant of France.†

The ravages of the cabbage-butterfly, *Pieris rapæ* Linn., brought to this country by the way of Quebec, about the year 1858, have greatly exceeded those committed by it in Europe. It has proved very destructive to cabbages wherever it has appeared, and it seems destined to spread over all of the United States, as it crossed the Missouri river in 1880 and has entered Nebraska.‡

The asparagus-beetle, *Crioceris asparagi* (Linn.), which has at times destroyed entire plantations of asparagus upon our sea-board in the vicinity of New York, has been known for centuries in Europe, but has hardly been referred to by writers on economic entomology as an injurious insect. Although common in Russia, a writer in referring to it, in 1880, states, that it is never known to be obnoxious there.

The carpet-beetle, *Anthrenus scrophulariæ* (Linn.), first noticed in this country in the year 1872, has been recognized as a common species throughout a large part of Europe for more than a century. While in several portions of the United States its ravages on carpets have excited serious alarm in housekeepers and have threatened to compel a resort to uncarpeted floors, no instance is known of its ever having been detected in feeding upon carpets in Europe, although stated to be injurious to "furs, clothes, animal collections and even leather and dried plants." More frequent reference is made by Eu-

*Fitch, *Sixth-Ninth Reports Ins. N. Y.*, 1865, p. 8.

†*Farm Insects*, 1860, pp. 260, 266.

‡*Canadian Entomologist*, xiv, 1882, p. 40.

ropean writers of the occurrence of the beetle upon flowers than of the larva within houses.* (The insect, in its several stages, is shown in Fig. 5.)

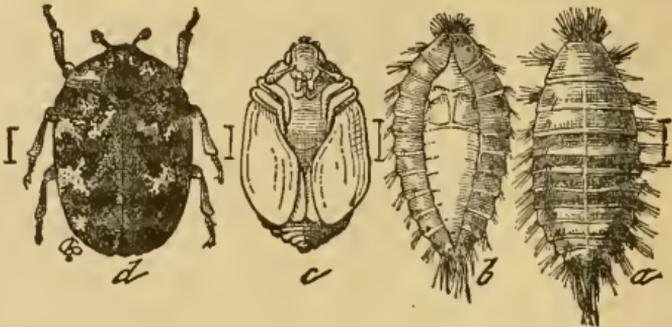


FIG 5.—*ANTHRENUS SCROPHULARIE*: a, the larva; b, the cast skin of the larva at molting; c, the pupa; d, the beetle — enlarged from natural sizes shown in accompanying lines.

The increased ravages of our introduced insects result from the new conditions under which they are here placed. The relations that during the lapse of centuries had grown up between them and their food-plants, their insect parasites, the birds and other animals that preyed upon them, whereby a balance and an interdependence had become established — have all been broken up. When brought to our shores they find, perhaps, more abundant food, of a character more acceptable and attractive to them. But mainly, in their importation, their natural parasites and the enemies which had kept them in subjection have been left behind, and they are free to ply their destructive work and to “increase and multiply” without hindrance or molestation, unless some of our native parasites shall at length acquire the habit of preying upon them, and other foes discover that they are “good for food.”

3. The Large Areas Devoted to Special Crops.—The excessive ravages of insects in the United States are largely owing to the cultivation of their food-plants in extended areas. We may illustrate this by a reference to our apple-tree insects. Two hundred years ago not even the wild crab, the earliest representative of the apple, existed in this country, and consequently there were no apple-insects. Later, when a few apple-trees became the adjunct of the simple homes of the early settlers, those of our insects to which they offered more desirable food than that on which they had previously subsisted, were obliged to wing their way often for many miles in search of a tree upon which to deposit their eggs. If birds were then abundant, how few of the insects could safely accomplish such extended flights. But in the apple orchards of the present day — some of them spreading in an almost unbroken mass of foliage over hundreds of acres — our numerous apple

*Hagen, in *Canadian Entomologist*, x, 1878, p. 161.

insects may find the thrifty root, the vigorous trunk, the succulent twig, the tender bud, the juicy leaf, the fragrant blossom, and the crisp fruit spread out before them in broad array, as if it were a special offering to insect voracity, or a banquet purposely extending an irresistible invitation to the tent-caterpillar, the codling-moth, the canker worm, the striped-borer, the bark-beetle, the twig-borer, the leaf-aphis, the bark-louse, the root-louse and every other of our one hundred and sixty species of apple insects. Here they may luxuriate as nowhere else. The required food is greatly in excess of insect need. Careful cultivation has made it the best of its kind; appetite is stimulated; development is hastened; broods are increased in number; individuals are multiplied beyond the conservation of parasitic destruction; facilities of distribution are afforded with hardly a proper exercise of locomotive organs, and when these almost useless members have become aborted, as in the wingless females of the bark-louse (*Mytilaspis pomicorticis*) and the canker-worms (*Anisopteryx vernata* and *A. pometaria*), the interlocking branches afford convenient passage from tree to tree.

In like manner, every crop cultivated on a large scale, holds out strong invitation to insect attack, and wonderfully stimulates insect fecundity. Nowhere in the world are crops massed in so large an acreage as in this country—their extension ever keeping pace with the invention of special mechanical contrivances for their gathering, and the extent to which hand-labor and horse-power may be replaced by steam. The following are a few instances of extensive areas devoted to special products:

The largest apple-orchard in the world is believed to be that of Mr. McKinstry, near Hudson, N. Y. It embraces about 300 acres and contains 26,000 apple-trees. Extending for nearly a mile along the public highway and for one-half a mile in the rear, it appears, when viewed from some favorable point, like a vast sea of orchard. Six miles of road extend through the grounds for access and for carrying away the gathered fruit.*

The peach orchard of the Orchard Hill Fruit Farm, at Orchard Hill, Georgia, is believed to be the largest in the world. It contains 54,000 peach-trees, and occupies 540 acres. The proprietor, Mr. John D. Cunningham, informs me that he will probably plant 250 additional acres the coming fall, which would then give him 84,000 trees.

A fruit-grower in California (Mr. G. G. Briggs, of Davisville) has 1,010 acres of grape-vines, in four parcels of respectively 120, 160, 270, and 460 acres. Nearly all are muscats of Alexandria and are culti-

**Proceedings Western N. Y. Horticultural Society, at 26th Ann. Meet. in 1881, p. 81.*

vated for raisins, the product of which, when all shall come to full bearing, is estimated at 200,000 boxes, or 4,000,000 of pounds.*

The cotton plantation of Col. B. G. Lockett, near Albany, Ga., contained in 1872, 6,500 acres of cotton.†

From the Dalrymple farm, in Nebraska, there were harvested 12,000 acres of oats and 24,000 acres of wheat. The grain was cut by 125 reaping machines moving in divisions, and a number of steam-threshing machines were employed.‡

In the San Joaquin Valley, in California, there were three wheat fields containing respectively 17,000, 23,000 and 36,000 acres. The crop of the latter was 1,440,000 bushels. One side of the field is seventeen miles long. When plowed, ten four-horse teams were attached to ten gang-plows, each gang having four plows. Lunch was served at a midway station and supper at the terminus.§

A Colorado potato field, near Denver (belonging to Mr. Rufus Clark) is 150 acres in extent, and its yield for 1864 was estimated at from 25,000 to 30,000 bushels. During the season more than \$2,000 were expended in defense against the potato-beetle.**

In 1877, in Dighton, Mass., 1,000,000 quarts of strawberries were raised — over 30,000 bushels.

The tendency in our country appears to be toward the cultivation of special crops on a scale only limited by the means of handling them. It is but the natural result of the proverbial industry and energy of the American people; the great improvements recently made in agricultural implements; the rapid increase in population; increased facilities of transportation; and an increasing foreign demand for our products. But it is questionable, in view of the alarming increase of insect depredations, to what farther extent this aggregation of single food-plants may be carried, without the attendant multiplication of attacking insects to a point where it shall be impossible by any human means or by parasitic aid to prevent their obtaining the entire mastery of us.

4. The Immense Number of Insects.

In number of species, insects far exceed that of all the other classes of the animal kingdom combined, viz.: mammals, birds, reptiles, fishes, crustaceans, worms, etc.†† The number already known is

*For yield in former years, see *Country Gentleman*, xlvii, 1882, p. 208.

†*Report of the Commissioner of Agriculture for 1872*, p. 448.

‡*The Rural Nebraska* for November, 1880.

§*Country Gentleman*, xxxvii, 1872, p. 633.

***Report of the Commissioner of Agriculture for the year 1874*, p. 280.

††There are about 55,000 species of animals known, exclusive of insects. (*Packard's Guide to the Study of Insects*, 1869, p. 103.)

immense, and the new species that are being continually added to our lists, as the results of an increased number of observers, more thorough collections, and more extended explorations, is constantly enlarging the estimate which naturalists from time to time present of the probable number occurring throughout the world. The discovery of new forms is ever in advance of the ability of entomologists to give them description, name, and classification. There are to-day in the British Museum no less than 12,000 species remaining undescribed, and like unworked material is to be found in every collection of any extent in both hemispheres. Fifty years ago, 70,000 species had been described, and it was then thought that there were at least twice that number in existence. The scientific activity of the past half century has more than quadrupled that number, and there are now 320,000 described species. In view of this rapid increase, it will not be safe to assume that even yet one-half of the actual number have been described. From our present knowledge, and from the vast extent of the globe which is still, in natural science, *terra incognita*, it does not seem improbable that the number of insects in the world may reach a *million of species*.

Leaving the species and passing to individuals — if we proceed to a calculation of number, we almost question the results shown by our figures. Dr. Fitch has given us a computation of the number of cherry-tree aphids — *Aphis cerasi* Fabr. — occurring upon some trees upon his grounds. He writes:* “Among the cherry-trees alluded to, was a row of seven young ones which had attained a height of about ten feet. By counting the number of leaves upon some of the limbs and the number of limbs upon the tree, I find a small cherry-tree of the size above stated is clothed with about seventeen thousand leaves. These leaves could not have averaged less than five or six hundred lice upon each, and there was fully a third more occupying the stems and the tips of the twigs. Each of these small trees was, therefore, stocked with at least twelve millions of these creatures.”

Even our knowledge of insect fecundity fails to explain such wonderful multiplication, and our reason cannot assign the purpose for which such seeming excess is designed. It is related of a little midge (*Chironomus nivoriundus*), that, on one occasion, in traversing a forest it was observed in such countless myriads as to prove of the greatest annoyance to the tourist, getting into his mouth, nostrils, and ears at every step, and literally covering his clothing. †

The Rocky Mountain locust, in its migratory flights, hides the sun, and fills the air as far as the eye can reach. From the highest peaks

* *First and Second Report on the Insects of New York*, 1856, p. 127.

† Fitch: *Winter Insects of Eastern New York*; *Amer. Jour. Agr.-Sci.*, v, 1846, p. 282.

of the Sierra Nevada, it has been seen filling the valleys below and the air above as much higher as they could be distinguished with a good field-glass.* Rich and fertile portions of Southern United States are incapable of cultivation from the hosts of mosquitoes that abound in them. The same insect effectually shuts out portions of British America from exploration, while in Eastern Europe and in Asia the attacks of its hosts have caused insanity in travelers, and the death of domestic animals unprovided with means of defense. The experiments of Reaumur have shown that a single aphid (a plant-louse) may, in a single year, through its frequent generations without pairing, be the progenitor of 5,904,900,000 (nearly six billions) descendants.

Through such prodigious multiplication, the tiny, often despised, insect attains an importance in the economy of nature to which the ravenous beast of prey may not attain, although surpassing it many thousand fold in size.

5. Necessity of a Knowledge of Insect Habits.

No great success can be expected in our efforts to resist insect depredations, until we know who and what our insect enemies are. We are told *who* they are, when they have been given the scientific name which they shall bear wherever they may occur throughout the civilized world; and we are first prepared to learn *what* they are, when they have been so intelligently described and faithfully illustrated that they may be unmistakably identified by the agricultural, as well as the scientific, student. Hundreds of persons, in different localities, may then be simultaneously engaged in the study of the same insect; or fact after fact may be separately ascertained and recorded, which, when collated and arranged, may so nearly furnish an entire life-history as to leave but a few inconsiderable details for special study to supply. The habits of the different species are so diverse as to necessitate separate study of each one of the immense number with which we have to do. Each history is a complicated one, as it embraces, for the greater part, four distinct forms of animal existence — the egg, the larva, the pupa, and the imago — which may differ so greatly one from the other, that, by the uninitiated, no relationship would be suspected. One or more of these forms may be artfully hidden, or existing under such peculiar circumstances as to elude discovery. Among the first hundred of our most injurious insects, there are those which we only know in their final stage, and there is not the naturalist among us who could identify them in their larval or their pupal state; while at least one-half of the number could not be determined in the egg. Such a confession

* *First Ann. Rep. U. S. Entomolog. Commis.*, 1878, p. 213.

is a strong argument in favor of continued investigation of insect lives, for it must be evident that until the several stages are known, the entomologist is not prepared to point out the particular phase in which the insect is the most vulnerable, and recommend the remedy or the preventive that has been found by experiment to be the most efficient and the simplest in its application.

These studies are laborious. They often involve earnest, long-continued and painful cloister work, in microscopic observation of the more minute forms. Other information can only be obtained in the field, orchard, and forest. So many are the details that enter into a complete life-history, that a single one may be the accretion of the united labors of individuals extending over a series of years. The number of persons who are devoting their entire time, or any large proportion thereof, to economic entomology in the United States is less than a dozen—a number ludicrously small in view of the extent of our country, its varied interests, its range of agricultural products, and an amount of insect losses in large excess, as has been shown, of those occurring elsewhere, and which, for reasons already given, are increasing among our larger crops to an extent that will, ere long, compel the study for their arrest which is so unwisely withheld.

PROGRESS MADE IN ECONOMIC ENTOMOLOGY.

We do not overstate the truth, we think, in asserting that the last twenty years have been signalized by a progress in entomology, equal, at least, to that made during the preceding century. In every direction it has displayed a marked advance—in the extensive collections made in every quarter of the globe; in the species described and illustrated; the distinguished scientific ability devoted to the study; the systematic and biological collections arranged in our museums and private cabinets; the classificatory work accomplished; the valuable contributions to its general literature; the monographs, manuals, and catalogues of families and orders published through the Smithsonian Institution; the embryological and anatomical investigations; and, lastly, the utilization and application of all that has been accomplished in these several directions, to the promotion of the arts of agriculture, horticulture, and others, which minister to the comfort, happiness and well-being of mankind.

1. The Writings of Economic Entomologists.

Economic Entomology, in this country, had its commencement in the labors of Dr. T. W. HARRIS, and directly, in the publication of his *Report on the Insects of Massachusetts Injurious to Vegetation*, in

the year 1841. Successive editions of this admirable work have been subsequently published. Of these, the last, issued in 1862, with additions and copious illustrations, finds place in most of the principal libraries both here and in Europe, and its pages may ever be consulted with pleasure and with profit. It still remains the first volume which the entomologist recommends to those who desire to learn of the relations which we bear to the insect world. A writer gives it this high praise: "It has saved millions to our country, and has been received with enthusiasm in all the countries of Europe. It is an imperishable honor to Massachusetts."*

The writings of my predecessor, Dr. ASA FITCH, especially those contained in his series of *Reports on the Noxious, Beneficial and other Insects of the State of New York*, commencing in the year 1855 and terminating in 1872, have been of such eminent service in the promotion of economic entomology, that I have felt justified in devoting several pages of the Appendix (A.) to a notice of the circumstances attending his call to the duties of the office of Entomologist—the instructions under which his work was conducted—the time, place and manner of publication of the several reports (fourteen in number), together with some remarks upon his labors made after his decease, to the State Agricultural Society with which he was so long connected.

To Mr. B. D. WALSH, State Entomologist of Illinois at the time of his lamented death through a railroad casualty, are we indebted for valuable progress in both general and applied entomology. His State Report and the large number of valuable papers contributed by him to the *Practical Entomologist* and the *American Entomologist* (as editor of the former and associate-editor of the latter), to the *Proceedings of the Entomological Society of Philadelphia*, and to other serials, show clearly his prolific pen, his untiring zeal, and the unusual ability with which he was gifted. His removal from us at a time when he had scarcely more than entered upon the work to which he was devoted is regarded as a loss to science deeply to be deplored.

The publications and official labors of Prof. C. V. RILEY—for nine years the State Entomologist of Missouri, for several subsequent years Chief of the United States Entomological Commission, and now the Entomologist of the U. S. Department of Agriculture—have contributed more largely than those of any other person to the extension of our knowledge in applied entomology and its general diffusion. The results of his studies, as given in the nine finely-illustrated Missouri Reports, the Reports of the Entomological Commission, the volumes of the *American Entomologist*, and numerous contributions to various

**Fourth Annual Report of the Michigan State Pomological Society*, 1875, p. 178.

scientific journals and the public press, have furnished us such a compendium of life-histories of our injurious insects, and means for controlling their ravages, as is possessed by none of the older nations of Europe. It is an honor to American science and a high attestation of the claim made by economic entomology of its utility, that the French Government has conferred upon Prof. Riley a gold medal inscribed with its appreciation of the value of his investigations of the grape phylloxera.*

The four reports of Dr. W. LE BARON, successor to Walsh as State Entomologist of Illinois, published during the years 1871-1874, contain much valuable information upon the insects infesting fruit-trees and other food-plants. The fourth report furnishes an excellent handbook for the classification of the Coleoptera (*beetles*), giving, as it does, synopses of the genera and illustrations of the several families.

Upon the death of Dr. Le Baron, Dr. CYRUS THOMAS was appointed State Entomologist of Illinois, and six annual reports have since been published by him. They present the results of his personal studies and investigations, together with those of the assistants with which the State, in appreciation of the work in which he is engaged, have liberally provided him — Prof. G. H. French and Miss E. A. Smith.† As each report is, in the main, devoted to a particular order of insects, as the Coleoptera, Lepidoptera, Hemiptera and Orthoptera, they will be found of eminent service to the general student in entomology who desires scientific knowledge, while they at the same time furnish to the agriculturist the means of recognizing his insect enemies and friends. Dr. Thomas, as a member of the U. S. Entomological Commission, has also rendered excellent service in his studies of the Rocky Mountain locust in its relations to agriculture and the settlement of the Territories. A bulletin upon the chinch-bug, *Mitropus leucopterus*, was also prepared by him and has been published by the Commission.

The economic contributions of Dr. A. S. PACKARD, Jr., have also been quite extensive. They are mainly the following: *Injurious Insects New and Little Known* (1870); the three annual *Reports on the Injurious and Beneficial Insects of Massachusetts* (1871-2-3); portions

*The medal was awarded by the Minister of Agriculture and Commerce of France, "in appreciation of discoveries in economic entomology, and especially of services rendered to French grape culture," and was transmitted, in 1874, through the Agence Consulaire de France à St. Louis. It bears upon its face the head of the Goddess of Liberty in bas-relief, with the words, "Republique Francaise." Upon the reverse is, "Mr. Riley, à St. Louis, Missouri. Services Rendus à la Viticulture Francaise, 1873," encircled by "Ministère de l'Agriculture et du Commerce." (*Canadian Entomologist*, vi, 1874, p. 78.)

†Dr. Thomas resigned his position as State Entomologist in June, 1882, and Prof. S. A. FORBES was appointed in his place.

of the two annual *Reports of the U. S. Entomological Commission; Report on the Rocky Mountain Locust and other Insects in the Western States and Territories*; * *Insects Injurious to Forest and Shade Trees*; † *Half Hours with Insects*; and, *Our Common Insects*. Beyond the above, Dr. Packard's writings in general entomology — anatomical, descriptive, classificatory, and reports on special collections made in various portions of North America — have been very extensive and of a high order. His *Monograph of the Geometrid Moths or Phalænidae* — a beautiful volume of over six hundred quarto pages and an equal number of illustrations, ‡ has added largely to our knowledge of a family possessing great economic importance; while his *Guide to the Study of Insects* has proved a rich boon to the American student, and merits place in the hands of every one who desires a comprehensive acquaintance with the insects of North America.

Prof. J. H. COMSTOCK'S labors, as Entomologist to the U. S. Department of Agriculture, have given results of much economic importance, which appear principally in the Departmental Report upon Cotton Insects, 1879, and the Reports of the Entomologist for 1879 and 1880.§ The main portion of the latter report is devoted to a very valuable paper on the common and extremely injurious insects known as scale insects, showing earnest study and extended investigation. An important addition to this report is a supplementary paper by Mr. L. O. HOWARD, of the Entomological Division of the Department of Agriculture, upon the parasites of the *Coccidæ*, in which many new species are described and the benefit urged that may result from the transportation of the more useful parasites from localities where they abound to those where they may not have been introduced.

The reports of Mr. TOWNEND GLOVER, Entomologist of the Department of Agriculture from the year 1863 to 1877, contain much material of economic importance valuable for reference, but, from the nature of his duties, not contributing to any great extent in original investigation. In his *Illustrations of Insects*, consisting of 273 plates drawn and engraved on steel by himself, and in the several volumes of *Manuscript Notes from my Journal*, of which small editions have been lithographed for private distribution, he has displayed a zeal for the promotion of science, not surpassed by any American Entomologist. It is much to be regretted that the Illustrations in the Orders of Lep-

*In 9th *Annual Report of the U. S. Geological and Geographical Survey of the Territories*, for 1875, pp. 579-809, pl. lxii-lxx.

†*Bulletin No. 7 — Department of the Interior. United States Entomological Commission*, 1881, pp. 275, figs. 100.

‡Forming vol. x of the Quarto Reports of the *Hayden Survey of the Territories*, 1876.

§Contained in the *Annual Reports of the Commissioner of Agriculture* for the years 1879 and 1880.

idoptera, Coleoptera and Hymenoptera have not, as yet, been published, even for private distribution, as were the other orders — accompanied, as they are, with extended notes collated with much care and industry, and of great practical value. Many of these illustrations, together with their text in manuscript, were exhibited by Mr. Glover at the Entomological Convention held at Paris in the autumn of 1865, and the interest which they excited was attested by the bestowal upon him of the gold medal of the Emperor, as appears in the following extract from the “Documents relating to the Exposition of Insects held at the Palace of Industry, at Paris in 1865 :”

“The grand gold medal of the Emperor yet remained to be decreed, and the jury sought to ascertain to whom the high award was due ; when, at a late hour, a stranger, an American, Mr. Townend Glover, attached to the Department of Agriculture at Washington, presented himself with a work on practical entomology, applicable to agriculture. This work, comprising, on 130 copper-plates, the useful and noxious insects of North America, belonging to all the orders established by naturalists, coleoptera, etc., is designed and executed by the exhibitor himself from nature, and presents them in their three forms of larva, pupa and perfect insect. To these 130 plates is attached a table with numbers, which refer to the text, and indicate the plants, trees, or shrubs, commonly inhabited by each larva or insect, mentioning the parts attacked, whether the roots, leaves, wood, fruits, grains, etc. ; the nature of the damage done, the habits of the insects, the remedies, old and new, to prevent their ravages, and, as far as known, the efficacy of the remedies. These plates have been executed with the greatest care, the insects being represented with exact fidelity to nature. In brief, this work, which has cost the author ten years of research and observation, and for which he well merits the high position he occupies in the Department of Agriculture at Washington, was judged, by an eminently scientific jury, to be original in its style and character, and deserving to be copied by the entomologists of France as a desideratum in the application of their science to agriculture.”

Prof. A. J. COOK, of the Michigan Agricultural College, has contributed a number of papers on the natural history and habits of our injurious insects, to the *Reports of the Michigan State Agricultural Society** the *State Pomological Society*,† the *Canadian Entomologist*, etc. The value of several of these papers is enhanced by their containing the results of careful experiments with insecticides and other applications to prevent insect injury, in which he has been aided by his associates in the college and the students under his charge.

Mr. WILLIAM SAUNDERS, as the able editor of the *Canadian Entomologist* during the past eight years, an enthusiastic horticulturist, and a member of the Special Commission of the Ontario Government for inquiring into the agricultural resources of the Province, has devoted much time to the study of insect pests, and has published upon them many papers of interest and practical importance.

The writings of a number of other of our entomologists deserve

* *Reports of the Mich. St. Board of Agricult.*, xii, for 1873 ; xiv, for 1875 ; xv, for 1876 ; xvi, for 1877 ; xix, for 1880.

† *Reports of the Mich. St. Pomolog. Soc.*, ii-x, for 1872-1880.

mention in connection with the above notices, but they are distributed among so many of our scientific journals that they cannot be conveniently referred to at this time.

It is announced in a circular of the U. S. Entomological Commission that it has in preparation a full bibliography of the publications in economic entomology throughout the United States, and that it will probably be given in its next (third) volume.* Beyond the great convenience which such a list will afford for the purpose of reference, it will also serve to show the great attention that has been given to this department of study in this country.

The results which we have attained in the investigation of our insect enemies and friends, for there are many of the latter, have been recognized in Europe, and the gratifying tribute has been paid to these labors, that, in the applications of entomology, we are quite in advance of European progress. Our studies have been gladly accepted as serviceable in the advancement of the like work there being carried on. Scientific investigation, of whatever nature, is of world-wide utility, and hence it follows that while the names of Harris, Fitch and Riley are familiar ones in Europe, so the researches of Ratzburg, Curtis and Westwood are aids to which the American student often resorts; and the appearance of a volume, presenting the most approved methods of dealing with European pests, as in the admirable volume recently given to the public, from the pen of Miss Ormerod,† is cordially welcomed by us. But if the applications of the science have made the greater progress in this country, it is but the consequence of the absolute necessity of attention in this direction, from the excessive insect ravages occurring here, as before referred to. In Europe, as the result of a more general study of natural history, the broad recognition of its importance, and the liberal aid extended to investigators through private munificence and government patronage, general entomology has reached a point which we have not approached. There, from the labors of devoted scientists for a century past, the discovery (as I have elsewhere written) of a new insect is comparatively rare. Nearly all the known insects have been described and pictured in accurate figures and faithful coloring, in all their stages, so far as ascertained, even of those microscopic but surpassingly beautiful Tineid moths, whose entire development from the egg to the perfect insect is perfected within the circumscribed limits of a single leaf.

*That the record may be as complete as possible, all entomologists throughout the United States are requested to aid in its preparation, by sending to the Secretary of the Commission, Dr. A. S. Packard, full lists of their papers on any subject connected with *Economic Entomology* (not general or scientific entomology unless bearing on the applied science), prepared in the style of that adopted in the bibliographical notices of *Psyche*.

† *A Manual of Injurious Insects, with Methods of Prevention and Remedy for their Attacks to Food Crops, Forest Trees, and Fruit.* By Eleanor A. Ormerod, F. M. S., etc., London [1881], 12 mo., pp. 323, many figures.

2. Increased Interest in Entomological Investigations.

The efforts made by our practical entomologists to promote, by their studies, the public welfare, are meeting with a gratifying return, in the growing recognition of their importance, a desire that they shall be continued and extended, and a general disposition to utilize the benefits which they offer. For many years much of the toil of the husbandman has counted for nought. Successive crops have been destroyed or yielded inadequate return, and this was accepted as if it had been blight, mildew, fire, war, or some other calamity which could not be controlled. The recent applications of science have shown that the evil may be greatly lessened, and eager inquiries are now being made how it can be accomplished. From every portion of our broad domain requests are received for instructions how to deal with this or that insect pest, and I doubt if there is one of our prominent economic entomologists who has not been thus addressed from every State in the Union. Many of our agricultural journals have columns specially devoted to the answer of such inquiries. Our agricultural, horticultural and pomological societies are alive to the value of the study, and are asking for the aid which it is capable of giving them; and very properly so, for if such study shall realize the present expectations of those who know its worth, it will further these pursuits, in our country, to an extent which no other science has the ability to do. In compliance with the wishes of the New York State Agricultural Society, officially expressed, the requests of the principal agriculturists in the State, the Board of Regents of the University of the State, and many distinguished citizens in this and other States, New York, foremost in the encouragement of entomological research, has resumed the good work, and provided for its continuance. Other States are moving for the appointment of State Entomologists, among which are California (aroused to the importance of excluding the grape phylloxera from her vineyards, and other of our eastern pests from her fruits), Michigan, Indiana, Iowa, Wisconsin, and Kansas. There is no doubt but that it would be wise economy for every State in the Union to have a properly qualified officer charged with the study of insect injuries and benefits, and that several times his salary would thereby be saved to the State.* Great benefit would accrue from such a number of earnest workers distributed throughout the entire country, extending to one another sympathy and aid, and stimulated to competition in working out the best results. Seldom, then, would it be necessary to make unsatisfactory replies to requests for directions how to arrest some form of in-

*Hon. A. B. Dickinson has given it as his opinion that the New York Entomological Reports of Dr. Fitch have saved annually to the State over \$50,000.

sect attack. How is it possible, in view of the fact that entomology, as a science, is but about a hundred years old, and that applied entomology had its birth among us within the life-time of most of those now engaged in its study, to tell just how to deal with every insect of the thousands that annoy or injure us, when of many we even do not know their names, and of most of their number, their habits and transformations in full. By far too much is expected by the public. The small number of workers and the brief time that they have been engaged in their investigations should be consideratively borne in mind. Much has been accomplished thus far, as some of the following considerations will show.

3. The Acquisition of Life-histories.

I have already referred to the importance of a knowledge of the life-histories of our insects, the difficulties attending their acquisition, and the long study that they often demand. It is desirable in a scientific point of view that a species should be known in each of its stages, and frequently it is only through a study of the earlier phases that we are able to decide upon the claim of a form to specific recognition. But in the domain of economic entomology, an acquaintance with the larval stage is of paramount importance, as this is the especial period of insect injury. Many of our entomologists are now actively engaged in these studies, under the incentive of a conviction that the student who presents a complete life-history of a single species makes a more valuable contribution than does the discoverer and the describer of a score of hitherto unknown forms. Within the last few years, Mr. W. H. Edwards of Coalburgh, W. Va., has worked out and given us the histories of the larger number of our butterflies east of the Mississippi, and other authors have made us acquainted with the histories of many of our moths. Directions are no longer given for destroying "the ent-worm," for instead of its being a single species to be dealt with in a certain manner, as formerly believed, we now know the moths of nearly three hundred species, which differ so greatly in their habits and transformations that each one needs separate study, and the several groups, greatly differing treatment. Growing attention is paid to the discovery and description of the larvæ of the Coleoptera, commonly known as grubs, and chargeable with injuries equal in amount to those of the Lepidoptera (butterflies and moths). Mr. F. G. Schaupp, of the Brooklyn Entomological Society, has contributed several papers to the Bulletin of the society, describing a number of hitherto unknown forms, and collecting the descriptions of previously described species.*

*See also, Horn, in *Trans. Amer. Ent. Soc.*, vii, 1878, pp. 28-40.

4. Formation of Biological Collections.

Several of our leading institutions have undertaken, and have made much progress in collections illustrative of the life-histories of our injurious insects, by showing them in all their stages in connection with their depredations, and whatever else may serve to present a knowledge of their lives; as for example, if a moth, the egg and shells from which the larva (caterpillar) has emerged; the larva, in each of its 3-6 stages of growth, before and after each molting, preserved in alcohol; larvæ preserved dry, by inflation; larval exuviae; larval excrementa; diseased larvæ; the pupa; cocoon or ground cell, exterior and interior; pupa-case from which the moth has emerged; empty cocoon; perfect insect in its typical form, varieties, aberrations, monstrosities, etc.; depredations on each of its food-plants; parasites and other natural enemies, etc. When these collections are connected with agricultural colleges and other institutions for promoting agricultural interests, they are usually arranged so as to present for convenient inspection all of the insects connected with a particular food-plant. By this method, rather than by following the order of insect classification, one whose wheat-crop has been attacked by an insect unknown to him, should be able, by consulting the cases devoted to wheat insects, to learn the name of the depredator, and at a glance much of its history, habits and changes. The biological collection of the New York State Agricultural Society, prepared by Dr. Fitch during the latter period of his connection with the Society, was arranged upon this plan. The cases contain the following material: Case 1 — Insects infesting grain and other crops (specifying each principal crop); Case 2 — Grass insects; Case 3 — Insects of the garden (specifying the principal vegetables, flowers, ornamental shrubs, etc.); Cases 4 and 5 — Insects infesting fruit-trees (apple, plum, pear, cherry and quince); Case 6 — Insects injurious to man and animals. About 1600 specimens are contained in this collection, while in another series of larger cases are shown the larger biological specimens illustrative of insect depredations on plants, timber, furniture, and books.*

In the Entomological Division of the Department of Agriculture at Washington, now under the direction of Prof. Riley, the commencement has been made (by Prof. Comstock) of a biological collection which shall, as fully as possible, illustrate the investigations of the Department. It at present contains one hundred and twenty-five cases (double-sided, 31x21 cm.), of which forty-eight are Hemiptera, mainly *Coccidæ*, illustrating the recent Departmental studies of these destructive insects. The collection will no doubt be rapidly extended,

**Psyche*, ii, 1879, p. 275.

for the liberal appropriations made by Congress for this Division, of \$35,000 per annum, is securing for it, through its corps of trained entomologists, a broad range of investigation and a large amount of biological material.

A recent circular ($\frac{3}{18832}$, No. 4) of the Smithsonian Institution announces that "Prof. C. V. Riley has deposited in the Museum [United States National Museum] his extensive private collection of insects. The collection comprises some 30,000 species and upward of 150,000 specimens of all orders. * * * * * The collection is chiefly valuable for the large amount of material illustrating the life-histories, habits, and economy of species, 3,000 of which are represented in one or all of the preparatory states, either in liquid in separate boxes, or blown and mounted dry with the imagines."

Perhaps no one fact may be cited that will better show the progress made in entomology in this country, than that in one of our museums — the Museum of Comparative Zoölogy at Cambridge, Mass., is to be found a biological collection *that has not its equal in the world*. For this we are indebted to the recognition of the great importance of the science by Louis Agassiz, shown in calling to the curatorship of the Entomological Department of the Museum the distinguished European entomologist, Dr. Hermann A. Hagen, and to the appreciation by Alexander Agassiz of the work initiated, in retaining for its successful prosecution the services of the able curator, in the face of unusual efforts to recall him to his former home. The biological collection, which the ability and zeal of Dr. Hagen has brought together and so admirably arranged for scientific study, was based upon extensive European material. To this, large American collections have been added, until it has become wonderful in extent, in variety, in fulness of illustration, with an arrangement permitting of convenience of study and insuring preservation, which it does not seem possible to improve. It occupies, at present, twenty cabinets of eighteen drawers each. Three hundred and fifteen drawers (of 16x19 inches — the size adopted by the principal museums of Europe) are arranged for exhibition and study, while fifty others are nearly ready for incorporation.

The examination of the collection by one qualified to judge of its worth compels a regret that it must forever remain an unique. How it would tend to the diffusion of knowledge could it but be multiplied and distributed for study, like the impressions of a printed page. And yet, the student, who appreciates the superiority of the natural object for purpose of study over any representation of it, and who would best learn what lessons may be taught by the proper assemblage and grouping by a master-hand of even otherwise worthless material, such as deserted tenements, cast-off integumenta, excreta, chips, worm-eaten

leaves and the like, will yield to its attraction, and make his pilgrimage even from the far west, as some have done, to pay his homage to the accumulated treasures of the Entomological Department of the Agassiz Museum at Cambridge.

5. Discovery of Valuable Insecticides.

Another indication of real progress in economic investigation is the knowledge attained within the past few years of several poisons and other substances which may be safely and easily used for destroying insect life. Paris green, which holds foremost rank among our Insecticides, and without which that almost indispensable article of food — the potato — could not be grown in some localities, was first recommended for the purpose in the year 1869, when a correspondent from Wisconsin, of the *Galena* [Ill.] *Gazette*, published the information that the preceding year, with one pound of Paris green mixed with two of flour, sifted through a coarse muslin cloth on the potato tops early in the morning, he had destroyed millions of the beetles feeding on them and obtained a fine crop of potatoes.* Pyrethrum had been used for several years under the names of "Persian Insect powder" and "Dalmatian Insect powder," for the destruction of household pests, but it was not until 1879 that it was shown by Mr. Wm. Saunders, of London, Ontario, by his experiments with it upon grasshoppers and plant-lice, that it could be employed in the destruction of insects infesting our fields and gardens.† London purple was first introduced in the year 1877.‡ It was analyzed by the chemist of the Department of Agriculture the following year and found to contain forty-three per cent of arsenic acid in such association as to warrant experiments with it as a substitute for Paris green.§ The experiments made by the U. S. Entomological Commission were successful and speedily brought the article into popular favor. The prompt action of oils, such as kerosene oil, coal oil and paraffine oil, in destroying insect life, is well known, and experiments are teaching us the best methods of their application without injury to plant-life.

The very great value of several of the popular Insecticides, in an economic point of view, warrants a special notice of some of them.

1. Paris Green as an Insecticide.

The popularity which Paris green has obtained as an Insecticide grew out of the need of some substance (hand-picking and mechanical

**American Entomologist*, i, 1869, p. 219.

†*Canadian Entomologist*, xi, 1879, pp. 185-6.

‡*Ninth Report on the Insects of Missouri*, 1877, pp. 45-47.

§*Annual Report of the Commissioners of Agriculture for 1873*, p. 144.

gathering having proved insufficient) which could be employed for the destruction of the hordes of the Colorado potato-beetle, which were invading and threatening the entire ruin of every potato field throughout Northern and Middle United States east of the Rocky Mountains and southward into North Carolina and Northern Texas.* It was found that by no other means could this be accomplished so quickly, economically and effectually, and it has, therefore, notwithstanding the popular prejudice against so free an use of a virulent poison, been very extensively resorted to, for several years past, in the cultivation of the potato. It has also been successfully employed in protection from other insect ravages.

Paris green is a combination of arsenic and copper, known in science, as arseniate of copper. In its pure state it contains fifty-eight per cent of arsenic (arsenious acid). The enormous demand for it—druggists in some of the great agricultural centers of the West have ordered it by the ton—and the prevalent disposition to economize in its use by purchasing it at the lowest price, have led to its great adulteration. As frequently sold, it contains less than one-half its proper proportion of arsenic. In using it as an insecticide, it is important that it be obtained pure, for otherwise the directions for its use are not applicable to its altered condition.

It may be used either in its dry form as a powder, or mixed with water or other liquid.

Diluents.—In its dry application, it is mixed with some other material to reduce it to a degree that will admit of its use without injury to the plants upon which it is cast, and of its convenient distribution. The materials usually employed are flour, plaster, finely sifted wood ashes, air-slacked lime and road dust. Care is necessary that it be thoroughly mixed, by long-continued stirring, unless some special contrivance is arranged for the purpose.†

The Dry Mixture.—The best results have been obtained when flour is used, as the compound seems to adhere better to the leaves of plants and to be more readily eaten than are the mineral and other substances. The proportion of flour required will vary with the crop to be protected. Potato leaves will safely bear a pound of Paris green to

*See map of invaded territory, in *Ninth Missouri Report*, p. 36, and estimates of area on p. 38.

† A simple contrivance for the purpose is thus constructed: "It consists of a barrel which has a longitudinal wooden axle projecting somewhat at each end. Five or six staves run through the barrel longitudinally but do not project at either end, and on one side is an aperture large enough to admit the ingredients. When they are in, the aperture is closed and the barrel is placed over a large open box, or fixed in any way so that it can be revolved by means of a handle attached to the projecting axle. (*Bulletin No. 3, of the U. S. Ent. Commis.—The Cotton Worm, 1880, p. 74.*)

twelve of flour, and probably even a less dilution. Other vegetation will show injury to the leaves unless twenty pounds of flour be used, and if desirable to dilute still further for delicate plants, even thirty pounds of flour to one of pure green will destroy a large proportion of insect pests in their early stage. Plaster of Paris as a diluent has the recommendation of its fertilizing properties where uneaten, and of its much less cost. Fifty pounds of it may be used with one of green. A recent statement announces that with a pound of *pure* Paris green thoroughly mixed with from 150 to 200 pounds of plaster, "all the bugs or young, as they appear upon the potato vines [probably having reference only to the newly-hatched larvæ] are readily destroyed." The mixture should be applied in early morning while the leaves are wet with dew, that it may adhere the better.

The wet mixture.—When in liquid suspension, for Paris green is insoluble in water, a half pound may be mixed with forty gallons of water. Double this amount of green, or, in ordinary household measurement, a tablespoonful (a little over an ounce and a half) in a pailful of water (four gallons) is often used on many plants without injury, when more active results are desired. It has been recommended that two or three pounds of flour, first boiled into a paste, be added to the water, or which is more easily done, the flour mixed in a bucketful of water may be set aside until it sours, to save the trouble of boiling.

The liquid application has several advantages over the dry method, as, for example, it is more quickly applied, it gives a more equable distribution, it obviates the danger of inhaling the poison that attends its scattering in the air, and by aid of proper appliances, it can be advantageously used in the protection of our fruit-trees.

Application of the Powder.—The most simple mode is to tie a muslin bag containing the powder to the end of a stick, and to shake it over the plants. A better method, however, and the one usually adopted, is that of a tin box of a convenient size with a cover and having the bottom finely perforated, or covered with wire gauze—the box to be fastened to a stick about three feet long. With this a person can walk along the plants to be dusted, and by gently striking the handle with another small stick, the powder can be uniformly distributed with the greatest care. Boxes made for this purpose and ready for convenient use, similar to that shown in Fig. 6, are to be purchased in our cities and in most of our larger towns. In applying the powder, care should be taken to keep to the windward of the plants to be dusted that it may not be breathed. For poisoning entire fields, numerous other contrivances have been devised and patented, which may be propelled on wheels,

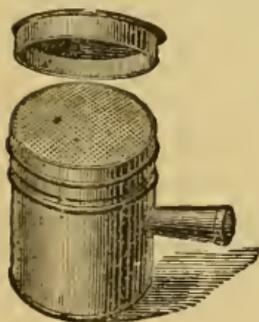


FIG. 6.—DUSTING BOX, for Paris green.

and are applicable to the protection of the Southern cotton fields. Several of these "Dusting Machines" are described and figured in *Bulletin No. 3, of the U. S. Entomological Commission*.

Cost of the Dry Application.—It is estimated that for the protection of the potato crop, an acre will require three pounds of Paris green and thirty or thirty-five pounds of flour. This, with the green at its usual price of fifty cents a pound, will make the cost of each application, without counting the labor, from \$2 to \$3. If the beetle is very abundant, and the powder should happen to be washed away by frequent and hard rains, three or four applications, or even more, may be needed during the season.

Application of the Liquid.—When but a few plants or small areas are to be poisoned, no other appliances are needed than a small pail and a brush-broom. With the latter in the right hand, the water, at each dipping, may be sufficiently stirred to hold the green in proper suspension, and the adhering liquid shaken over the plants. When a larger amount of the liquid is necessary, it may be applied with an ordinary watering-pot, provided with a more finely perforated rose than that which commonly accompanies it, which can be made by any tinman. The contents of the pot will require frequent stirring with a stick, to prevent the settling of the poison.



FIG. 7.—SPRINKLER. For distributing Paris green water.

For poisoning on a still larger scale, cans of a large size to be strapped upon the back have been devised, and are for sale in some of our principal cities. One of these, shown in operation in Fig. 7, is thus described in Prof. Riley's *Seventh Missouri Report* (1875, p. 15):

"It consists of a can capable of holding about eight gallons of liquid, and so formed as to rest easily on the back, to which it is fastened, knapsack fashion, by adjustable straps, which reach over the shoulders and fasten across the breast. To the lower part of the can are attached two rubber tubes, which are connected with two nozzles or sprinklers. The inside of the can has three shelves, which help to keep the mixture stirred. There is a convenient lever at the bottom which presses on the tubes and shuts off the outflow at will, and two hooks on the sides near the top on which to hang the tubes when not in use. On the top is a

small air-tube and a capped orifice. Two bucketfuls of water are first poured into the can, then three tablespoonfuls of good green, well mixed with another half bucketful of water and strained through a funnel-shaped strainer which accompanies the machine, and the use of which prevents the larger particles of the green from getting into the can and clogging up the sprinkler. Five to eight acres a day can readily be sprinkled by one man using the can, and from one to one and a half pounds of good green, according to the size of the plants, will suffice to the acre. Two lengths of nozzle are furnished, one for use when the plants are small, the other when they are larger. The can should be filled on the ground, and then raised on a bench or barrel, from which it is easily attached to the back. The walking serves to keep the green well shaken, and the flow of liquid is regulated at will by a pressure of the fingers at the junction of the tube with the metallic nozzles. When not in use, the tubes should be removed, and the can emptied and laid upon its back."

When it is desirable to apply the poison to tall shrubs, vines, evergreens or fruit-trees, a forcing-pump is almost a necessity, and perhaps no better one can be recommended for general use than the "Hydronette," manufactured by Messrs. Rumsey & Co., of Seneca Falls, N. Y. It is shown in the accompanying figure.



FIG. 3.—THE HYDRONETTE, for the application of Paris green, London Purple, etc.

It consists of two brass tubes, one working telescopically within the other. When the inner tube, by means of the handle **B**, grasped in the right hand, is drawn outward from the outer tube **C**, held in the left, the water enters the pump through the rubber hose **E**, the brass capped end of which is dropped in a pail of water. When the inner tube is pushed back by its handle, the water, being prevented by a valve from returning, is forced outward through the nozzle at **A**, with such force as to project it to a distance of about forty feet. At **D**, a rose is represented, which may be unscrewed and substituted in place of the nozzle **A**, whenever it is desirable to distribute the water in a fine spray. The Hydronette works so easily that it may be used by a boy of eight years of age. A man may hang a bucket of water upon his left arm, and dropping or coiling the hose in it, may apply the liquid as he walks along the plants to be sprinkled. Or, when it is desirable to distribute the liquid uniformly over a field, the tubes may be continuously worked by one person while another carries the pail, and still

another supplies the poison as fast as used. The instrument is made in two sizes, which are sold by the manufacturers or their agents at \$8 and \$10.

The same Company also makes another force-pump, having the advantage of throwing a continuous stream of water, at the rate of from eight to ten gallons per minute to a height of forty or fifty feet.



FIG. 9.—THE AQUAJECT, for application of mixtures and solutions.

Whitman, of Providence, R. I., which has been extensively advertised, and highly recommended by some of our practical entomologists who have tested its working, appears to be very similar in construction to the Hydronette of Ramsey & Co., and is to be used in the same manner.

In using any of the above forms for the application of Paris green or London purple to apple-trees or other tall trees, it was found that the single stream thrown by the ordinary nozzle could not be distributed over the tree without the consumption of a large quantity of water: if thrown above the tree and allowed to break in drops in its fall, the momentum permitted but a small portion of the poison to adhere to the leaves. With the rose, the water would be scattered in a spray, but only the lower branches could be reached. To obviate these

It is known as the "Aquaject," and is sufficiently shown in the accompanying figure, without explanation. Its price, with three feet of suction hose and the same length of distributing hose, with brass discharging pipe and rose sprinkler, is \$9.00. Still another form, made more particularly for a fire extinguisher, but by means of a rose which may be procured with it, may also be used for destroying insects, is arranged for standing in a pail of water, where it is held in position by an iron attachment which fastens it to the rim. The catalogue price of this, with pail, is \$8.00.

The Whitman Fountain pump, manufactured by J. A.

difficulties, Messrs. Rumsey & Co. have made, at my suggestion, a flattened nozzle pierced with six minute apertures, as represented in Fig. 10, by means of which fine streams can be thrown to the tops of apple-trees, distributing the liquid most economically, and in the form which seems to be the most favorable for the spreading and adherence of the poisons. The nozzle may be applied to any of their pumps, and is to be obtained by application to the Company.



FIG. 10.—NOZZLE, for applying Paris green and London purple to fruit and other trees.

Several more complicated sprinklers have been patented, most of which were specially devised for use in cotton plantations. The U. S. Entomological Commission mention, with more or less full description and illustration, no less than twenty of these sprinklers and atomizers.* The complication of structure displayed in some of these serves to show the inventive talent and mechanical skill called in requisition in order to attain the most practical and economical method of protecting large areas of vegetation, by means of poisons, from insect destruction.

No danger in properly using the poison.—Paris green has not gained its popularity as an insecticide without opposition in many quarters. Several of our scientific men have protested against so free and extensive use of the poison, predicting that grave results would follow. The experience, however, of more than ten years has shown that the apprehended danger has not been, nor will be, realized. It is now believed by those who have given the subject the closest study, that with proper precaution, and in obedience to directions, it may be used with entire safety. The following precautions should always be taken :

The poison should be kept in a safe place and plainly labeled, "POISON."

Do not distribute the powder with the hand, as is sometimes done. An abrasion of the skin might result in serious harm.

Apply the powder with the wind, if any, so as not to breathe it.

Do not use it upon leaves or fruit which are soon to be eaten, or where it will not be washed away by repeated rains (as on cabbage, cauliflower, etc.).

Prevent animals from feeding on poisoned vegetation, and poultry from eating the poisoned insects.

Test the strength of the poison upon a few plants first, lest it may be too strong for the leaves.

Use it of no greater strength than is necessary to kill the insects.

Make such change in crops that its use upon the same ground may not be continued for many years. (Perhaps not important.)

* *Bulletin No. 3. The Cotton Worm*, by Chas. V. Riley, M. A., Ph. D., 1880, pp. 77-97,

There is no foundation for the fear entertained by some persons that potatoes grown from plants treated with the poison are either poisonous or unwholesome. Repeated examinations of such potatoes made by our best chemists have failed to give the least trace of arsenic; and if the potatoes prove watery or appear to be in otherwise bad condition, it may be the result of a diminished foliage of the plants through the insect attack, rather than the poison administered.

Nor can we believe, in view of recorded experiments, that the poison, as it is now being employed, can affect the soil so as to interfere with healthful plant-growth. Prof. R. C. Kedzie, of the Michigan State Agricultural College, has shown conclusively that the arsenic of Paris green does not remain in the soil as such for four months, but before that time it undergoes chemical changes which render it harmless.*

Mr. Wm. McMurtrie, as chemist of the U. S. Department of Agriculture, has instituted a series of very interesting and satisfactory experiments to test the influence of Paris green upon soil and the plants grown therein, which have been published in detail, accompanied with copies of the photographs of the fifteen pots of pease experimented upon and treated respectively with from one hundred milligrams to one grain of the Paris green.† The results obtained were these:

1. An aggregate of 906.4 pounds of Paris green per acre must be applied to the soil before any injurious effects on plant-growth are appreciable [the ordinary application to a potato field is from a pound to two pounds per acre.]

2. Arsenic cannot be absorbed and assimilated by the plant in the economy of growth. All of the plants grown in the arsenical soil, tried by Marsh's test, failed to indicate the presence of arsenic.

3. Potatoes subjected to applications of Paris green failed to give evidence of the presence of arsenic.

The Insects that may be destroyed by Paris Green. — In addition to the Colorado beetle, there are many other injurious species against which this poison may be conveniently used. It would be well, however, not to resort to its aid except in cases where it will accomplish the desired purpose better (convenience, economy and efficiency being considered) than non-poisonous substances.

It may be advantageously used against several other of the potato-insects which occasionally appear in numbers and destructiveness almost equalling the Colorado beetle, as, for example, the three-lined leaf-beetle — *Lema trilineata* (Oliv.), the ash-gray blister-beetle — *Macropa-*

*Quoted in the *Eighth Annual Report on the Insects of Missouri*, 1876, p. 7.

†*Report of the Commissioner of Agriculture for the year 1875*, pp. 141-147, pl. 10.

sis unicolor (Kirby), the margined blister-beetle — *Epicauta cinerea* (Forst.), the striped blister-beetle — *Epicauta vittata* (Fabr.), the cucumber flea-beetle — *Epitrix cucumeris* (Harris), and species of the tortoise-beetles — *Chptocycla aurichalcea* (Fabr.) and *C. clavata* (Fabr.), when numerous.

It would also be useful against the striped cucumber-beetle — *Diabrotica vittata* (Fabr.), and other leaf-eating beetles and their larvæ.

It would be effectual, used in its liquid form with a force-pump, for the prevention of the defoliation of the horse-chestnut, the smaller elms and other shade-trees by the caterpillar of the white-marked tussock-moth — *Orgyia leucostigma* (Sm.-Abb.), which has become such a public nuisance in many of our principal cities.

It has been found to be of great value in preventing the ravages of the spring canker-worm — *Anisopteryx vernata* (Peck), an insect which for some reason, has not occurred as the serious pest in the apple orchards of New York that it has in the Eastern and several of the Western States. With this agent at command, and its efficacy having been thoroughly tested, it is hoped that the threatened increase and spread of the canker-worm in New York may be effectually checked.*

The liquid may be used for the protection of low evergreens from the larvæ of saw-flies and of the basket or bag-worm — *Thyridopteryx ephemeraformis* (Haw.). It should also be available for ridding the Virginia creeper — *Ampelopsis quinquefolia*, from the eight-spotted Forester — *Alypia octomaculata* (Fabr.), and the beautiful wood-nymph — *Eudryas grata* (Fabr.), two prettily-banded blue caterpillars which frequently almost strip the vines in the city of New York and its vicinity.

Paris green would also be an excellent agent for the destruction of the army-worm — *Leucania unipuncta* Haw., applied copiously to the fields where it abounds, or, when it has commenced its marches, to broad strips of grass-land lying in its line of march, and subsequently plowing under the poisoned surface.

In brief, it will be of service whenever extensive depredations occur, not easily controllable by other means, from leaf-eating insects and their larvæ, upon leaves not used for food of men or animals, or only used after so long a period that the poison shall have been entirely washed away, or even upon edible fruit occurring at the time in so

*The following active measures against this pest were employed in the extensive orchard of Mr. Chapin, in East Bloomfield, Ontario county, N. Y., of one hundred and twenty acres: "The canker-worm commenced its inroads, and was worst last year on the interior trees. Mr. Chapin showered them with a mixture of Paris green and water, which brought them dead to the ground in a few hours. The water was drawn in a box holding over two hundred gallons, in which was mixed two and a half pounds of Paris green. A forcing-pump and hose threw a stream high above each tree, where it broke into a spray, and falling, sprinkled every part." — *Country Gentleman*, xliv, 1879, p. 710.

immature a stage or in such condition that it will not permanently retain the poison.

2. London Purple as an Insecticide.

An analysis of a specimen of London purple by the chemist of the U. S. Department of Agriculture gave the following results:*

	Per cent.
Rose aniline	12.46
Arsenic acid.....	43.65
Lime	21.82
Insoluble residue.....	14.57
Iron oxide.....	1.16
Water.....	2.27
Loss.....	4.07
	100.00

As appears from the above analysis, it is mainly an arseniate of lime. It is a refuse material, obtained in the manufacture of aniline dyes, heretofore worthless. Its cost, therefore, need not much exceed that of package and transportation. Its efficacy in the destruction of insects appears to be about equal to that of Paris green, although it does not accomplish its work so rapidly, for often its effects are not apparent until the second or third day after its application. From the short time that experiments have been made with it, we are not prepared to say that it may entirely take the place of Paris green, yet there are several considerations which seem to give it a greater value as an insecticide than that substance.

Its cost is much less, as it can be purchased at fifteen cents a pound, and at ten cents or less by the keg or barrel. Less than half the quantity is needed. Prof. Riley states that while the cost to the cotton planter of the Paris green material per acre has been one dollar, that of the purple will not exceed five cents.

It is of nearly uniform strength, as its production being much in excess of demand, it does not pay the manufacturer to adulterate it by mixture with any other substance.

As mixed for use it is far less poisonous than Paris green, as is shown from its having been eaten by persons without serious harm.†

It is more adhesive to vegetation and, therefore, not as readily washed away by rains.

**Annual Report of the Commissioner of Agriculture for the Year 1878*, p. 144.

†“I know of two negroes who stole some flour in which it had been mixed in the ordinary proportion for use on cotton, and made biscuits thereof. Both were made sick, but neither seriously. (Prof. Riley in *American Entomologist*, iii, 1880, p. 246.)

Its effects are more permanent, as from its fine state of pulverization it is partially absorbed by the leaves.

The color that it imparts to vegetation shows its application and may serve to prevent the careless use of poisoned plants for food.

In its condition of a very fine powder it admits of a more thorough admixture when used dry, and is more easily kept in suspension in water.

Method of using.—It may be mixed with flour, plaster, or any of the diluents mentioned for Paris green, and dusted upon the vegetation by any of the means there given which may be found the most convenient. When prepared of the strength of one pound of the purple to ten of flour it will injure only delicate vegetation. Reduced with seventy pounds of flour, it will be found to kill nearly all of the leaf-eating larvæ. For general use, the proportion recommended, and which has given the best practical results, is one pound of the purple to forty of flour or other substance.

Its application in water may also be made as directed for Paris green. With one pound mixed with forty gallons of water, some vegetation has been injured. A dilution with forty gallons of water will probably destroy most larvæ. For quite young and more delicate ones, a dilution of one hundred gallons will suffice, and the experiments of the Entomological Commission in the cotton fields have shown that in dry weather and under other favorable conditions, with a pound of the purple mixed in one hundred and fifty gallons, the cotton-worm was readily killed. It should be mentioned that the cotton-worm—*Aletia argillacea*, Hübn., has been found to be more sensitive to the poison than some other larvæ of the *Noctuidæ*. It is, of course, desirable that the poison be not used in greater strength than is needed for killing the species to be destroyed, and the maximum degree of dilution can easily be ascertained by experiment.

The addition of a small quantity of flour to the water will give greater adhesiveness to the poison.

Useful in the destruction of the Apple-worm.—London purple has been used successfully by Prof. A. J. Cook for destroying the apple-worm or codling-moth—*Carpocapsa pomonella* (Linu.). In his recent experiments, continued through two seasons, a tablespoonful was mixed with a pail of water, and this quantity was sufficient, usually, for three trees. It was used in early summer, and the results were very satisfactory, as a large proportion of the fruit was saved from attack. It was believed that the purple formed a thin coating over the fruit and prevented the deposit of the eggs (the eggs are deposited soon after the apple forms), or that the upturned calyces at this time held sufficient of the poison to kill the newly-hatched larvæ in the attempt to

penetrate them to enter the apples. In subsequent chemical examinations of the fruit treated in this manner, no arsenic could be detected, and it was freely eaten by Prof. Cook and his family without any injurious effects. Still, additional experiments in this direction are desirable, before we may give to this method of protecting apple trees unqualified recommendation.

A circular of Hemingway's London Purple Company, 90 Water street, New York, gives the following directions for the use of the purple on potato plants :

"The best method of use is with water. Mix the purple into a smooth paste, and then add water in the proportion of three gallons to each ounce, or forty-eight gallons to one pound. Stir well, and apply by sprinkling with a whisk or fine watering-pot, taking care not to deluge the plants, but only cover with a fine spray. From an economical point of view it is wise to pass it through a strainer. This can be done by tying some cheap cotton-cloth over an iron hoop a little larger than the tub or cask in which the mixture is made, the purple put into the strainer and the water poured over it into the cask, which, as it goes through, will leave behind all dirt or bits of sticks which might otherwise choke up the Fountain pump or other spray-producing instrument.

"If preferred, it may be used dry in the proportion of six pounds of plaster to one ounce of purple, or 100 pounds of plaster to one pound of purple. Mix well by passing the two materials through a sieve. The more perfectly this is done the more certain the effect.

"The proportions given above are the strongest that should be used. If care be taken, a much more dilute mixture may be used with equal advantage."

3. Pyrethrum as an Insecticide.

The Persian and the Dalmatian insect powders are the finely pulverized flowers of species of *Pyrethrum*—the former of *Pyrethrum roseum* and *P. carneum*, and the latter and the most highly esteemed, of *P. cinerariæfolium*. The Persian powder has been known for a number of years, and the peculiar properties of the powder of some species of *Pyrethrum* had been utilized even in the past century; but until within the last three years, it had only been employed against household insect pests, as flies, mosquitoes, roaches, bed-bugs, etc. A small quantity of it diffused in a closed room by means of the bellows made for the purpose, acts very quickly upon flies, by bringing them to the floor, struggling upon their backs. They are unable to fly, and if placed upon their legs, they are incapable of using them in locomotion. The powder appears to produce a paralysis from which they rarely recover, although death may not follow until a day or two thereafter. While affecting insects in this manner, it may be distributed in a room as above, and be breathed by persons with perfect safety.

Since the experiments of Mr. Saunders, previously referred to, whereby it was shown that Pyrethrum could be employed against some of our out-door insect pests, other experiments in continuance have been made which have so extended its range of usefulness as to lead us to believe that we have but begun to learn its value as an insecticide. Under the demand which is springing up for it, it is being extensively cultivated in this country, mainly by Mr. Milco (a native of Dalmatia), near Stockton, California, and an article is being produced by him from the *Pyrethrum cinerariaefolium* and sold under the trade name of "Buhach," which is represented by those who have thoroughly tested it, to be superior to much of the imported Dalmatian powder. The high cost of the imported powder (about \$1.25 per pound) has been hitherto an obstacle in the way of its use, but Mr. Milco, from the facilities which he has for its production, promises shortly to place it in market at a price which will admit of its general use.

The Department of Agriculture has also shown a commendable zeal in importing the seed and distributing it, through the Entomological Commission, to numerous persons in the United States, with the request that experiments be made in its cultivation in various localities and under different conditions, in accordance with detailed instructions given. It is hoped that some one of the species will be found to admit of such easy culture that it may be grown by farmers and others for domestic use. The circular recently issued by Commissioner Loring contains a statement of Professor Riley, giving a history of Pyrethrum, its method of cultivation, its preparation for use, its uses as an insecticide, and modes of application. From the latter, we extract the following:

Pyrethrum can be applied:— 1, as dry powder; 2, as a fume; 3, as an alcoholic extract diluted; 4, by simple stirring of the powder in water; 5, as a tea or decoction.

1. *Application as dry powder.*— It is generally used without diluent, but if unadulterated and fresh (which it not often is, as retailed by druggists), it may be considerably diluted with other pulverized material, without losing its effect. For this purpose flour seems to be the best, but finely-sifted wood ashes, sawdust from hard wood, etc., or any substance that will mix well with the powder, will answer. If the mixture is applied immediately after preparation, it is always less efficacious than when left in a perfectly tight vessel for twenty-four hours or longer before use. Experiments have shown that one part of the powder to eleven of flour were required to kill the cotton-worm, when applied immediately after its application; but when it had been kept in a tight glass jar for about two days, double the amount of diluent (twenty-two pounds of flour) sufficed to kill most of the average-sized worms with which it came in contact. For very young cotton-worms, a mixture of one part of Pyrethrum to thirty parts of flour, and applied one day after preparation, proved most effective, hardly any of the worms recovering.

2. *Application in fumes.*—The powder burns freely, giving off considerable smoke and an odor which is not unpleasant. It will burn more slowly when made into cones by wetting and moulding. In a closed room the fumes from a small quantity will soon kill or render inactive ordinary flies and mosquitoes, and will be found a most convenient protection against these last where no bars are available. Insects of soft and delicate structure are affected most quickly. This method will be found very effective against insects infesting furs, feathers, herbaria, books, etc. Such can easily be killed by inclosing the infested objects in a tight box or case and then fumigating them. The method will also prove useful in green-houses.

3. *Alcoholic extract.*—The extract is easily obtained by taking a flask fitted with a cork and a long and vertical glass tube. Into this flask the alcohol and Pyrethrum is introduced and heated over a steam tank or other moderate heat. The distillate, condensing in the vertical tube, runs back, and at the end of an hour or two the alcohol may be drained off and the extract is ready for use. Another method of obtaining the extract, and a less expensive one, is by re-percolation after the manner presented in the American Pharmacopœia. The former method seems to more thoroughly extract the oil. In either case, the extract is more expensive than the other preparations, though convenient for preserving and handling.

The extract may be greatly diluted with water and then applied with any atomizer. Diluted with fifteen parts of water, it killed all the cotton worms in a few minutes upon which it was sprayed. When mixed in the proportion of one to forty of water, it killed two-thirds of the worms in twenty minutes and disabled the remainder. A dilution of one to fifty still killed some of the worms and disabled others.*

4. *Water solution.*—This method of application is believed to be the simplest most economical, and most efficient. The bulk of the powder is most easily dissolved in water, to which it at once imparts the insecticide principle. No constant stirring is necessary, and the liquid is to be applied in the same manner as the diluted extract. The finer the spray in which it is applied the more economical is its use and the greater the chance of reaching every insect on the plant. Experiments have shown that 200 grains of the powder (about one-half an ounce), stirred in two gallons of water, was sufficient to kill all but the most hardy full grown cotton-worms; but was not strong enough to kill some other larvæ, especially such as are protected by dense long hairs. A solution of one-half of the above strength would destroy young cotton-worms. The solution is most efficient when first made, and gradually loses its power. On the third day it develops a fungoid growth and its efficacy is then much impaired.

5. *The tea or decoction.*—Prof. E. W. Hilgard, of California, who has experimented with the Pyrethrum in this form, thinks that the tea simply prepared from the unground flowers is the most convenient and efficacious method in which it can be used. When sprayed from a fine rose, he found it to be efficient even against the armored scale-bug of the orange and the lemon, which fell off in two or three days after the application, while the young brood are almost instantly killed. Tea made from the leaves and stems has similar although considerably weaker effects. The plants might be grown by the farmer and fruit-grower, when, by simply curing the upper stems, leaves and blossoms all together, the tea

*For a statement of the mode of preparation of the extract and experiments with it upon the boll-worm (*Heliothis armigera*) and the cotton-worm, see the *American Entomologist*, iii, 1880, pp. 252-3.

could be made by the hogshead at a trifling expense, and distributed from a cart by means of a syringe. The tea should be made with briskly boiling water, covered over closely, to prevent evaporation, but not boiled, as that would seriously impair its strength.

While the simple mixture of the powder with water gives such satisfactory results, it hardly seems worth while to look for any other method of using the Pyrethrum, for nothing can surpass this in simplicity. It is only necessary, if the fresh and unadulterated powder can be obtained, to mix a half pound of it in a pail of water and apply it in a fine spray over the young caterpillars, slugs, etc., feeding upon the leaves. The effects upon them are wonderful: they quickly show its operation in writhing and falling to the ground, from which, if the solution is of sufficient strength, they cannot regain the plants, although in some cases, death may not ensue until the following day. If any are found eventually to recover, the solution should be made of greater strength. It must be applied directly upon the infesting insects, as it only acts by contact, and does not have the permanent effect of the poisonous insecticides which are eaten with the leaves.*

The Insects that may be destroyed by it.—Pyrethrum appears to be a very valuable agent for the destruction of the troublesome caterpillars of the cabbage butterfly — *Pieris rapæ* Linn. Its efficacy for this purpose has been recently shown in some experiments by Prof. Cook at the Michigan State Agricultural College. One part of the dry powder mixed with forty parts of flour and dusted over the cabbages, in the latter part of September, killed two-thirds of the caterpillars and stupefied some others. A tablespoonful of the powder mixed with a gallon of water and applied with a common sprinkling-pot to nine cabbages, killed of the larvæ present 17, stupefied 39, and left but 3 alive — the examination being made the following day. From the experiments which were carefully conducted (see *American Naturalist* for February, 1881, pp. 145-147) Prof. Cook draws these conclusions: "they show conclusively that this powder is fatal to the caterpillars, and that, too, in very dilute liquid mixture — 1-200 of a pound to a gallon of water. We have only to sprinkle it on the plants, though it may be necessary to make more than one application to insure complete success. The success was better with the liquid than with the flour mixture and can be applied with greater speed and economy."

Some squash-bugs — *Anasa tristis* De Geer, which had been kept in a close tin box, in the clear powder for three days, were not killed by it. The Colorado potato-beetle can be killed by dusting with the powder, and the larvæ are quite susceptible to it.

I have found the powder ineffectual for killing the harlequin cabbage-bug — *Murgantia histrionica* (Hahn.): it only paralyzed them

*For the peculiar effect of Pyrethrum upon the heart-beat of a caterpillar, see *American Naturalist*, 1882, p. 1015.

for a few hours; but my material was not fresh and may have been adulterated.

Dusted over house-plants and in the green-house it is said to kill the Aphides (plant-lice) and to preserve the plants from subsequent attack (*Canad. Entomol.*, xi, 1879, p. 42; *Amer. Entomol.*, iii, 1880, p. 105).

It has been found to free the Passion vine from the attack of the striped blister-beetle [*Epicauta vittata* (Fabr.)], by stupefying them and causing them to drop from the vines (*Amer. Entomol.*, iii, 1880, p. 193).

It is said to drive away the flea-beetle from turnips and the harlequin cabbage-bug from cabbages by dusting the powder upon the leaves (loc. cit., p. 296).

The powder sprinkled over grain in a mill infested with the grain-weevil [*Sylvanus Surinamensis*], killed them so that they could be swept up by the quart (loc. cit., p. 178).

Hymenoptera (bees, wasps, etc.), are stated to be the most readily affected by the powder. In some experiments made with the fumes upon insects of different orders, they were affected in the following order: ground beetles, locusts, erickets, flies, mosquitoes, gnats — the last yielding most quickly to its influence (loc. cit., p. 195).

The above is but a general résumé of what has recently been learned and published of this very popular insecticide. For those who may desire additional information, references to some of the recent literature upon the subject are herewith given:

Trans. N. Y. St. Agricul. Soc. for 1859; xix, 1860, p. 445 (seed sent to the Society); for 1863, xxiii, 1864, pp. 201-2 (general notice).

Rep. Commis. Agricul. for 1877 (1878), pp. 59, 60 (tests of powders of Pyrethrum and other Compositæ).

1st Rep. U. S. Entomolog. Commis., 1878, p. 400 (inefficient on locusts).

Rep. on Cotton Insects, 1879, p. 236 (brief notice).

Canad. Entomol., xi, 1879, pp. 40-43 (kinds, use, effects, etc.); p. 185 (general notice).

Amer. Entomol., iii, 1880, pp. 43-45 (general notice); p. 96 (preparation, etc.); p. 128 (price); pp. 193-195 (effects on different insects); p. 197 (cultivation); p. 222 (for codling-moth); p. 242 (on cotton-worm); p. 246 (properties); p. 250 (effect on different insects); p. 252 (effect on boll-worms); p. 276 (for sereworms); p. 296 (for cabbage and cotton-worm).

Bull. No. 3, U. S. Ent. Commis., 1880, pp. 62-65 (methods of use, price, etc.).

Proc. West. N. Y. Horticul. Soc. for 1881, pp. 75-77 (kinds, effects, price, etc.)

Amer. Naturalist, xv, 1881, pp. 569-572 (cultivation and manufacture); pp. 744-746 (use and application); p. 817 (applications).

4. Hellebore as an Insecticide.

This insecticide is the root of the white hellebore — *Veratrum album* ground to a fine powder, and used either in this state by sifting it upon

the insects to be destroyed, — by mixing the powder with water, or by a decoction made from the roots by boiling water, and applying it with a sprinkler.

Its insecticidal property was first discovered in England, when it was employed for the destruction of the currant-worm — *Nematus ventricosus* King, in the year 1841. When the same pest was afterward introduced in this country, and had commenced to destroy currant bushes in the vicinity of Rochester, in the year 1858, the hellebore remedy which had been so successfully used in England was resorted to here, and with equal success. Dr. Fitch, in his Twelfth Report on the Insects of New York, writes thus enthusiastically of its virtues :

“ Words fail us for suitably expressing the value of this substance. In the whole round of remedies for injurious insects we know of no other one that is so efficacious, we know of no other one that possesses such virtue for destroying any insect as does this substance for destroying this larva [the currant-worm]. It is a sovereign cure for the evil. It is a specific. It operates like a charm. Easy of application and certain in its effects, it is all that can be desired. The larva does not require to eat it. It kills the moment it touches. In the words of R. Lymburn, ‘ wherever a particle reaches a caterpillar, it collapses as if stabbed,’ yes, as if stabbed to the heart. Every one who notices this powder as it falls upon a worm will confirm the literal truth of this statement. The worm is instantly convulsed with a death spasm, rolls off the leaf and drops lifeless to the ground. It is ‘ a spectacle wonderful to behold.’ But if standing on the underside of a leaf where the powder does not touch it, when it afterward comes to eat a particle of it, its doom is sealed with equal certainty.”

Methods of use.—In using the hellebore as a powder, dusting boxes such as have been previously mentioned in connection with the other insecticides—a tin can with a piece of fine muslin tied over one end—or even a bag of simple muslin, may be employed. The box or bag should be attached to a short stick, of perhaps two feet in length, to permit of its being thrust among the bushes, and to remove the powder to some distance from the face, as when inhaled in the nostrils it excites violent sneezing; this property has caused it to be employed as the basis of many of the sneezing snuffs. Quiet days should be selected for the dusting, unless its need, when discovered, admits of no delay, as the fine powder is readily carried by the wind; the gentlest breeze that may be stirring will soon indicate to the operator the desirability of the application being made from the windward side. The slightest dusting of the leaves is all that is required. Before using, its strength should be tested by applying a small pinch to the nostrils.

and if it fails to produce a tingling sensation, it should be rejected as comparatively worthless. A pure and fresh article should be purchaseable at about forty cents the pound. This quantity should suffice to keep a garden of ordinary size free from the currant-worm for an entire season — to be applied as often as a fresh hatching or a new brood makes its appearance. With six pounds of the powder, a gardener in England cleared 3,000 gooseberry bushes from the larvæ which were thickly infesting them, by simply dusting them with a large pepper box.

In its liquid application, one pound of the powder may be mixed with from twenty to twenty-five gallons of water, or an ounce and a half (about three tablespoonfuls) in a pail of water, and finely sprayed over the plants. As hellebore kills not only by contact, but unlike pyrethrum, also by being eaten by the larvæ, the addition to the liquid of a small quantity of flour or any other substance that may give it greater adhesiveness, will promote its operating as a protection for a number of days following, from such larvæ as may have escaped the spraying or are subsequently hatched from the egg.

Insects against which it may be used.— In addition to its being a specific for the destruction of the currant-worm, it will probably be found equally efficacious against most of the “saw-flies” as they are popularly called — four-winged insects belonging to the family of Tenthredinidæ, of which the currant-worm may be taken as a representative. Its virtue has been tested upon the strawberry-worm — *Emphytus maculatus*, Norton and Abbot’s white-pine worm — *Lophyrus Abbotii* Leach; and it may be expected to operate with equal success upon the Fir saw-fly — *Lophyrus abietis* Harris, Le Conte’s saw-fly of the pines and fir — *L. Le Contei* Fitch, and the other species that infest our evergreens. It should also be valuable for use against the saw-fly of the Tartarian honeysuckle — *Abia caprifolium* Norton, which is often so destructive to its foliage. It may also be used for destroying the “slugs” which abound to such an injurious extent upon our rose-bushes, pear-trees and raspberries, viz.; *Selandria rosæ* Harris, *S. cerasi*, Peck, and *S. rubi* Harris. To all of these larvæ the liquid may be conveniently applied by means of a sprinkling-pot, the hydro-nette or the aquaject. The following method of using the liquid upon rose-bushes has been recommended: one tablespoonful steeped in hot water for ten minutes, diluted in five quarts of cold water, to which a small quantity of soft soap has been added to make it adhere better to the leaves, and applied through a syringe or fine rose of a watering can, while the leaves are still wet with dew. It is said that two applications, three or four weeks apart, will effectually repress the slug each season.

The common poke-weed, *Veratrum viride*, which grows so commonly in wet meadows, should have similar insecticidal properties, but we are not aware that it has been tested for the purpose. Whenever the prepared powder cannot be conveniently procured, this might be resorted to, as a substitute, by making a decoction of it with boiling water.

The following are references to some of the writings which have treated of the insecticidal properties of hellebore :

Fitch's Twelfth Report; in *Trans. N. Y. St. Agricult. Soc.* for 1867. xxvii, 1868, pp. 911, 919, 928, 930.

Canad. Entomol., ii, 1869, pp. 13-15 (effects on currant-worms).

Fourth Rep. Ins. Mo., 1872, p. 14 (useless against Colorado potato beetle).

Ninth Rep. Ins. Mo., 1877, pp. 13-16 (method of use, etc.).

Ormerod's Rep. Inj. Ins. for 1881, pp. 7, 43 (destroys cabbage butterfly larva and pine saw-fly).

5. Kerosene as an Insecticide.

While most of the oils are deadly to insects, kerosene seems particularly so, perhaps from the rapidity with which it spreads over the surface of the insect to which it is applied, at once reaching and closing the breathing pores and producing, through suffocation, speedy death. It is one of the cheapest of the insecticides and is among the most efficient, wherever it can be used without injury to vegetation. In many cases foliage has been injured by its application, and there seems to be justly a prejudice against its general employment, as the statements of experiments made with it are rather contradictory. While it is generally thought necessary to use it only when greatly diluted with water, yet Prof. Comstock reports that he has sprayed it undiluted upon orange leaves and ivy to destroy scale insects, and upon *Cratægus* to destroy the woolly-apple louse (*Schizoneura lanigera*) without the least injury to the foliage. The following testimony is borne to its value in the destruction of a class of insects which are among our most persistent and pernicious pests: "After the failure of many attempts to eradicate this insect [a scale insect infesting a number of imported varieties of orange, lemon, lime, etc., in the grounds of the Department of Agriculture at Washington] the collection may now be said to be entirely rid of it. This has been effected by the persistent use of a small quantity of coal oil [kerosene] applied in water. About one gill of astral oil in five gallons of water applied to the plants through a syringe on alternate days for several months has destroyed the insects without injury to the plants; weaker solutions seemed ineffective, and when the oil was increased to an appreciable degree, the young leaves and tender shoots of the oranges were injured."*

**Ann. Rep. Commis. Agricult.* for 1878, pp. 205-6.

A difficulty in the use of kerosene and water is found in the readiness with which they separate when at rest, requiring for their union violent and almost constant agitation. In the above applications the mixture was made by discharging the syringe several times into the vessel containing the liquid before each discharge upon the plants. Prof. Riley has announced the following method of overcoming the difficulty and dispensing with most of the attendant labor :

Nothing is more deadly to the insect in all stages than kerosene or oils of any kind, and they are the only substances with which we may hope to destroy the eggs. In this connection the difficulty of diluting them, from the fact that they do not mix well with water, has been solved by first combining them with either fresh or spoiled milk to form an emulsion, which is easily effected ; while this in turn, like milk alone, may be diluted to any extent so that particles of oil will be held homogeneously in suspension. Thus the question of applying oils in any desired dilution is settled and something practical from them may be looked for.*

Experiments made by Prof. Comstock do not fully confirm the above statements, as he experienced difficulty in obtaining the emulsions and in their subsequent dilution to any great extent, as appears from the following extract from his last Report :

An emulsion of kerosene and milk can be easily made by placing the fluids together in a bottle and shaking them violently for several minutes ; about three minutes is the time usually required. The quantity of milk used should be at least equal to that of the kerosene. The best results were obtained when the kerosene formed only one-third of the mixture, but equal parts of kerosene, milk and water gave as good results as one part of kerosene to two parts of milk. For example, in one series of experiments I was unable to make an emulsion of equal parts of oil and milk, but by the addition of a third part of *either water or milk* I was able in each case to make a good emulsion. These emulsions were of a thick, creamy consistence and were very stable, no indication of a separation of the oil from the milk in one case, or from the milk and water in the other, being observable even after the emulsion had stood for twenty-four hours. But as soon as water was added to the emulsion in any considerable quantity, the oil, or the oil and milk together, floated on the surface of the water ; and no amount of shaking would serve to mix the liquid so that the mixture would be stable. It is true that in some of the experiments the emulsion separated from the water less readily than oil alone would ; but in each case the mixture was of such a nature that it was necessary to stir it constantly in order to keep the oil suspended in the water.†

In all cases where kerosene can be used without applying it to vegetation it is a very valuable insecticide. It may thus be employed in various methods against a large number of insect pests, as for example :

A small quantity poured in a broad tin basin, either by itself or floated upon water, is serviceable for the collection of the Colorado potato-beetle (where there is an unwillingness to use Paris green and

**Scientific American*, Oct. 16, 1880, and *American Entomologist*, iii, 1880, p. 246.

†*Ann. Rept. Commis. Agricul.* for 1880, pp. 283-9.

London purple), the rose-bug, etc., by shaking them into it; and for destroying nocturnal insects attracted to lights placed in fields.

Cloths may be saturated and spread beneath trees to be jarred. The curculio would be killed by falling upon them, and this method would be of particular value with those insects which show a readiness, upon dropping from the foliage, to take wing or travel away, unlike the *curculionide* which usually counterfeit death for a while. A saturated cloth may be stretched upon a light frame and while held in a proper position beside or among infested vegetation, large numbers of the smaller leaf-hoppers, flea-beetles and other minute forms could be driven upon them and destroyed. Or a frame for the cloth could be so constructed as to be pushed by a long handle or drawn by cords over the surface of low-growing crops, by means of which many of these small insects flying or leaping against the cloth would absorb sufficient of the oil, even from the temporary contact, to kill them.

Cattle may be relieved from lice by simply applying the oil in a small quantity to a card, and occasionally carding them with it; its use for a few days will prove effectual (*Country Gentleman*, April 18, 1872, p. 250). It has been used successfully upon horses when the mane and neck have become, through neglect, infested with these annoying parasites, by rubbing it upon them; and upon hogs, by applying it thoroughly with a stiff brush or the stump of an old broom (*Ib.*, March 6, 1873, p. 155).

It is very valuable for henneries infested with lice and mites. Applied to the sides, top and bottom with a sprinkler or, which is better, with the rose of a force-pump, it will effectually destroy the vermin. When the nests of sitting hens are found to abound with a small species of the Acarina, to the extent, at times, of driving the hens from them, a moderate sprinkling of the nest will suffice to kill them and to keep them away. It may also be applied to infested fowls with a feather, to the portions of the body where the vermin are observed. It may even be used with safety upon young chickens, if judiciously employed. In all cases care should be taken not to permit the oil to enter the eyes, nostrils, or mouth.

In addition to kerosene being destructive to insects, it seems to be disagreeable to some species, or at least to prevent their presence. A writer in the *Country Gentleman* states that he has discovered a very simple means of ridding his stables from flies, by keeping the floor free from droppings, and sprinkling it slightly with kerosene by means of a tin can having a small hole pierced in the cork through which a pint of the oil may be distributed in a week's time.

6. Paraffine oil as an Insecticide.

This material has, within the last few years, become a popular insecticide in England, where it is highly esteemed for the destruction of underground larvæ. I am not aware that it has been experimented with in this country, nor do I know if it is manufactured for sale.

The oil is produced by the distillation of Cannel coal. The crude oil gives four products, viz.: 1st, Paraffine naphtha; 2d, Paraffine oil, used as a burning fluid in lamps, in England; 3rd, a heavy oil much used for machinery in Lancashire; 4th, Paraffine used for candles.

When applied to vegetation by sprinkling, in the proportion of one pint of oil to two gallons of water, it has been used with satisfactory results in England for destroying the carrot-fly (*Psila rosæ*), the currant-worm (*Nematus ventricosus*), the onion-fly (*Anthomyia ceparum*), etc. It is claimed that even so dilute a mixture as a glassful of the oil to six gallons of water, and sprayed over the plants two or three times has arrested an attack of the onion-fly; and a wine-glass of oil to one gallon of water has been of service in attack of the carrot-fly.

A plot of young larches nearly destroyed by a species of aphid (*Chermes laricis*) was saved and restored to health, by watering them at intervals of three or four days, for about three weeks, with diluted paraffine, in the proportion of a wine-glassful to a watering-can of water.

An excellent method of mixing the oil is said to be the following: Put the oil first in a pot and then fill in the water vigorously with a syringe. In applying it, one man is kept lifting a syringe out of the mixture and discharging it into itself, while another applies it to the plant. In using upon tender vegetation, it should be syringed off with clear water in two or three minutes (*London Gardener*).

When mixed with some absorbing substance, as ashes, sand, sawdust, or even dry earth, and applied in this form to the ground, it is more gradually absorbed and is more lasting in its results. Thus one quart of oil to a wheel-barrow of wood-ashes has operated quite beneficially in protecting carrots, turnips, etc., from attack. A convenient method of applying it to plants is to mix with sand just a sufficient quantity of the oil to moisten it, but not to prevent its running readily through the hand, when it may be scattered broadcast or applied directly to the roots of plants. In the absence of rain, sprinkling with water will aid in carrying the oil into the ground. A field of turnips badly infested with the wire-worm (*Agriotes lineatus*), was saved by strewing the paraffined sand with spoonfuls along the center of the drills, so as to fall directly above the roots of the plants,— the whole

crop of four acres being gone over in one day by employing several persons; the effect was thoroughly satisfactory.

The above statement of application and results are drawn from Miss Ormerod's Manual and Reports.

7. Bisulphide of Carbon as an Insecticide.

This material was first brought to notice during the long series of experiments made in France a few years ago, by Government Commissions, distinguished chemists, and others, for the discovery of means for destroying the grape phylloxera. It was proposed to utilize the vapor given off by it in its decomposition when buried in the ground, which should permeate the soil and reach the hidden and sheltered insects among the roots of the vine, more effectually than could be accomplished by liquid poisons as ordinarily applied. In employing it for this purpose, holes to the depth of two or three feet were made in the ground among the roots by a pointed bar, into each of which about two ounces of the bisulphide was poured. Later, an auger was devised to take the place of the bar, having a hollow shank, perforated just above the cutting portion and with an opening at the handle for receiving the liquid. When the auger was withdrawn after the introduction of the liquid, the hole was tightly closed with earth. Very good results attended its use in this manner; and there is no reason to doubt that it would be equally beneficial for destroying other minute forms that infect the roots of growing plants. It should be a remedy for the injuries of the apple-root plant-louse — *Schizoneura lanigera* (Hausm.), — the *Pemphigus pyri* of Fitch, which causes the death of so many apple-trees — of much more common occurrence in the Western States than in New York, where the species is oftener found upon the trunk than on the roots.

Prof. Cook, having experimented with the bisulphide of carbon for destroying the species of *Anthomyia* infesting our root crops, and some of the root-borers, strongly recommends it for use against the cabbage fly, *Anthomyia brassicæ* (for method of use see page 190), the peach-tree borer — *Ægeria exitiosa* Say, and the squash-borer — *Melittia cucurbitæ* (Harris).

While there are reasons why this material may not come into extensive use as an insecticide, it promises, from its pungent and penetrating odor, to be a valuable agent in protecting plants from egg deposit.

8. Carbolic Acid as an Insecticide.

Carbolic acid has also been used to arrest the ravages of the phylloxera in the same manner as above mentioned for the bisulphide of carbon, and with very good success. Vineyards, through its use, have

been preserved in good condition, while adjoining ones not thus treated have been destroyed.

Prof. Cook has used it, both in its crude state alone, and as combined with soft-soap, for the protection of radishes from the radish-fly, *Anthomyia raphani* (see page 199 where, under the remedies for *A. raphani*, his experiments are given). While the experiments are reported as entirely successful, it does not appear from the account whether the application of the carbolic acid served to destroy the eggs and the larvæ of the fly, or whether it prevented the deposit of the eggs.

I have made use of the acid when quite diluted—one part to one hundred of water, and have recommended its use to others, for ridding potted plants from the small larvæ and worms having their abode in the soil to the great injury of the roots: in all cases when tried, as far as I have learned, the application has been successful.

A correspondent of the *Country Gentleman* (vol. xxxviii, p. 186) commends it very highly for removing vermin from animals.* He used it in the form of carbolic soap prepared by James Buchan & Co., of New York, and by simply washing the hair of cattle with a lather from the soap, he was always able to kill the vermin and the eggs with which they were infested. It also killed those on hogs. A lamb suffering from a bad attack of the "fly," so that a large part of its back and one side was a mass of living larvæ, was cured by two applications of carbolic ointment and lard oil—the oil being used to dilute the ointment so that it could penetrate the wool. At the same time that it killed the larvæ, it also served to prevent fresh attack and to heal the sore. The correspondent concludes his statement of the beneficial effects of the carbolic treatment, with "I know of nothing as valuable to a stock-raiser as the preparations of carbolic acid."

For insecticidal purposes the crude carbolic acid should be used, as being much less expensive than the crystals. It can be purchased of the principal druggists in our larger cities.

9. Soluble Phenyle as an Insecticide.

This material has been brought to the notice of economic entomologists mainly through the experiments reported by Miss Ormerod, of England—made directly by her, or upon her suggestion. It is manufactured in England, under the name of "Little's Soluble Phenyle,"

*The Pediculidæ, or lice ordinarily infesting domestic animals, belong largely to the genus *Hæmatopinus*. Of these, *H. vituli* and *H. eurysternus* are parasitic on both cattle and horses, often becoming very abundant and of serious annoyance and injury to them. *H. suis*, as its name imports, a large species of nearly one-eighth of an inch in length, occurs on the hog. *H. piliferus* lives on the dog.

where it has been known for some time as a highly valuable disinfectant, deodorizer and antiseptic. It is sold in this country through its general agent, T. W. Lawford, No. 296 East Chase street, Baltimore, Md. It has some of the more valuable properties of carbolic acid, although containing but a very small percentage of this material. An analysis made of it shows that "Phenyle contains 0.79 phenol (carbolic acid) and between eighty and ninety per cent of a high-boiling tar-oil—probably 'dead-oil,' whose most prominent component is naphthaline, and which itself contains little or no phenol. The emulsifier is probably a potash soap or something closely allied."

It appears from Miss Ormerod's Reports that she checked with it an attack of the celery-fly (*Tephritis onopordinis*) by syringing with a very dilute mixture of it and water: others had used, without effect, paraffine-oil and water. A strong attack of the carrot-fly (*Psila rosæ*) was also arrested by its use (Report for 1880, p. 24). It also acted as an excellent preventive of attack, for peas were saved from any injury from the pea-weevil (*Sitones lineatus*) by sowing them in coal ashes saturated with a tablespoonful of phenyle to a gallon of water, the ashes left covered for several days before use to become thoroughly charged with the smell (Report for 1879, p. 8).

It is claimed for this fluid that it will quickly and effectually destroy vermin on sheep, horses, cattle, swine, dogs, cats and poultry. Numerous testimonials to its value in the destruction of the insect pests of animals have been given to the general agent in this country, several of which have been published in circulars (some of them giving the methods of use—degree of dilution of the fluid, etc.) which may be obtained upon application to the agent. As a sheep-dip, for killing ticks and other parasites, it has attained a high reputation, and is being "largely used in all the great wool-growing countries of the world. In Australia it is the recognized dip, and in New Zealand is used at the Government Dipping Stations."

The following directions are given by the agent for its use for Horticultural purposes:

Aphis.—For clearing peach, apple, rose bushes, geraniums, etc., from the aphis, syringe with a mixture of one teaspoonful of fluid to four gallons of water, and syringe with clear water in a few minutes.

Scale on orange trees, etc.—Three, four, five and six teaspoonfuls of the fluid to four gallons of water. Three applications at eight days' interval completely destroy the scale insects. Syringe off with clear water fifteen minutes afterward, more especially if any young foliage is upon the trees.

Ants.—Three spoonfuls of fluid to four gallons of water will destroy these insects.

The claims made for the Soluble Phenyle as an insecticide warrant thorough experiments for testing its value. I have received a package of it, but too late to report any experiments with it at the present time. It may probably be procured in most of our larger cities of prominent druggists. It is put up for sale in bottles, at from twenty-five cents to one dollar each, equal to from three to twenty-five gallons when diluted for use.

10. Coal-tar as an Insecticide.

Dumas, the celebrated French chemist, who was employed by the Government to discover the best means for the destruction of the Phylloxera, experimented with over a hundred substances—most of which were active poisons, and found that the best results were obtained with the sulpho-carbonates and coal-tar.* The latter substance has accordingly been employed in France for destroying the Phylloxera with very good results.

In this country it has been largely employed as a means for catching and destroying the Rocky Mountain locust in several of the Western States. A very simple contrivance was invented for its use, which was known as the Robbins Coal-tar Pan: "A strip of sheet-iron twelve or fifteen feet long is bent up one edge sufficiently to admit of its passing over lumps of earth; other strips, from four to six inches wide, are riveted to the other edge and at each end, forming a kind of scoop. A wire is attached to each front corner of the scoop by which it can be drawn over the ground. A chain or rope is fastened so that it will drag upon the ground about eighteen inches in advance of the machine to scare up the grasshoppers. The inside of the pan is covered with tar, and the machine is dragged across the field against the wind. The efficacy of this simple contrivance is wonderful. One gallon of tar is good for a bushel of grasshoppers when rightly used."

This simple arrangement so satisfactorily accomplished its purpose, giving relief from the fearful locust invasions when nearly all other means had been found ineffectual, that Governor Pillsbury, of Minnesota, undertook to furnish to all parties throughout the State who would make application, immediate supply of the required material, upon understanding of future reimbursement by them. In his Annual Message for 1877, the Governor states: "This offer was promptly accepted, and all available supplies for material having been secured at wholesale, a rigorous war of extermination was maintained simulta-

* *Annales de Chimie et de Physique*, 5e série, vii, 1876.

neously in twenty-nine counties of the State. * * * * * In the prosecution of this enterprise there were employed about 56,000 pounds of sheet-iron and 3,000 barrels of coal-tar, which required a total expenditure of about \$10,350."

Another trap was employed in Colorado for destroying the locusts, which is described as "a piece of oil-cloth, nine to twelve feet long and six wide, one side and each end of which are secured to light, wooden strips by common carpet-tacks, the corners being strengthened by braces. The oil-cloth being smeared with coal-tar, the trap is dragged over the ground by two men, a cord about ten feet long being fastened to the front corners for that purpose. The entire expense of the trap is about \$3.50."

A still more simple trap has been used with very satisfactory success, by substituting sheets of building paper for the oil-cloth, and coating it with the tar.

For more detailed accounts of these and other coal-tar traps, reference may be had to the *First Report of the U. S. Entomological Commission*, 1878, pp. 387-391.

It is evident that these traps may also be employed for the collection of other low-feeding insects occurring in extensive numbers, especially for the hopping species.

A method of using coal-tar in the irrigating ditches in Colorado may suggest somewhat similar methods for its use elsewhere. "It consists essentially in pouring, or better, in dropping coal-tar on the running water with which the irrigating ditches were supplied. It is only necessary to sprinkle a few drops on the stream, when the oils contained in the tar are diffused over the surface of the water, and coming in contact with the insects (no matter how many), cause their speedy death. The toxic power of coal-tar upon the insects is very remarkable; a single drop of it floating on the water is capable of causing the death of a large number of insects." (*First Rep. U. S. E. C.*, p. 382.)

A convenient method of using coal-tar for the destruction of many of the smaller insects that infest our garden, is to procure a coal-tar barrel with a few gallons of tar remaining in it; fill with water and use from it as needed with a sprinkler. It may be refilled a number of times if the tar be occasionally stirred with a stick to disengage the oil. Used in this manner, it is also a valuable deterrent from insect attack.

It has been stated (*Country Gentleman*, xli, 1876, p. 262), that a gallon of coal-tar mixed with a pound of sulphur, placed in a frying-pan and set on fire, and passed under plum-trees in the morning while wet with dew, every other morning during the curculio season, made

the trees black with the deposited soot, and effectually prevented the attack of the curculio.

Coal-tar, known also as gas-tar, is one of the residual products of gas manufacture. As the result of scientific investigations, these residuals, which were formerly of no value whatever but were simply a waste material, to be disposed of at no inconsiderable cost, have, of late years, become valuable articles of commerce, as they now form the basis of manufactures of great importance. Thus, the corporation of Bradford, England, has lately been offered \$50,000 per annum for the ammonia and tar liquids, which eight years previously had been disposed of at a yearly expense of about \$4,000—the former being now almost the only source of ammonia, which has become so popular as an agricultural fertilizer, and from the latter is obtained asphaltum, carbonic acid, cresylic acid, naphtha, the various and beautiful aniline dyes, anthracine, and other valuable products. In this country ammoniacal liquid is seldom utilized. In the vicinity of New York it is employed to a limited extent for fertilizing purposes. Coal-tar is purchasable at a very low price—at the Albany gas-works at \$2.50 per barrel. In the Western States, during the large demand for it in the destruction of locusts, its prices ranged from from \$3 to \$8 per barrel.

11. Gas-Lime as an Insecticide.

The value of this material for checking and for averting insect depredations is recognized among the agriculturists of England, where it appears to be growing in popular favor, as may be seen from the frequent references to it in Miss Ormerod's Manual of Injurious Insects and her later Annual Reports. It has been extensively experimented with, and, for the most part, with quite satisfactory results. For example, it was found, when sprinkled among onions, to check an attack of the onion-fly; it was successfully used against the cabbage-worm (*Pieris rapæ*) by distributing it over the plants, probably both killing the larvæ present and preventing egg-deposit (Manual, p. 37); and applied when fresh to the ground in the autumn as a dressing, and "pointed in" with a few inches of the surface soil, it killed the pupæ of the celery-leaf miner (*Tephritis onopordinis*) lying an inch or two beneath the surface (Ib., p. 60.)*

A refuse material in gas manufacture.—Gas-lime is a refuse material produced in the manufacture of illuminating gas. The common slacked lime, slightly dampened, is spread in numerous shelves of perforated iron in a cast-iron chamber, and as the gas distilled from

*It would doubtless be of equal value, when used in the same manner, against other pupæ lying near the surface, as those of the onion-fly, cabbage-fly, turnip-fly, etc.

the coal is forced through it, it leaves with it its sulphuretted hydrogen and other impurities. It is produced in large quantities by all our gas-works, and, up to the present, it is regarded only as a waste material of no commercial value. As it entails an expense to dispose of it, it would, no doubt, be readily given to any one who would remove it from the works. The Albany Gas Light Company, last year, produced 19,000 bushels, which was carried away by the company and used for filling up some low grounds.

Its value as a fertilizer.—In this country, gas-lime has, within a few years past, been used to some extent as a fertilizer. If its value for this purpose were generally known, and also its proper method of use, there is scarcely a doubt but that every bushel would be reclaimed from waste, and utilized upon lands with quite beneficial results. In reply to frequent inquiries made of one of our leading agricultural journals by correspondents, of its value and method of use, the reply has generally been to this effect: Gas-lime is beneficial to such land as may be improved by the application of common lime. As it is dangerous to vegetation when applied in its fresh state, it should be kept for a year or two, and then fifty bushels may safely be applied to an acre. It may be either made into a compost with two or three times its bulk of swamp-muck, or applied directly to the soil after having been pulverized.

From some experiments made with it during several years, it would seem that it may be much more freely used than above stated and with less caution. A gentleman who claims that he has thoroughly tested its value as a fertilizer, states that two hundred bushels per acre may be safely spread upon meadows and pastures through the winter and up to March 1st, letting the rain wash it into the soil. During the month of February he drew two loads a day fresh from the works, and spread it as it was drawn. (*Country Gentleman*, xlvi, 1881, p. 85.)

Its use, in its fresh state, as an insecticide.—Used as above, in its fresh state, in the latter part of winter, besides its value as a fertilizer, it would unquestionably be of much additional value as an insecticide. It would be destructive to most hibernating larvæ near the surface of the ground and perhaps to the depth that they ordinarily penetrate. The young and less than half-grown larvæ of the vagabond Crambus (*Crambus vulgiragellus*) in their slight protective coverings, would certainly be killed by it. As the latest studies render it probable that the army-worm (*Leucania unipuncta*) in this portion of the United States, usually passes the winter as a caterpillar, sheltered, perhaps, among the roots of the grasses, we should be able to prevent the

excessive multiplication of this pest by the free use of this material. And if we are ever to obtain the mastery of the "white-grub" of the May-bug (*Lachnosterna fusca* Frohl.), so destructive often in grass lands, it seems to me that it is to be accomplished by the use of gas-lime or some very similar product. Experiment could only teach us the proper method and time of its application. We can hardly hope to destroy the pupæ at the great depth at which they are buried, but it may be operative against the young grubs during the first year of their existence. If it should be found that the very early conjunction of the sexes of an allied species (*Polyphylla variolosa*), noticed on page 72, is the general rule among the Lamellicornes, and, as I am inclined to believe, from so extraordinary a development of the generative instinct, that immediately after mating, the earthen ball to receive the egg deposit is shapen by the female and the eggs placed therein, before she takes wing in search of food, then, if as soon as the beetles are seen abroad, the lime be freely applied in as great strength as is consistent with safety, and rain soon follows in sufficient quantity to dissolve out and carry into the soil the poisonous sulphites, the egg-deposits lying just underneath the surface will be reached and killed. If the female requires to be abroad for awhile before she returns to lay her eggs, then the lime meantime applied should serve to prevent their deposit, for reasons given in subsequent pages.

Useful for destroying hibernating insects.—Probably in a large majority of cases where crops have been badly infested with insects which are known to pass the winter in the earth for transformation or simple hibernation, and where the ground is to be prepared in the spring for another crop, a liberal application of fresh gas-lime to the soil at any time between the removal of the crop and near to the time for again planting or sowing, will prove of great benefit.

Useful upon infested crops plowed under.—Whenever a standing crop has become so infested as to render it advisable to turn it under, if the plowing be followed by an application of gas-lime, the insects which have escaped crushing or serious harm in the disturbance of the soil, should be reached by the poison and their destruction completed, while the danger of subsequent attack is greatly lessened. In the many instances in which our economic entomologists have recommended plowing under the infested crop, I would venture to supplement this direction: follow with a liberal application of fresh gas-lime, if it can be conveniently obtained, of perhaps a hundred bushels to the acre. I believe that this would prove the best possible method of arresting severe attacks of the two great clover pests, the clover-seed midge (*Cecidomyia leguminicola*) and the clover-root borer (*Hylastes trifolii*), whenever they occur within easy reach of the gas-works

of our cities. As for any general use for the protection of our farm crops, the supply, at the above rate, would be entirely inadequate, it might be well to economize its use by employing it first against the insects of our gardens.

Its change by age and exposure.—When fresh from the works gas-lime cannot be used in any large quantity upon growing crops without destroying them, as the large proportion (nearly one-sixth) of sulphite of lime which it contains is readily washed out by rain and moisture, and when carried into the soil is destructive to nearly all plant growth. Upon exposure to the atmosphere, the sulphite is changed into the harmless sulphate of lime (plaster). This marked change which it undergoes by age and exposure is shown in the following analyses by Prof. F. W. Johnston :

Composition of Gas-lime.

	Nearly fresh.	Year or two old.
Water and coal-tar.....	9.59	9.59
Carbonate of lime.....	58.38	56.41
Hydrate of limo (caustic).....	5.92	....
Sulphate of lime (plaster).....	2.78	29.32
Sulphite and hyposulphite of lime.....	15.92	....
Sulphur.....	0.92	....
Prussian blue.....	1.80	1.80
Alumina and oxide of iron.....	3.40	3.40
Sand, etc.....	1.29	1.29
	<hr/>	<hr/>
	100.00	101.81
	<hr/> <hr/>	<hr/> <hr/>

The length of exposure required to fit it for use upon growing crops may best be learned by experiment. If left until it has parted with nearly all of its sulphurous odor, it will no longer be of special value as an insecticide ; it should, therefore, be tested from time to time and used just as soon as it is found that no harm to the plant follows its application. In many of the experiments made by English agriculturists and gardeners, it had lain from four to six months. In this condition it may be sprinkled directly upon garden plants, even upon cabbages quite advanced in growth, or scattered over the soil, killing the insects without injury to the plants.

Valuable in preventing insect attack.—In addition to its value as an insecticide and as a fertilizer (the latter directly tending through vigorous growth to lessen the losses from insect attack), it may also claim a high order of value in preventing the attack of injurious insects by protecting vegetation from the deposit of their eggs. The operation of this principle will be referred to at some length hereafter.

REMEDIES FOR INSECT DEPREDACTIONS.

In the preceding notice of the principal Insecticides, such directions have been given for their use, together with mention of some of the insects against which they may be employed, as should enable any careful person, possessing even a moderate knowledge of the insect world, to use them with safety, with discrimination, and with success, selecting from the number the one which may seem to be the best adapted to the existing emergency, after giving due consideration to the object attacked, the season of the attack, the nature of the attack, and the insect attacking. The frequent inquiries in the pages of our agricultural papers in regard to the use of Paris green, London purple, gas-lime, etc., show, that notwithstanding all that has been published in relation to them, there is still a wide-spread ignorance of their proper methods of use, and an increasing desire for the information which we have endeavored to bring together in convenient form.

It will also be of service to those who are desirous of availing themselves of the knowledge already obtained of the means for the control of insect ravages, to present, in this connection, some of the many remedies and preventives which have been successfully employed for the purpose. Several pages could be filled with them, but those given will serve to suggest others. In the brief form in which they are offered, they may be regarded as a list of weapons serviceable in our warfare with insects, while the skill for their use, the knowledge of how and when to use them to the best advantage, and against what insect foes, may be better learned by experiment than through a long detail of directions — impossible to give in limited space, and necessarily reserved for the discussion of special insect attacks.

The remedies which consist in the use of the insecticides already noticed are omitted. Others, are the following:—

Hand-picking and destroying the eggs: as those of the currant-worm (*Nematus ventricosus*) on the lower leaves of currant bushes, and of the apple-tree tent-caterpillar (*Clisiocampa Americana*) on the leafless twigs in autumn or winter.*

Hand-picking the larva: as the tobacco-worm (*Macrosila quinque-maculata*), the sphinx and other large caterpillars of the grape-vine, etc.

*At a time when the ravages of the caterpillars of the Grape-vine Tortrix, of Europe, *Enectra Pilleriana* (W. V.), were unusually excessive, it was found that the best means of abating the evil was by picking off the leaves containing the eggs of the moth which were laid in clusters of about sixty each. In one vineyard of one hundred and fifty hectares, thirty persons (women and children) were employed for eleven days in gathering and destroying the egg-clusters; and during this time they collected 1,134,000 of the clusters, representing over sixty-eight millions of caterpillars which would have been produced by them. This method proved so effectual that a decree of Government was demanded compelling the proprietors of the vineyards to perform it annually.

Hand-picking the cocoons: as those of the bag-worm (*Thyridopteryx ephemeraformis*), during the winter when they are so conspicuous as to be readily seen.

Hand-picking the perfect insect: as the rose-bug (*Macroductylus subspinosus*), when not too abundant.

Jarring trees by pounding on an inserted iron spike, or by shaking and collecting on sheets spread beneath, or on prepared frames; as for the curculio (*Conotrachelus nenuphar*) and the May-bug (*Lachnosterna fusca*).*

Jarring as above for caterpillars that drop by threads when alarmed, and sweeping them upon a rod for destroying: as for the canker-worms (*Anisopteryx pomctaria* and *A. vernata*).

Beating the insects from low plants into a pan of water, soap-suds or oil: for those that readily fall when disturbed, as the blister beetles upon potato leaves, the ash-gray b. b. (*Macrobasis unicolor*), the margined b. b. (*Epicauta cinerea* Forst.), the striped b. b. (*Epicauta vittata* Fabr.); and the tortoise beetle on the same (*Coptocyclus aurichulcea* Fabr., and *C. clavata* Fabr.).

Collecting the webs of tent caterpillars with their contained larvæ: for the apple-tree tent-caterpillar, and the autumn tent-caterpillar (*Hyphantria textor*).

Cutting off twigs containing companies of social caterpillars, as for the red-humped prominent (*Edmasia concinna*) and the yellow-necked apple-tree caterpillar (*Datana ministra*), on the apple.

Cutting off infested stems and burning: for the currant borer (*Aegeria exitiosa*), the raspberry-twig girdler (*Oberea tripunctata*), and the rose-twig borer (*Grapholitha Puckardi?* Zell.).

Crushing between the fingers the shelter of leaf-rollers and leaf-tiers: for the rose-leaf caterpillar (*Penthina nimbata*) and other tortricids.

*An excellent apparatus for the purpose, convenient for orchards of moderate size, is the following: Take a square of two yards white muslin, or if a larger size is needed for larger trees, make a piece by sewing together, two by three yards, or larger. Stiffen it with light rods across the ends, and with one rod at the middle to keep them apart and to serve as a handle, as shown in the figure. Let it be a little slack, so as to give a slightly concave form to the sheet. Iron plugs having previously been inserted in the tree, or into each main branch, the operator holds this sheet in his left hand under one side of the tree, and strikes the plug with a heavy hammer in his right hand. The curculios caught upon the sheet may be turned into a pan of water and kerosene. Oil-cloth might be substituted for the muslin, as it would not wet with the dew when used in the morning, and as affording a smoother rolling surface for the beetles. (*Country Gentleman*, xlv, 1881, p. 259.)

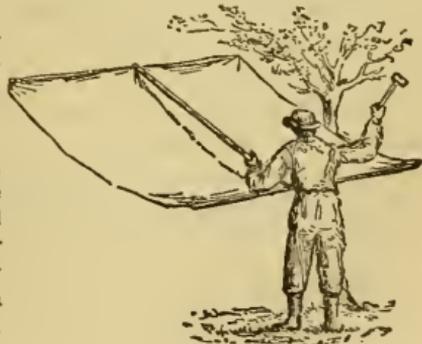


FIG. 11. CURCULIO CATCHER.

‡ Gathering and destroying fallen infested fruit: for the apple-worm (*Carpocapsa pomonella*), and the plum curculio.

Probing burrows and killing the grubs with a bent wire or flexible stick: for the round-headed apple-tree borer (*Saperda candida*).

Cutting out the larvæ from tree-trunks: for the flat-headed apple-tree borer (*Chrisobothris femorata*), and the peach-tree borer.

Digging about plants for cut-worms destroying young cabbages (larvæ of *Hadena devastatrix* and *H. subjuncta*), tomatoes (the greasy cut-worm, *Agrotis ypsilon*), and other plants (various species of *Agrotis*, *Mamestra* and *Hadena*).

Searching with a lantern for night-feeding caterpillars upon grape vines (for *Agrotis cupida**), and upon apple, pear, peach, and cherry trees, for the climbing cut-worm (*Agrotis scandens*), the dark-sided cut-worm (*Agrotis Cochranii*), and others. A sudden jar upon the tree will cause many to drop to the ground when they may be readily noticed and killed.

Attracting to fires of dry wood where it is abundant, or of refuse material from the fields, insects abounding at certain seasons, and known to be readily attracted by light.

Attracting to lamps placed in a vessel of oil or adhesive mixture; as has been done for destroying the cotton-worm moth (*Aletia argillacea*).†

Attracting to poisoned sweets, as molasses and beer (the bait used by collectors in "sugaring" for moths for their cabinets), in which a small quantity of arsenic or cyanide of potassium has been mixed, to be spread on trees, fences, or leaves of plants.

Burning the dead stalks, leaves and other garden refuse in the late autumn to destroy hibernating insects.

Burning stubble in the autumn to destroy the pupæ of the Hessian fly (*Cecidomyia destructor*), unless they are found to contain parasites, when burning would do more harm than good.

Deep plowing in the autumn, to crush or bury delicate pupæ that lie near the surface.

Ditching to collect "marching" caterpillars, as of the army-worm (*Leucania unipuncta*), and in the Western States the chinch-bug (*Blissus leucopterus*).

Barricading with boards coated with coal-tar to prevent migration from one field to another.

Ponring tar upon the ground along the exposed sides of fields to serve instead of boards to arrest migration.

**Thirtieth Rep. N. Y. St. Mus. Nat. His.*, 1878, p. 236; *Lintn. Ent. Contrib.*, iv, 1878, p. 124.

†In Bulletin No. 3 of the U. S. Entomolog. Commis., on the Cotton-worm, are given notices of ten different lamps, of which some are movable on wheels for drawing through the fields, with illustrations of several of them.

Rolling the ground to pack it and render it more difficult for root-attacking insects to enter the ground for the deposit of their eggs.

Applying benzine in floor-joinings near the walls and beneath the base-boards of rooms to kill the carpet-bug (*Anthrenus scrophulariæ*).

Sprinkling with hot-water, of a temperature of from 130° Fahr. upward; for the cabbage-worm (*Pieris rapæ*), and many others.

Sprinkling with lime water will destroy many of the more tender insects.

Sprinkling with alum water — one pound of common alum dissolved in three gallons of rain-water, is stated to be effectual in killing cabbage caterpillars, and the currant-worm.

Sprinkling with copperas water is destructive to many of the smaller caterpillars that feed on shrubbery and garden plants.

Sprinkling with sulphuric acid water — one part of acid to fifty of water — is effective and safe on hardy plants.

Sprinkling with a weak solution of blue vitriol (sulphate of copper) — one ounce to a pail of water — kills many kinds of larvæ.

Sprinkling with an infusion of quassia — three pounds to a barrel of water — is recommended for killing cabbage-caterpillars, and preventing subsequent attack.

Sprinkling with a solution of soft soap and carbolic acid; for plant-lice on rose-bushes, etc.*

Sprinkling with a solution of one pound of whale-oil soap in one gallon of water, for insects infesting rose-bushes. A solution of this strength should after a few minutes be washed off with water.

Sprinkling with tobacco water is an excellent remedy for many insect attacks, from its poisonous nature.

Watering copiously, at nearly the boiling point, for killing the peach-tree borer.

Watering with ammoniacal liquor from gas-works will kill many larvæ attacking root crops.†

Dusting with air-slacked lime; for the larvæ of the asparagus beetle (*Crioceris asparagi*), the larvæ of the grape-vine flea-beetle (*Graptodera chalybea*), and other similar Coleopterous larvæ.

Dusting with air-slacked lime and carbolic acid — a tablespoonful of

*Take of the crude carbolic acid one part to ten of soft soap, and after mixing it thoroughly, let it stand for a few hours. Test the mixture by stirring a little in soft water. If oily globules of the acid float on the surface add more soap to the mixture, and do so until the globules no longer appear. Dilute the mixture to a moderately strong solution, with which sprinkle the infested plants. If the plants are delicate they will need to be washed off in a few minutes, otherwise the solution may remain to serve as a preventive, for some time, from another attack.

†A severe attack upon cabbages and cauliflowers was arrested by three or four applications of this liquid, diluted with twice its quantity of water and poured upon the soil directly around the stem of the plants (*Miss Ormerod's Report on Injurious Insects, for 1881, p. 8*).

the acid to a quart of lime: said to be effectual against the striped flea-beetle, *Phyllotreta vittata* (Fabr.), infesting the turnip, cabbage, radish, mustard, and many cultivated flowers, such as candytuft, sweet alyssum and most others belonging to the order *Cruciferæ*.

Dusting with soot: recently recommended as quite as destructive to the currant-worm as hellebore; it may be questioned whether it can operate as quickly.

Dusting with wood-ashes: of greater value when applied to vegetation that will hold it for percolation by rain and dew, for gradual penetration to the attacked portions.

Dusting with road dust or any other fine material that will readily adhere to a viscid surface, like that of the cherry and pear slug (*Selandria cerasi*), closing the breathing pores.

Showering a solution of soap by means of a force-pump: for killing scale insects upon the trunk, branches, and leaves of trees.*

Showering fish-brine upon trees infested with scale insects has been quite effectual in experiments with it—the oil with which it is charged doubtless penetrating the scale and killing the eggs beneath.

Smoking with burning tobacco confined by a vessel or tight bag over house-plants for fifteen minutes, for scale insects.

Watering with mustard water—a tablespoonful of mustard to a gallon of water; for soil of potted plants infested with worms and the larvæ of small flies.

Spreading soot upon the ground over the roots of plants in gardens attacked by small insects, and sprinkling occasionally with water.

Pasturing sheep in orchards to feed on fallen fruit: for the apple-worm of the codling-moth, and the apple-curculio (*Anthonomus quadrigibbus* Say).†

*Prof. Comstock, who, in the course of his special studies of the scale insects (see Report of the Entomologist of the U. S. Dept. of Agriculture for 1880), has been experimenting extensively upon methods for their destruction, recommends a strong solution of soap as preferable to any other substance, so far as known, for killing them without harm to the tree. The solution, in his experiments, was applied to some orange-trees infested with the red scale of California (*Aspidiotus aurantii* Maskell), of the strength of three-fourths of a pound of whale-oil soap to one gallon of water, with the result of killing all the insects upon the tree. A solution of half the above strength left only a few of the insects upon the leaves alive. As the result of all the experiments made, one-fourth pound of soap to one gallon of water is recommended—the application to be repeated after a few days. (*Ann. Rep. Commis. Agricul.* for 1880, pp. 286-7; *Id.*, *Proc. West. N. Y. Horticul. Soc.* for 1882, pp. 41-2).

†Sheep, in orchards, are also of much service in the prevention of insect injuries, by the more healthful condition of the trees through fertilization of the soil, not only by their manure but largely from the quantity of the soluble salts of potash (estimated at one-ninth of the weight of the fleece in the grease), which, as it is washed out by the rains, gives to the soil an element which is almost indispensable in successful orchard culture. For a statement of the benefit of sheep pasturage in an orchard, see *Report Commis. Agricul.* for 1873, pp. 405-6.

If the trees are young and the bark smooth, they may need protection from the sheep.

Employing swine to root for grubs in grass lands, for the white-grub (*Lachnosterna fuscus*), and in orchards for the spring canker-worm (*Anisopteryx vernata*).

Employing a flock of fowls to feed upon the asparagus beetle (*Crioceris asparagi*).*

Placing coops of young chickens in gardens to feed upon the numerous small beetles, such as the flea-beetles, and other insects infesting garden vegetation.

Protecting and encouraging such insectivorous birds as are found by the recent studies of Prof. Forbes, and others, to feed principally upon injurious insects.

Levying a war of extermination upon that unmitigated nuisance, the English sparrow (*Passer domesticus*), to which we owe, in the city of Albany and many of our other cities, a great increase of the caterpillars of the white-marked tussock-moth (*Orgyia leucostigma*) which defoliate our shade trees, and of other injurious hairy caterpillars.

Protecting the skunk for the service it renders the hop-grower in discovering and destroying the "grub" attacking the root of the hop-vine; and for the many other injurious insects which it feeds upon.†

Domesticating toads in gardens (the large common species, *Bufo Americanus*), where they are such successful nocturnal collectors of beetles, that entomologists have pressed them into the service of collecting for their cabinets. The stomach of one examined was found to be nearly filled with flea-beetles of a species abounding on cabbages and turnips in a garden.

Colonizing lady-bugs (the *Coccinellidæ*), on house plants and other vegetation infested with plant-lice.

Collection of parasitized insects and carrying them to localities where the parasite has not occurred. ‡

*Fitch: 6th to 9th Reports on the Insects of the State of New York, p. 186.

†Report of the Commissioner of Agriculture, for 1863, p. 268; Country Gentleman, xlii, 1877, p. 52.

‡This is quite practicable, and was accomplished by Dr. Le Baron, while State Entomologist of Illinois, who collected at his home in Geneva, in the southern portion of the State, a package of apple-tree twigs infested with the bark-louse (*Mytilaspis pomicorticis*), which were largely parasitized with the eggs of its parasite (*Aphelinus mytilaspides*)—a minute Chalcid fly. The twigs were sent into the extreme northern portion of the State, to Galena, where the same bark-louse abounded, but was entirely free from parasitic attack. Here they were tied to the branches of infested trees. On the second year thereafter, the presence of the parasites was discovered in many of the scales of the bark-louse examined at Galena, leaving scarcely room for doubt that the experiment had proved successful, and that the parasites had been introduced by means of the twigs sent for the purpose. The experiment, in view of the incalculable importance of parasitic aid in controlling insect depredations, may justly be regarded as "one of the most admirable instances on record of the triumph of science in its application to economic entomology." See Le Baron's *Third Ann. Rep. Ins. Ill.*, 1873, pp. 200-202.

Washing with tobacco, 16 pounds; oil of tar, 3 pints; soda-ash, 20 pounds; soft-soap, 4 pounds: for sheep (sufficient for a flock of fifty) infested with ticks (*Melophagus ovinus*).

Washing with "Sheep Dip," sold by Messrs. Kidder & Laird, 83 John street, New York, agents for James Buchan & Co.'s Carbolic Soaps, etc., for freeing from ticks.

Anointing with Cresylic Ointment, sold by the above firm, for destroying the "screw-worm" — very destructive to living animals and occasionally to persons in the Southern and Western States.*

Anointing with sulphur, lard, and kerosene, on the head and beneath the wings of fowls infested with vermin.

Suspending a thin muslin bag containing washed sulphur from the top of the cage of canary birds in position that it may be occasionally struck by the birds; for killing the mites (*Dermanyssus avium*) that infest caged birds.

Washing infested places with corrosive sublimate dissolved in alcohol (one-half ounce to one pint), for destroying bed-bugs (*Acanthia lectularia*).

Attracting to a paste of molasses and red-lead; for poisoning the cockroach (*Stylopyga orientalis*) and the Croton-bug (*Ectobia Germanica*).

Attracting to a mixture of molasses and London purple; for destroying the large black ant (*Formica Pennsylvanica*), which occasionally infests dwellings.†

Attracting to a sponge saturated with sweetened water, the little red ant, and when well filled, dropping in boiling water.‡ If very abundant, repellants are preferable (see page 65).

Attracting to a lighted candle in a basin of water on the floor of an infested room, at night, for fleas (*Pulex irritans*).

Trapping in a glass of soap-suds covered by a piece of card-board with a small central opening and covered within by molasses, honey or other sweets; for house-flies.

*The fly, which is believed to be a species of *Lucilia*, deposits its larvæ on blood or bloody living flesh, and in seasons of great abundance, also on meat exposed in markets. See *American Entomologist*, iii, 1880, pp. 21, 203, 275, 276.

†A house infested by this insect was entirely relieved from its presence in a single night by removing all food from the pantry to which the ants were accustomed to resort, and placing in it a saucer of maple-syrup in which was thoroughly mixed a teaspoonful of London purple. The saucer, for hours, was blackened with the congregated ants, and the following day, their dead bodies were thickly strewn along their trail. Not an ant was there after seen in the house (*Country Gentleman*, for June 22, 1882, p. 501, col. 4).

‡This species, which has become so great a pest in many localities, is known, according to our best authorities, as *Monomorium Pharaonis*. It is the *Myrmica molesta* of Say. It is a cosmopolitan — is found everywhere in Europe, and has no doubt been very generally distributed through commerce.

Attracting, for pupation, the larvæ of the apple-worm to paper bands placed about the trees, from the latter part of June to their disappearance, — the bands to be examined at intervals of about ten days for the removal and killing of the pupæ.

Attracting nocturnal feeders to shelters of pieces of wood, bark, chips, leaves, bunches of freshly-mown grass, placed in gardens; for the curculio, squash-bug (*Anasa tristis* De Geer), the harlequin cabbage-bug (*Murgantia histrionica*) in the South, for cut-worms, etc.

Attracting to baits of sliced potato or other vegetables buried beneath the ground in gardens, upon the end of a stick for convenience of examination; for wire-worms (larvæ of the *Elateridæ* or snapping beetles, *Melanotus communis* Sch., etc.).

PREVENTIVES OF INSECT DEPREDACTIONS.

Our more accurate writers in economic entomology, in the recommendations which they present for the arrest of insect depredations, have, of late, made a very proper distinction between *preventive* and *remedial* measures. If we construe an "insect attack" in its broadest sense, as a habit pertaining to a species of insect, of regularly attacking a plant or an animal, then its arrest at any time or in any manner may properly be regarded as a remedy of the evil, and remedial measures would thus comprise preventive ones. But if we limit the "attack" to each separate periodical recurrence of the same, then it is possible by the interposition of preventives to preclude the attack and to render remedies unnecessary, and, indeed, impossible. In this latter sense, "remedies" imply that an attack has commenced; "preventives," that means are resorted to prior to the commencement of attack.

Of the latter are such measures as the following:—

High culture, to impart strength to resist insect attack, by proper preparation of the soil and employment of fertilizers.

Rotation of crops and their removal as far distant as possible from the soil which has become infested with their attacking insects.

Selection of seed less liable to attack: thus it is claimed that the Hessian fly has not been found in Lancaster nor Fultz* wheat (*Bull. No. 4, of U. S. Entomological Commission — The Hessian Fly*, p. 29).

Refraining for a year or two in an infested locality from the cultivation of crops formidably attacked.

Late sowing: for the Hessian fly, after the first frosts occurring about the 20th of September in New York. †

*Originating near Allenville, Penn., from three tall stalks bearing peculiar looking heads, picked by Mr. Fultz in 1862, in a field of broken-down and tangled Lancaster red wheat (*New York Weekly Tribune*, for Jan. 17, 1883, p. 11, col. 2).

† The wheat seeding in New York last year (1881) extended from August 15th to October 30th, averaging September 16th (*Special Report — No. 42, Dept. Agriculture*, p. 5).

Surrounding fields with a border or traversing it with rows of a more attractive food-plant to concentrate the attack, and perhaps permit of the destruction of the insect in its early stages.

Encircling trees near the base with a strip of freshly-tarred cloth (six to ten inches wide), the tar to be renewed as often as it becomes dry, to prevent the ascent of the wingless moths of the canker-worms.

Encircling trees with the canker-worm trap, made of a tin band and a muslin supporter,² described and illustrated in the *Register of Rural Affairs*, vol. vii, p. 189,* and shown in fig. 12.

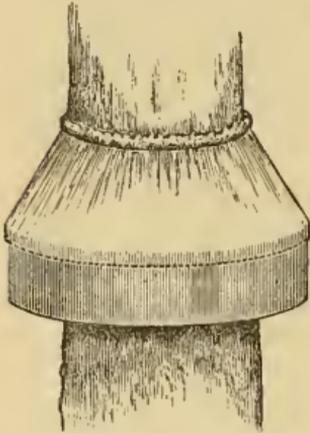


FIG. 12.—CANKER-WORM TRAP.

Washing trunks of trees and larger limbs with soft-soap to prevent egg-deposit: for the apple-tree borers (*Saperda candida* and *Chrysobothris femorata*), the peach-tree borer (*Aegeria exitiosa*), etc.

Mounding with earth or ashes about the base of peach trees, adding a few inches each year, to prevent the egg-deposit of the peach-tree borer (see 1st *Missouri Report*, pp. 48-49).

Wrapping a piece of stiff paper around the roots of cabbage and tomato plants when transplanting, reaching to, or just above, the surface of the ground, to protect from the cut-worms that cut the stem near the surface.

Encircling tree-trunks with a band of loose cotton batting, to prevent the caterpillars of the white-marked tussock-moth (*Orgyia leucostigma*) in their travels for food from ascending the trunks of horse-chestnuts, elms, etc.

Spreading strips of roofing paper (prepared with gas-tar) of about two feet in width, beneath the border of carpets, to prevent attack of the carpet beetles (*Anthrenus scrophulariæ* and *Attagenus megatoma*) and the carpet-eating moth (*Tinea pellionella*).†

Spreading strips of paper saturated with printers' ink, as above, for the same purpose.

Encasing in paper bags, as early as the month of May, small woolen articles to protect from the *Anthrenus*, *Attagenus*, and *Tinea*; also,

Pinning in sheets (linen preferable) and with edges turned over, articles too large for convenient bagging, after placing in their folds shavings of red cedar, scraps of Russia leather, spices, ground pepper or camphor: also,

*Also in 5th *Rep. Ins. Mo.*, 1876, p. 20, 6th *Rep. Mich. St. Pomolog. Soc.* for 1876, p. 42; *Country Gentleman*, xlvii, p. 393.

†The only "clothes-moth" known in the United States, the larva of which constructs a case for its occupancy. It feeds indiscriminately upon all kinds of woolen clothing, carpets, furs, feathers, etc. (FERNALD, in *Canad. Entomol.*, xiv, 1882, pp. 166-169.)

Tobacco dust for protecting such large articles as those referred to, and carpets rolled up during the summer.*

Sprinkling powdered borax near the base-board or wainscoting of basements, to repel the cockroach and the Croton-bug.

Washing, with strong alum water shelves and other infested places; for the above insects.

Drawing a broad line of chalk about the border of a shelf or around dishes upon it, for the red ant. Pennyroyal, and sassafras bark and roots, are also said to repel it.

Imbedding the lid of stone jars of pickled fruit in paper charged with tar-water or carbolic acid; for the pickled-fruit fly (*Drosophila ampelophila*).

Pinning naphthaline, prepared in cones for the purpose, by C. A. Blake, of Philadelphia, in cases and drawers of insect collections; for the museum pest (*Anthrenus varius*) and the minute *Psocidæ* (*Psocus domesticus* and *Atropos divinatorius*, Fabr.).†

Washing with a camel's-hair brush the dried plants in a herbarium with a preparation consisting of corrosive sublimate, four drams, sulphuric ether, three ounces, mixed; to which add two ounces of spirits turpentine and three ounces of alcohol. (Used in the N. Y. State Collection.‡)

Showering plum trees with a solution of putrid whale-oil after each rain, commencing with the falling of the blossoms, has protected from the curculio. (*Country Gentleman*, xli, p. 310.)

Soaking the seeds of turnips and onions in spirits of turpentine to prevent the attack of the larvæ of the Anthomyian flies, has been recommended and may be tried, but it is of doubtful utility.

Manuring with spent hops has been found of service in cabbage-growing districts as a preventive against the attacks of the cabbage-gall weevil and other pernicious insects. (*Manual Inj. Ins.*, p. 44.)

Tansy tea; made strong by boiling the leaves in sufficient water to cover them, and applied through the rose of a sprinkling pot, has protected bearing cucumber vines from the flea-beetle (*Epitrix cucumeris* Harris), and cabbages from caterpillars.§

*B. Pryn & Son, Tobacconists of this city, inform me that their sales of this material to dry-goods-merchants, for the protection of woolen fabrics, to furriers, to livery-men for protection of carriage robes, to gardeners for destroying insects, and to others for household uses, etc., have amounted to four and five tons per annum.

†If it is desired to keep the preparation on hand, the State Botanist suggests that the ether might be omitted without materially impairing its efficacy.

‡This preparation is said to be injurious to collections of Lepidoptera, producing greasing etc. (See *American Naturalist*, xvi, 1832, p. 410.)

§A correspondent of the *Country Gentleman* states that he has saved his plants for two years by steeping tansy and pouring it upon them after they began to head, only two applications proving to be necessary. When the moths (*Plusia brassicæ*)? commenced depositing their eggs, he gave the plants a dose every two weeks, and no injury by caterpillars was subsequently seen.

A NEW PRINCIPLE OF PROTECTION FROM INSECT ATTACK.*

It will readily be conceded that the use of preventives, whenever practicable, is more economical, more effective, and often more convenient than a resort to remedies. An old familiar adage affirms this truth, when it asserts that "an ounce of prevention is better than a pound of cure."

It has been claimed by some of our economic entomologists, that the most valuable methods of prevention are to be found in the husbandry that tends to promote healthful and vigorous plant growth, imparting strength and vitality which will greatly lessen insect injury, and in the clean culture which shall remove from the garden, orchard, and field, valueless harborage and protection for insect hibernation and transformation.

The results of recent experiments with various substances in the effort to find those that shall best enable us to control insect depredations, have led me to believe that we have, within our reach, still more valuable preventives than the above, in certain substances, which, applied to the soil, or to the plant directly, shall furnish us *a safeguard against the deposit of insect eggs*.

The great benefit of commencing our efforts at this point is so obvious as to need no words to commend it. It would not be "nipping in the bud," or "erushing in the egg." It is prior to and beyond these. If no egg be deposited, we have no artfully concealed egg to search for; no larva, whose rapacity and destructiveness we must arrest; no pupa, whose retreat is to be discovered, and no imago, whose egg-distended abdomen is fraught with evil, to be captured or entrapped — in short, we have dispensed with the four insect stages that require such unwearied and unending investigation in order to ascertain the most vulnerable point of attack of insect life, and the best means with which to assail it.

How may the deposit of eggs be prevented. — It may be prevented by applying to the plant or to the soil certain odorous substances which are popularly believed to be disagreeable to the insect, and therefore, to drive it away. Such substances have been termed "repellants," but we doubt that they exert a repellant force, and we believe the name to be a misnomer.

Among these substances may be mentioned kerosene oil, coal-tar,

*The following pages in which this topic is discussed have already been published in the *Proceedings of the Western N. Y. Horticultural Society*, 1882, slightly modified in some portions to adapt it for presentation as a Society paper. The new views advanced are not offered as proven truths. They have been but recently conceived, without the opportunity of maturing them or of submitting them to the varied tests by which they should be tried, and therefore, they can only claim, at present, theoretic value.

naphthaline,* carbohc acid, gas-lime, and bisulphide of carbon. That these and similar substances have been successfully used in preventing insect attack is undeniable, resting, as the claim does, on the authoritative testimony of some of our best writers and experimenters in economic entomology.

How do they prevent egg-deposit — They do so, by giving out an odor overpowering that of the plant (or animal), thereby preventing its recognition by the insect.

For the acceptance of this proposition, it is necessary also to accept the following: Insects, as a rule, are guided in the deposit of their eggs, not by the sense of sight, but by that of *smell*. A somewhat extended consideration of this view seems desirable, before proceeding to its practical application. The idea is a popular one, that most of the moths and beetles, and many of the insects that attack vegetation, select by means of sight the particular plant upon which to place their eggs. Their marvelous compound eyes, consisting of hundreds and even thousands of separate lenses, even to the number of 34,000, as in the eye of the butterfly, have been cited as a wonderful provision in nature, to afford that acuteness of vision which was needed in their selection of the proper plant upon which to oviposit. While sharing in this belief, I had often wondered at the incomprehensible acuteness shown by an insect in the discovery of the particular species of plant upon which alone the young caterpillars proceeding from its eggs could feed, — in the discovery of a single individual of a rare species occurring in a certain locality, and growing in such a manner as effectually to hide it from human observation. When its range of food-plants extends beyond a species to all the members of a genus, how could it detect all of the often greatly differing forms? When a still broader range embraces the several genera of an extended order, a still greater variety of forms are presented, which the rude insect brain must group and classify, and claim within its province. How amazing such knowledge without previous instruction. It had no parents living, as in the class of vertebrates, which might teach it by example. It had no ancestors a whit wiser than itself from which to learn. The deposit of the egg in its proper place may have been but the second voluntary act of its imago life, regarding that of flight for the purpose as the first. Perhaps a plant from some distant shore, of which not one of its ever so remote ancestry could have had any knowledge, is

* Naphthaline is one of the products of the distillation of coal-tar, which, together with the other two products, anthracine and benzole, is largely employed in the manufacture of aniline colors. One hundred pounds of coal-tar gives from six to eight pounds of naphthaline, from one-fourth to one-half pound of anthracine, and from two and one-half to three pounds of benzole.

brought within its range of wing; its flight is unhesitatingly directed to it, and its precious burden of eggs, without a shadow of mistrust, is at once committed to its leaves. Such knowledge has never been attained by our most distinguished botanists, and it is beyond the scope of human intellect. We have called its displays instinct — a word conveniently framed to cover manifestations in other classes of animated beings, which we are utterly unable to explain. As a partial explanation of these wonders, it has been suggested that to the insect world may have been given senses differing in number and in kind from those that we possess. But all the wonderful phenomena attendant upon insect oviposition by selection, may readily be explained under the supposition that it is guided and controlled by the sense of smell. We know the value of this important sense to us, how greatly it may minister to our pleasure and what service it may render in guarding us from deleterious exhalations and from improper food. It is capable of cultivation to the extent of rendering us still greater service. I have been told of a chemist in one of our colleges, who can make quite a correct qualitative analysis of a patent nostrum, by applying it to his nostrils, and picking out one after another of the ingredients, first naming those which are simply added as covers. It is related of a blind person, that he acquired the faculty of recognizing his acquaintances by the sense of smell. There are negroes in Africa who will follow their masters by scent. A fish-dealer in Albany claims the ability of naming each species of fish offered in the market, when presented to him blindfolded, by the odor peculiar to each. The illustrations given us of the acuteness of this sense in some of our domestic animals, are so numerous as not to need citation. We will quote a single instance of this almost miraculous acuteness, related upon undoubted authority. “A person, to make trial whether a young blood-hound was well-trained, caused one of his servants to walk to a town four miles distant, and then to a market-town three miles further. The dog, without having seen the man he was to pursue, followed him by the scent to the above-mentioned places, notwithstanding the multitude of market-people that went along the same way and of travelers that had occasion to cross it; and when the blood-hound came to the chief market-town, he passed through the streets without taking notice of any of the people there, and left not till he had gone to the house where the man he sought rested himself, and found him in an upper room, to the wonder of those that followed him.”

That insects are controlled in the discharge of their most important functions by this same sense, may seem a bold supposition, in view of the fact that, notwithstanding the laborious investigations in insect

structure, conducted through a century by some of our most distinguished scientists, we are utterly unable to point out with positive certainty the precise location and nature of the organs of smell. Naturalists have differed and still differ in their views in regard to their location. Cuvier, Audouin, Dumeril, and Burmeister, have regarded the spiracles, or breathing-pores, as discharging this office. Reaumur, Lyonnet, Latreille, and others, have referred it to the antennæ. Others have believed that the palpi were the true smelling organs, and others that the sense belonged to certain cavities in the front part of the head, and to the mucous lining of the mouth; while Kirby and Spence have thought that they have discovered a nose in the fore-part of the head, which they call the rhinarium or nostril-piece, connected with which is a beautifully-striated structure, which they have described as the veritable organs of smell.*

Although we do not surely know the position and structure of these organs, their existence is beyond a doubt. If a decaying carcass be concealed beneath a sod or other cover, carrion beetles, in their season, may soon be seen hovering over it, seeking it as a nidus for their eggs. I have seen swarms of flesh-flies, *Calliphora vomitoria* and *Lucilia Cæsar*, drawn to the disgusting odor of the "stinkhorn" fungus, *Phallus impudicus*, which so perfectly counterfeits that of decaying flesh.

Collectors of Nocturnal Lepidoptera know the readiness with which

*I am indebted to Dr. Hagen, of Cambridge, Mass., for the following information as to the location of these organs, drawn from *Hauser: Zeitschrift, f. Wissenschaft, Zoologie*, 1880, and giving the latest observations of the best investigators.—

Strong smelling substance, as turpentine, carbolic acid and decayed meats, proved that the organs of smell were situated in the antennæ in very many insects. Nevertheless, not all the insects employed in the experiments were deprived of the sense after the amputation of the antennæ, among which were *Carabus*, *Pyrrhocoris*, etc. After the antennæ were cut, the males rarely mated.

Sensitive bristles are present in Orthoptera (*Edipoda* and *Caloptenus*) on every joint of the antennæ after the eighth or ninth, and fifty sensitive pits or furrows, which are probably closed by a fine membrane and have interiorly one smelling-rod. *Stenobothrus* and *Gryllotalpa* are similarly provided. Diptera have in the third joint from 100 to 200 furrows, with as many as 200 sensitive bristles. *Vanessa* has on each joint of the knob of the antennæ, fifty furrows. Of the Coleoptera, the Carabids, Cerambycids and Curculionides, possess no antennal furrows, while they are present in the Silphides, Staphylinides and Tenebrionides. The Lamellicornes have on the underside an immense number of very small furrows, viz.: in the female 17,500, and in the male 39,000.

All insects which have to rely upon the sense of smell for discovering their food or placing their eggs, possess many sensitive furrows or pits in the antennæ, as bees, wasps, ichneumons, Diptera and Lepidoptera.

Dr. Hagen suggests that probably in many insects the organs of smell and taste are united. Such may be the organs which are found in the honey-bee in the epipharynx (on underside of the labrum), consisting of numerous sensorial furrows or channels and connected interior structure, and which have just been discovered in the same position in *Pemphigus* and *Cicada*, by Prof. H. Osborn, of the Iowa State Agricultural College (See *Canadian Entomologist*, xiv, 1882, p. 64).

the *Noctuidæ* are drawn to their bait of molasses and beer, spread upon tree-trunks to allure them for capture.

It is to the existence of these organs that some of the families of the Lepidoptera, especially among the moths, owe the continuance of the species. They operate in the association of the sexes, with such an irresistible and far-reaching force as to exceed our conception and to be marvelous to our eyes. The following are a few examples illustrating the exercise of this sense:—

A female moth just emerged from its pupa, within a closed room, has disclosed its presence to its mate and drawn its visit through the only means of entrance—a chimney opening into the apartment. An instance is recorded in which a moth forced its way into a collector's pocket, where, through this same sense, the information had been communicated to it of the presence of a mate, although hidden within a collecting box.

An interesting account has recently been given by Mr. W. H. Edwards of the attraction of *Heliconia Charitonia* (Linn.)*—a butterfly common in Southern Florida, Mexico and Central America—to the female chrysalides of the same species. Two or three days before the inclosed insect bursts her shell and appears in her winged form, the males are attracted to the chrysalis hanging from the passion-vine. Sometimes as many as six males may be seen clinging to a single chrysalis, entirely concealing it from sight. They remain upon it day and night, or if leaving it at all, it is only to feed for a brief interval and return. Lighted matches held under them will not drive them away, nor even shaking the twig. If pulled off by force, after a few circuits in the air, they resume their position. The explanation of this powerful attraction and persistent waiting and watching, admits of no doubt. A chrysalis which had turned almost black, and was momentarily expected to disclose its imago, was seen by the observer to burst at the abdominal end, when, “instantly one of the males made connection with the female imago while the head and thorax of the latter were still enclosed in the shell.”

Not long ago, two female *Promethea* moths—the species whose cocoons are often to be found suspended to lilac bushes during the winter months—had emerged from cocoons in my office and were within a box near an open window. A visitor of the same species soon entered the room through the window, followed by a second, a third, a fourth, while others fluttered against the upper sash endeavoring to effect an entrance. Looking outside, I saw numbers of the males, readily recognized by their dark color and vigorous flight, circling

* *Papilio*, i, 1881, pp. 209–215.

about in front of the window. One after another of the passers-by were arrested by the unusual spectacle of perhaps fifty of the large *Promethea* moths, congregated in a small space and actuated, apparently, by one common purpose. A crowd of persons, men, women and children, had soon assembled before my window, completely blocking up the sidewalk, and eagerly asking, "what are they?" "where did they all come from?" and, "what are they here for?" I left the window with the questions unanswered, for I did not care to give the information that they were *Messrs. Promethea*, drawn some of them from the remotest portions of the city, to pay their *devoirs* to the Misses *Promethea*, within my office. I trust that my reference to these sensorial flights may not be deemed indelicate, for the amorous flutterings of insect wings are but in obedience to a law of their nature, which lies entirely outside of our code of morals, and is of equal, if not superior authority.*

Another confirmation that insects have the perception and appreciation of odors is found in a recent discovery of scent-producing organs in the males of certain *Lepidoptera*, particularly among the moths. These organs are pencils of hairs, associated with special structure, located in different portions of insects, which emit, at certain times, peculiar odors, resulting from some volatile oils, as is believed. In some of the *Sphingidæ*, according to Mr. A. H. Swinton,† they are located at the base of the abdomen. In some of the genera of the *Noctuidæ*, as in *Acronycta*, *Leucania*, *Mamestra*, and *Phlogophora*, they are hidden beneath the first five dorsal arcs of the abdominal segments. In other *Noctuidæ*, as in *Apamea*, they are at the anus, while in *Catocala* they are to be found in the legs — at the upper part of the second pair of tibiæ. In the *Geometridæ*, they are on the posterior

*See, also, in this connection, an interesting account given by Professor F. H. Snow, in the *Transactions of the Kansas Academy of Science* for 1874 [vol. iii], pp. 27, 28, of his observation upon Penikese Island, of the male of *Polyphylla variolosa* (a beetle closely allied to the common May-bug, *Lachnosterna fusca*) digging in the barren soil of the island for the female, when about to emerge from its pupation, while still buried beneath the surface. He states: "My attention was first arrested by a male vigorously scratching the ground with his feet while his antennæ were fully extended with their antennal plates widely separated. His progress being too slow to suit my purpose, I assisted him in his excavation, and at the depth of half an inch discovered a female, who, with head upward, was struggling to reach the surface, having evidently but just emerged from the pupa. A little further on another male was busily scratching the soil, and another female was unearthed directly underneath; while a moment later two rival males were discovered digging for a third female, who was buried nearly an inch below the surface." There can scarcely be a doubt but that the knowledge of the subterranean presence of the females was conveyed, not by the sense of hearing, as was supposed by Professor Snow, but through the antennal organs of smell with which the male of the *Lamellicornes* is so abundantly provided (see *ante*, page 69, in foot-note).

†*Proceed. Lond. Entomolog. Soc.* for 1876, p. 20.

tibiæ in *Boarmia*, *Tephrosia*, and *Acidalia*, and on the submedian vein of the forewing in some species of *Macaria* and *Cidaria*.

The particular effect produced by these odoriferous organs, is not known, but from their being brought in action and extended like a fan, during the union of the sexes, they doubtless serve an important purpose in the economy of nature, by aiding in the continuance of the species. It is not unlikely that attractive odors may be given to the males as a compensation for the more brilliant coloring or more complicated ornamentation often possessed by the other sex.

Special odors pertaining to male butterflies, have been noticed by several entomologists. Dr. Müller has called the attention of the London Entomological Society to the odors of the males of several species of Brazilian butterflies, which he regards as an especial sexual attraction. Miss Murtfeldt has recorded a delicate violet like odor in fresh males of *Callidryas Eubule* (not discoverable in the females), which was retained for several days after death.*

If, as we believe, insects have been given this acute sense of smell, we may see in it a provision admirably adapted to their need. Very many of the insects are night-fliers, sleeping or hiding in concealment during the day, and only coming abroad during the night to deposit their eggs and to partake of a limited supply of food — the latter quite a secondary consideration in their economy. We have no reason to believe, from a study of their eyes, that vision in insects is very acute, and even if it were, it would operate under serious disadvantage under cover of the night. In utter darkness the organs of smell could discharge their functions to their extreme extent — better enabled, perhaps, to do so through the humid atmosphere of night, and stimulated to their full exercise by the more numerous and stronger odors which are emitted from the vegetable world during the hours of darkness.

And again, many insects must find their mates only through searching them out under the seeming disadvantages environing the females of limited locomotion, and a greater or less degree of concealment. As a rule, the females fly less than the males. In some species, as in *Samia Cecropia*, *Callosamia Promethea*, *Hyperchiria Io*, and others, the burden of eggs borne by them render them almost incapable of flight, until the main purpose of their being has been discharged. The females of *Orygia leucostigma*, *Anisopteryx pometaria*, *A vernata*, *Hybernia tiliaria* and a number of others, are wingless, and therefore incapable of flight. In a moth quite destructive to arbor-vitæ and many other food-plants, *Thyridopteryx ephemeraformis*, or the basket-worm, the

* *Psyche*, iii, 1881, p. 198.

necessity of eyes is not apparent, for the sexes never can see one another. Not only is the greater part of the caterpillar life of the female passed within its bag or basket, but inside of its walls it attains its growth, it undergoes its pupation, it changes to the mature insect, the eggs are fertilized, and the mother dies. It never emerges from its cocoon. Sight alone *could not* have brought about the fertilization of the eggs, nor could other sense than the one with which we believe insects to be, for necessary uses, specially endowed.

When we recall larval growth, and the source from which the larva derives the material which forms its entire structure, it will seem but natural, that when, through transformation, it has attained its perfect state, it should be peculiarly sensitive to the presence of its food-plant and be led to select it for oviposition, through the exercise of its most acute sense. Take, for illustration, the familiar caterpillar of the tomato plant, known as *Sphinx quinquemaculata*. In its larval state it lives but to eat and grow. Its skeleton — its outer integument — can not grow fast enough to meet its insatiate demand for food, and therefore, at intervals — four several times — it is cast off and a new and more capacious one is supplied. Observe the play of its powerful jaws; unless frightened into temporary quiet, they almost give us a perpetual motion; they rest not day or night; their sweep is like a mower's scythe, and a tomato leaf disappears before them as a meadow falls before a mowing machine. The creature is scarcely more than an animated eating apparatus. Its life is passed on a single plant, if that suffices for its appetite. It never tastes other food. And when it has finally attained its beautiful winged form, every particle entering into its composition, of fluid, nerve, muscle, and chitin, is but transmuted tomato leaf. Is it strange, then, that the moth should be able to know tomato when it smells it? Would it not be more strange if its organs of smell should respond to any other odor? This alone would be familiar to it — others, perhaps, might be acquired.

Having now offered plausible reasons, why, from physiological causes, insects may be supposed to be extremely sensitive to the odor of their natural food-plant, — having shown the important purposes that the possession of this sense in an acute form may serve them in the perpetuation of the species — and having presented some marvelous manifestations of insect attraction, sexual and otherwise, which are only explicable upon the theory that they are directed by the sense of smell, — need we hesitate to accept the opinion advanced, that many of our more injurious insects are guided in the deposit of their eggs by the sense of smell alone.

There are classes of insects in which oviposition would not be con-

trolled by this sense, for example, most of those which in their larval stage live in the water and are predaceous upon other animal life, as many of the Neuroptera and some of the Coleoptera. The purpose of oviposition in such is accomplished if the eggs are deposited convenient to water. Then there are Hymenoptera, as bees and wasps, which place their eggs in cells constructed by them, having previously provided for the grubs to be hatched, their needed food; and Orthoptera, that only require for their eggs secure deposit in the ground. Exceptions to the rule need not be multiplied, for they will readily present themselves.

And now, to proceed without further delay to the application which it is proposed to make of the views above presented, of the particular sense, which, in many insects, controls their oviposition. If the insect discovers the plant upon which its larvæ feed, and is drawn to it for the deposit of its eggs by the peculiar odor characterizing and emanating from it, then, if that odor be neutralized or overpowered by the introduction of another stronger odor—a counterodorant, it might be termed—eggs will not be deposited upon the plant; it will be preserved from such attack as effectually as if it were inclosed in glass.

We already know several substances, some of which have been named, which are sufficiently powerful to overcome many vegetable odors. It is not necessary that they should be disagreeable or repulsive to the insect. We need not, therefore, search for substances disagreeable to us, which might prove quite otherwise to insects. We do not know that camphor, carbolic acid, or naphthaline, when inclosed in our insect cabinets, preserves them from the entrance of the *Anthrenus* and *Dermestes*, by being disagreeable or repellant to them, but we do know that their strong odor is sufficient to overpower that of the dried insects, so that the pests may not be attracted for the deposit of their eggs. We have doubtless erred in assuming that certain odors are disagreeable to insects, and that for this reason their presence protects from insect attack. That some odors are not *attractive* to them is probably true, and in this truth may lie the explanation why certain individuals enjoy immunity from the attack of mosquitoes, bed-bugs and fleas in infested localities. The protection afforded to visitors of our northern wilderness from the black-fly and the mosquito, through pennyroyal, oil of tar, and carbolic ointments, results, doubtless, from their overpowering the odor proceeding from the exposed portions of the body; and, in the same way, the creosotic odor of the smudge-fire smoke prevents the attack of the midge.

The chief requisites in the materials to be employed for plant protection, in the manner proposed, are strength and permanency; the lat-

ter quality contributing to economy of material and labor of application. A degree of strength not wholly overpowering would be proportionately protective in lessening the distance at which the plants would attract. If the above properties were embodied in a fertilizer, the resultant benefit would be enhanced by enabling the plant better to resist, through vigorous growth, any form of insect attack. Among manures, the drainage from pig-styes has been found to act with great efficiency in preventing the egg-deposit of the *Anthomyia* flies upon onions, radishes, turnips and similar crops. The dry manure from piggeries has a remarkably pungent and strong odor, when distributed upon lands, and we can all recall the offensive, almost insupportable, odor escaping from a passing freight-train laden with swine, from some remote point in the West. It is very probable that upon our seaboard, where the mossbunker (*Brevoortia menhaden*) and other fish can be obtained in quantities to permit of their use as manure, they will prove of great value in protecting from egg-deposit. The gas-works of our cities and the farther distillation of coal-tar, in the various uses to which it is applied, should afford us several valuable materials for this purpose.

Can not chemistry come to the aid of the economic entomologist, in furnishing at a moderate cost the odorous substances needed? Is the imitation of some of the more powerful animal secretions impracticable? It has been thought possible, and a distinguished perfumer has long been experimenting at a cost of thousands of dollars, in the production of a substance having the properties of the peculiar secretion of the *Mephitis mephitica** (the skunk), to serve as the basis of a perfume which would, he is confident, enrich the discoverer. Can there be any doubt of the conservative action and the value of this substance as a counterodorant, could it be obtained in sufficient quantity; and what an additional charm would its general employment impart to horticultural and agricultural pursuits, when the alembic of the chemist shall have converted it into a delightful perfume, as proposed, surpassing in agreeability even that of musk — a similar animal secretion.

What would be the result, it may be asked, should this method of plant protection from insect oviposition prove effectual and be generally adopted? Might it not produce serious disturbance in the

*If, in our zoological nomenclature, we were permitted to go beyond the names given in the tenth or twelfth edition of Linne's *Systema Naturæ*, in 1758 and 1766, this animal, in strict compliance with the law of priority, might now be known by the name under which it was originally described in 1744, by the French Naturalist, Charlevoix, viz.: l'Enfant du Diable — *the devil's own child*. Certain'y the designation would be quite as expressive as the scientific one which it now bears.

economy of nature, of the relations existing between the insect and the vegetable world?

A friend—a distinguished jurist and an accomplished botanist—whose opinion had been asked upon this new method of protection from insect attack, with that judicial habit of thought which leads him to meet a new proposition first with the question, “is it right,” and afterward, “is it useful,” gave me the following note in reply, presenting, although under a vein of pleasantry, some of the objections that arose in his mind. He asks: “Ought I to countenance recommendations which may prove disastrous to the great scheme of nature? Scatter that mischievous carbolic acid all over or around the plant nature has commanded the insect to lay her eggs on, and the leaves of which she has given to the children of those eggs for food, and what tremendous consequences may ensue! She must and will lay them somewhere, and if, being unable to distinguish the plant devoted to her use by nature, she lays them on another species—if, for instance, the eggs designed by nature for a mint, be laid upon an oak, a mullein or the tomato, what monsters may not the grubs be evolved into? Varieties of silk-worms have been evolved from differences of food. The progeny may differ very widely from their progenitors, be far more destructive, and ruin much more precious plants.”

“This awful protection may not only be productive of new insect enemies, but it actually aims at striking out of the chain of life one animated link. The insect, led by the nose to the plant to lay its eggs on, fails to lay them. Another insect, which feeds upon the eggs or larvæ, is led by its nose to the plant, but fails to find its food and dies of inanition; its parasites perish with it;—and thus, link after link is broken, and the frame of nature is disordered and falls into disconnected fragments, and all life is obliterated and vanishes *in fumo*—the foul, all-pervading stench of carbolic acid. I’ll none of it!”

The above picture of the full realization of the purposes of the practical entomologist, although drawn in the colors of badinage, calls for a serious reply, as it is one not unfrequently held up to view by those who regard our efforts as chimerical. We do not propose to exterminate—but only to control. The true naturalist would not, had he the power, strike out of existence a single species of insect, believing, as he does, that each one has its place and purpose in nature. There is ample food for every species—possibly, under ordinary circumstances, for all individuals, although doubtless certain species might be diminished in number without violence to the harmony of nature. For this excessive multiplication of individuals, the agriculturist and the horticulturist are at fault, in inciting and encouraging insects to such multiplication by offering them food greatly superior to, and far more

tempting under their cultivation than, their original wild food, and massing it in gardens, orchards, and fields, where the united odors of many acres extend irresistible attraction. Since, therefore, they have unduly multiplied injurious insects, it is their undoubted right and their bounden duty, to diminish their number, if by so doing, while advancing their own interests, they also promote the public good.

The method of protection herein suggested would be attended with the following direct results. Let us illustrate by its operations upon a single food-plant : If, by means of smoke, or other counterodorant, an apple orchard be protected from egg-deposit, the odor-attracted apple insects, failing to recognize it, will wing their way to other orchards. These in turn must be protected. As the area protected increases, the number of eggs deposited in unprotected orchards increases proportionately, compelling a resort to preventive means, if remunerative crops are to be grown. When at length not a single well-cared-for orchard offers its odorous invitation, the neglected, worthless ones, of which there are far too many within our State, standing only as nurseries of insect pests, are seized upon and, fortunately, soon destroyed. Single trees, scattered here and there, must now be resorted to. The aggregate of food supply has been greatly reduced, and only a diminished number of insects can be fed. In the lengthened insect flight in search of food-plants, insectivorous birds find more abundant prey. The steadily diminishing number of insects are driven back step by step to their native food-plant—the wild crab—upon which they subsisted for long ages before apple orchards of hundreds of acres of delicious fruit were known. The crab, the wild cherry, the wild plum, the thorns, with some other members of the family of *Rosaceæ*, will furnish all the food that our one hundred and fifty apple insects require for their support. Here they may feed, unmolested by the economic entomologist, except as he may chance to need an occasional specimen for study or with which to enrich his cabinet.

Let the apple-tree stand for every other plant that we value, and for which we seek protection, and let the attacking insects of each, in the manner above suggested, be driven from them to their corresponding wild plants ; then shall we have accomplished all that our economic investigations may aspire to. Its complete realization we shall never attain, either by the method now proposed, or through any other ; but in proportion as we approach it, in the same degree will the earth yield her increase more abundantly in willing return to the labors of the husbandman.

CLASSIFICATION.

It was intended to present with this Report a general view of the Classification of Insects, to the extent at least, of giving the more prominent characters of the several orders and of the principal families into which insects are divided, but the length to which the introductory remarks of the preceding pages has extended, compels the postponement of the purpose to another year. A certain amount of elementary knowledge — such as shall embrace the essential features of the principal divisions of insects, a recognition of the several forms under which they present themselves during their transformations, and familiarity with some of the names applied to portions of insect structure, is indispensable to every one who would intelligently observe insects and who desires to avail himself of the information which is so freely and abundantly offered in the economic entomological literature of the day. As such knowledge is supplied in but few of our public schools, or even higher institutions of learning, the entomologist, in his communications with the public, is compelled to presume upon a surprising and, as it appears to him, a criminal lack of even an elementary acquaintance with the insect world.

As the insects to be discussed in the following pages will each, after its scientific and popular name, be referred to its order and family, it seems but proper that they should be preceded by a mention of the several orders, their meaning, and the common names of some of the insects which they embrace.

While authors differ in their systems of classification, the one most generally adopted in this country recognizes the division of six-footed insects or *Hexapoda* (the spiders, or *Arachnida*, and the centipedes, or *Myriopoda*, forming the other divisions of the Class of Insects) into seven orders, which, commencing with those deemed highest in rank, are the following :—

1. HYMENOPTERA — (of Greek derivation, from *hymen*, a membrane and *ptera*, wings) comprising bees, wasps, hornets, ants, ichneumon flies, saw-flies, etc.

2. LEPIDOPTERA — (from *lepis*, a scale, and *ptera*, wings) embracing butterflies and moths — the former diurnal and the latter usually nocturnal.

3. DIPTERA — (from *dis*, twice, and *ptera*, wings) comprising flies, mosquitoes, gnats, sheep-ticks and some other wingless forms, etc.

4. COLEOPTERA — (from *coleos*, a sheath, and *ptera*, wings) including the beetles, as the carpet-bug, May-bug, rose-bug, snapping-bugs, lightning-bugs, weevils and lady-bugs.

5. HEMIPTERA — (from *hemi*, half, and *ptera*, wings) including plant-

lice, scale insects, mealy bugs, tree-hoppers, lantern-flies, seventeen year locusts, the bed-bug, body-lice, etc.

6. ORTHOPTERA — (from *orthos*, straight, and *ptera*, wings) including crickets, locusts (the true), grasshoppers, walking-sticks, cockroaches, Croton-bugs, etc.

7. NEUROPTERA — (from *neuron*, nerve, and *ptera*, wings) including white-ants, May-flies, dragon-flies, lace-wings, ant-lions, caddis-worms, etc.

Several other orders have been proposed, and have been adopted, in whole or in part, by entomologists, as they differ in their views as to the extent to which these divisions should be carried. Some of them contain but a single family each, or a Linnean genus. As of interest to the student, and as explanatory of differences in classification which may present themselves to the general reader, they are here given :—

APHANIPTERA, of Kirby (inconspicuous wings), or APTERA Leach (wingless): consisting of the flea family (*Pulicidæ*) above included in Diptera.

STREPSIPTERA, of Kirby (twisted wings); the RHIPSIPTERA, of Latreille: consisting of bee parasites, constituting the family of *Stylopidæ* of Coleoptera.

HOMOPTERA, of Latreille (equal wings); embracing those of the Hemiptera which have the wings wholly membranous, the remainder being placed in a separate order of HETEROPTERA, of Westwood (dissimilar wings).

EUPLEXOPTERA, of Westwood (well-folded wings), or DERMAPTERA, of Leach (skin-wings): consisting of the family of earwigs or *Forficulidæ*, usually placed in Orthoptera.

THYSANOPTERA, of Haliday (fringe wings): containing the minute insects known as Thrips, of the family *Thripidæ*: generally classed with Homoptera, although having affinities with both Orthoptera and Neuroptera.

TRICHOPTERA, of Kirby (hairy wings); containing the caddis-flies, or *Phryganidæ* of the Neuroptera.

HOMALOPTERA, of Leach; containing the spider-flies, bird-flies and sheep-ticks of the families of *Hippoboscidæ* and *Nycteribidæ* of the Diptera.

THYSANURA, of Latreille — (from *thysanos*, a fringe, and *oura*, a tail): containing the bristle-tails or *Lepismatidæ* and the spring-tails, or *Poduridæ*, usually united with the Neuroptera.*

*Dr. Packard, in his last edition of his *Guide to the Study of Insects* (1875), accepts this Group as an 8th Order, to be added to the seven usually adopted.

MALLOPHAGA — (from *mallos*, wool, and *phago*, to eat); containing the bird-lice of the Hemipterous group *Mallophaga*, having jaws for feeding on the delicate parts of the feathers and hairs of birds and mammals.

BIBLIOGRAPHY.

A feature introduced for the first time in our State Entomological Reports, and which it is hoped will meet with approbation, is the list of references to publications which will precede each species discussed, giving in addition the synonymy when the species has been known under different names. It is not attempted to make the lists as full as those presented in the popular volumes of Dr. Coues on *The Birds of the North-west* and *The Birds of Colorado Valley*, and by other recent writers in Natural History, for such elaborate and valuable compilations can only be the fruit of the systemized study of years with this purpose in view, together with unusual facilities for the work. It is only proposed to cite the author of the species and its first publication; to give a few references to European authors when such occur and seem to be of value to the entomological student; to note some of the best figures which have been given; and to refer to such of the notices occurring in the recent entomological literature as have come under observation, many of which may be accessible to the general reader, in the Reports of our State Entomologists, Agricultural Reports, and leading agricultural journals.

A bibliography limited to this extent should not be regarded as objectionable by those who have no desire to avail themselves of it; while the student who would gladly obtain more extended information of the species than that presented, may find it of practical value. Full bibliography, in all departments of Natural History, is of great importance in scientific research, and it is much to be regretted that the vast amount of labor which it involves so seldom permits it to be presented. If shared by many, each contributing his mite, the task will be materially lightened and eventually accomplished.

INJURIOUS LEPIDOPTEROUS INSECTS.

Thyridopteryx ephemeræformis Haworth.

The Bag or Basket-worm.

(Ord. LEPIDOPTERA : Fam. BOMBYCIDÆ.)

- Sphinx ephemeræformis*. HAWORTH: *Lepidoptera Britannica*, 1810, p. 72.
Egeria ephemeræformis. STEPHENS: *Illus. Brit. Entomol.*, *Haust.*, i, 1828, p. 145.
Thyridopteryx ephemeræformis. STEPHENS: *Illus. British Entomol.*, *Haust.*, iv, 1835, p. 387; in *Trans. Ent. Soc. Lond.*, i, 1836, p. 76. pl. 10, f. 1.
Oiketicus sp. MELSHEIMER (1840): in *Harr. Corr.*, 1869 p. 113.
Oiketicus sp. HARRIS: *Treat. Ins. New Eng.*, 1852, p. 319; *Ins. Inj. Veg.*, 1862, p. 415; *Ent. Corr.*, 1869, pp. 150, 243, 246; *Ib.*, *Oiketicus coniferarum*, pp. 177, 299, pl. 3, f. 4.
Thyridopteryx ephemeræformis. MORRIS: *Synop. Lep. N. Amer.*, 1862, p. 142.
Thyridopteryx ephemeræformis. PACKARD: in *Proc. Ent. Soc. Phila.*, iii, 1864, p. 350; *Ib.*, *Oicketicus coniferarum* Harris MSS., p. 351; *Guide Stud. Ins.*, 1869, p. 291, f. 222; *Ins. Inj. Forest and Shade Trees*, 1881, p. 248.
Hymenopsyche coniferarum. GROTE: in *Proc. Ent. Soc. Phila.*, v, 1865, p. 249; *Thyridopteryx ephemeræformis*, *New Check-list Amer. Moths*, 1882, p. 18, no. 202.
Thyridopteryx ephemeræformis. CLEMENS: in *Proc. Ent. Soc., Phila.*, vi, 1866, pp. 221, 222; in *Tineina N. Amer. (STANTON)*, 1872, p. 274.
Thyridopteryx ephemeræformis. GLOVER: in *Mouth. Repts. Dept. Agricul.*, 1866, p. 423. — RATHVON: in *Prac. Entomol.*, ii, 1857, p. 53. — RILEY: *First Ann. Rept. Ins. Mo.*, 1869, pp. 147-151, f. 84. — KING: in *Psyche*, iii, 1871, p. 241. — LINTNER: in *Count. Gent.*, xlv, 1880, pp. 535, 631. — MARTEN: in *Thomas' Tenth Rept. Ins. Ill.*, 1881, p. 118, f. 32. — H. EDWARDS: in *Papilio*, ii, p. 24.

Numerous reports reached me from the southern portions of the State of New York during the summer of 1880, of depredations upon arbor vitæ, which I was able to refer to the above-named insect. A letter from West Brighton, Staten Island, stated: "I have recently found several arbor vitæ standing together in a row completely stripped of their foliage, and covered with cocoons like those sent, strongly attached to the twigs. I have never before remarked any thing of the kind. Please inform me whether you know of the arbor vitæ being frequently despoiled in this manner. If so, its usefulness as a hedge plant will be greatly impaired."

The Bag or Larval Case and the Insect.

The case built by this insect for its shelter during its caterpillar stage, and subsequently to serve for its cocoon within which to undergo its pupation, is so peculiar in appearance and structure, that

once seen, or even after a study of its description and illustration, it cannot fail of being recognized. There are other species of basket-worms occurring elsewhere which construct similar cases. They are very much alike, except in size, usually of an elongate, pointed, oval form, and are composed of a tough silk, interwoven with bits of the leaves and pieces of the stems of the food-plant upon which they are found.

These cases are always worn by the larvæ, and when, toward maturity, they have, by continued additions, increased to a large size, they hang downward (whence their name of *bag-worm*), in apparently a cumbersome burden, but, firmly held by the abdominal segments and their legs, they are carried about with the greatest ease, by means of the anterior segments and their three pairs of legs extended from the

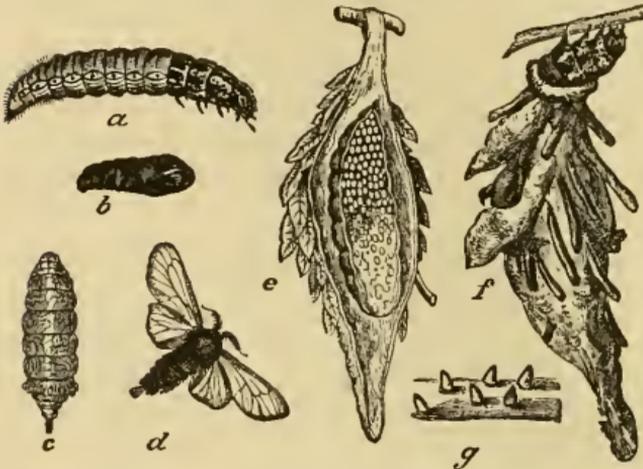


FIG. 13.—The Bag-worm, *THYRIDOPTERYX EPHEMERAIFORMIS*.—*a*, the caterpillar; *b*, male pupa; *c*, wingless female moth; *d*, male moth; *e*, section of female pupa and cocoon; *f*, case or bag of mature caterpillar; *g*, cases of young caterpillars.

case, as shown in Fig. 13 at *f*. When alarmed, the larva retreats within its case, where it is kept from falling by the silken thread which it spins and attaches to the twig in its travels over the tree. To those who are unfamiliar with the strange-looking cased caterpillars, they and their operations are of great interest. They commence their cases as soon as they escape from the eggs. These at first appear as little tips of extraneous matter attached to and surrounding their hinder end. Gradually they assume the form of a cone, beneath which, when drawn down to the surface of the leaf, the caterpillar is entirely hidden, as represented in the little cones at *g*. With the larval growth the cones are enlarged, until they become the oval cases which cover all but the anterior portion of the larva while feeding.

The male moth, shown at *d*, is of small size (an inch in spread), and very plain in appearance, with its transparent and thin wings. The female is very imperfectly developed, as may be seen from its figure at *c*. It has neither legs, wings, antennæ, or any external features from which one would be led to refer it to the order of Lepidoptera. It is scarcely more than an animated, although a very sluggish, egg-case.

The immense number of eggs which it contains and their arrangement, is shown in a section of its pupa within its cocoon-case at *e*. It is never seen unless the case is opened, for within its inclosure, its entire life in its moth state is passed. Indeed, the case shelters it during nearly all of its larval stage, throughout its pupation, its transformation to the moth, its copulation with the male, its oviposition, and its death.

Those who may desire to acquaint themselves more fully with the many interesting details that enter into the life-history of this species are referred to the excellent paper upon it, by Professor Riley, contained in his *First Report on the Insects of Missouri*.

Difficulties attending the Classification of the Species.

The singular appearance of this insect, so unlike most of the Lepidoptera, was the occasion of much perplexity in its classification for a number of years after its discovery. As may be seen from its synonymy, it was originally described as a *Sphinx*, although possessing none of the characteristic features of the *Sphingidæ*. Previous to this, it had been believed to be a species of *Tinea*. Later it was regarded as belonging to the *Egeridæ*. An interesting paper upon the species, assigning it to its true position among the *Bombycidæ*, was communicated by Mr. J. F. Stephens to the *Trans. Ent. Soc. Lond.*, i, 1836, p. 76, under the title of "On the Apparent Identity of *Sphinx ephemera*-formis of Haworth with *Psyche plumifera* of Oechsenheimer," of which the following is the substance.

It appears that the original specimen was found in Yorkshire by Mr. Boton, and was placed in Mr. Drury's collection. At the sale of this collection, it was purchased by Mr. Donovan, and at an auction sale of some of Mr. Donovan's insects, in the catalogue of which it was announced as "an undescribed *Cossus ligniperda*," it came into Mr. Stephens' possession. Mr. Stephens was able to see, upon a cursory inspection, notwithstanding its mutilated condition, that it was not a *Sphinx* or even one of the *Sphingidæ*. He referred it to "the singular group known by the name of Sackträger by the Germans, and considered by some writers as belonging to another order of insects—*Trichoptera* Newman, *Phrygania* Scopoli, and *Tenthredo* by Roda; in fact it appears to be a *Psyche* of Oechsenheimer [*Psyche plumifera*], so far as can be ascertained by the remains of the unique specimen." Reasons are given why it could not be classed among the *Egeridæ* where it had been placed in the first volume of *Illustrations of British Insects*, 1834, "nor had it any alliance with *Zeuzera*, to which genus it would appear Donovan had assigned it." It did not fully agree with *Psyche*, and a new genus—*Thyridopteryx*, was constituted for it.

The above genus had been published by Stephens prior to the above paper, in vol. iv, of his *Illustrations*, page 387, printed in 1835.

The following generic diagnosis accompanied it :

Antennæ short, deeply pectinated on both sides at the base, and apparently simple at the base; *head* small, *eyes* globose, rather prominent; *thorax* very robust; *abdomen* also robust at base and gradually attenuated to the apex; *wings* completely hyaline; anterior elongate-lanceolate, discoidal areolet closed, and with a central longitudinal nervure; first and fourth marginal nervures furcate; posterior wings small.

It was believed to be allied to *Psyche* and *Fumea* and was assigned place immediately preceding these genera.

Food-Plants of the Larva.

The caterpillar is a very general feeder, readily feeding on a large number of our fruit, forest, and other trees. It has been observed on apple, pear, plum, cherry, choke-cherry, apricot, quince, linden, maple, locust, oak, elm, poplar, osage orange, spruce, hemlock, larch, red cedar, and arbor vitæ. For the last two, it seems to manifest a decided preference. The accounts of its ravages during the year 1880, which appeared in agricultural journals, were unusually numerous, and in the majority of instances, the arbor vitæ was the greatest sufferer.

Geographical Distribution.

The species is a southern form, and does not occur extensively in the State of New York. It has not been found in the vicinity of Albany, and I know only of its occurrence within the State, on Long Island and Staten Island. Its presence, and injuries from it, are recorded in Pennsylvania, Maryland, District of Columbia, Virginia, Carolina (North and South), Georgia, Alabama, Kentucky, Ohio, Illinois, and Missouri.

Natural Enemies.

Notwithstanding the concealed life of this caterpillar, it appears to be quite liable to parasitic attack, for no less than six parasites are known to destroy it. They are the following :

PIMPLA INQUISITOR (Say).— Mr. Glover mentions the destruction of *Th. ephemeraformis* by *Cryptus inquisitor*, a small, yellow-banded ichneumon fly, with no other information in regard to it.* Originally described by Say in the genus *Ichneumon*, † it was afterward referred to *Cryptus*, and in 1870 it was placed, by Mr. Cresson, in *Pimpla*, in a synoptical table given of the known species of that genus. ‡ The dis-

**Rept. Commis. Agricul.* for 1866, p. 41; for description of the larva and pupa, see *Bulletin No. 3 of the U. S. Entomolog. Commis.*, p. 45.

†*Contributions to MacLurian Lyceum*, i, 1827, p. 71.

‡*Trans. Amer. Entomolog. Soc.*, iii, 1870, p. 144.

tinctive features assigned to it in the table by which to distinguish it from its congeneric forms, are "Body black; legs and coxæ yellowish-red; posterior tibiæ black annulated with white; posterior tarsi white, the joints tipped with black; antennæ unicolorous, brown or ferruginous; *abdominal segments entirely black; aureolet of anterior wing complete; head entirely black in female, face white in male; tegulae white.*" The italicised characters separate it from the next species mentioned.

PIMPLA CONQUISITOR (Say).^{*}—This species, not hitherto published, to my knowledge, as a parasite upon the bag-worm,[†] was obtained from some bags kindly sent to me by Mr. F. G. Shaw, of West Brighton, Staten Island, N. Y. In the package containing about two hundred of the bags, when opened upon its reception, October 12th, four of the Pimplas were found alive. Others continued to emerge until November 8th—not in large numbers, however—twenty-one examples only being obtained. Probably not many had left the cocoons previously, as it seems to be a late species, in the Southern States making its appearance in mid-winter or early spring, and attacking only the *last brood* of cotton-worms. Quite a difference in size was shown in the examples, especially in the female, the largest measuring eight-tenths of an inch to the tip of the ovipositor, and the smallest but four tenths.

A popular description of this species, as a common parasite upon the cotton-worm, was given in 1847 by Dr. B. G. Gorham, of Louisiana, which is quoted in Prof. Comstock's *Report upon Cotton Insects*, 1879, p. 190. On page 198 of the same Report, the insect is figured, accompanied with Say's original description of the two sexes—the female described as a distinct species under the name of *pleurivinctus*.

HEMITELES? THYRIDOPTERIGIS Riley.—This species, belonging with the two preceding species to the *Ichneumonidæ*, was described and figured by Prof. Riley from five examples bred from a cocoon of the basket-worm.[‡] It is a small form, being about one-third of an inch in length, and one-half inch or less in expanse of wings. The ovipositor is about one-half the length of the abdomen. The sexes are quite unlike in appearance, for while the female is of a dull ferruginous color, with its front wings covered by two dark bands, the male is shining black with the wings destitute of bands or spots. Other dif-

^{*}*Bost. Journ. Nat. Hist.*, i, p. 234.

[†]It is possible that the example referred to by Say as "obtained from a follicle of the common folliculate Linnean *Bombyx* with transparent wings, extremely abundant a few years since in Maryland," was the *T. ephemeraformis*, although it was identified as *Clisiocampa Americana*, the apple-tree tent-caterpillar, by Mr. Walsh. See statement and footnote on p. 45 of Bulletin No. 3 of the U. S. Entomological Commission.

[‡]*First Rep. Ins. Mo.*, 1869, p. 150, pl. 2, figs. 11, 12; same description in *Bull. No. 6, U. S. Ent. Comm.*, 1881, p. 65.

ferences are indicated in the description. This species is stated to be quite common in Washington (the described examples were from St. Louis, Mo.), where it is often attacked by a secondary Chalcid parasite.

Two other species of this genus, viz.: *Hemiteles Smithii* and *H. sessilis?* are parasitic upon *Samia Columbia*, and have been taken from its cocoons by Dr. Hagen.*

CHALCIS OVATA Say.— This large and beautiful Chalcid parasite, and the following minute one, were obtained by me from the Shaw sending of cocoons, and are now for the first published as parasitic upon the species. Two examples of *C. ovata* were given out, the first on October 21st; later, another was found dead underneath the cocoons.

Like *Pimpla conquisitor*, it is also a common parasite upon the cotton-worm in the Southern States. Examples of it continued to emerge from the pupæ of the cotton-worms sent to the Department of Agriculture for breeding, from the 4th of August until the 10th of September. It is figured on page 195 of the Report upon Cotton Insects, and the original description of Say is given. The figure may also be found in the Departmental Report for the year 1879.† Prof. Riley has described its earlier stages (larva and pupa), and recorded its widespread distribution throughout the Southern States, West Indies and Mexico; also his having reared it from *Desmia maculalis*, the grape-leaf folder, in Missouri, and from two species of butterflies, *Apatura Lycaon* (Fabr.) and *A. Herse* (Fabr.) in the Southern States.‡

It is among the larger forms of the genus, measuring one-fifth of an inch in length; but one much larger has recently been described by Mr. Ashmead, from Florida, under the name of *Smicra gigantea*, which is 0.43 of an inch long.§

PTEROMALUS sp. — This species has not been determined specifically, but it appears to be closely allied to *P. puparum*, the parasite so destructive to the cabbage-butterfly, *Pieris rapæ*, of which large numbers frequently issue from a single chrysalis. The attack of this species seems not to have been a strong one, for only sixteen specimens were obtained. They were taken during the latter part of October and first week of November, either at rest upon, or very slowly moving over, the cases, and it is not, therefore, known, whether they all emerged from a single pupa.

Prof. Riley, to whom I owe the identification of the above Chalcids, informs me that he has also reared them from the *Thyridopteryx*, and, in addition, the dipterous insect mentioned below.

* *Bull. Buff. Soc. Nat. Sci.*, ii, 1875, p. 208.

† *Rept. Commis. Agricul.* for 1879, plate 12, fig. 13.

‡ *Bull. No. 3, U. S. Ent. Commis. — The Cotton-Worm*, 1880, p. 42.

§ *Canadian Entomologist*, xiii, 1881, p. 90.

TACHINA ? sp.— This fly, a large bluish Tachinid, has not been specifically determined. Its eggs had been found by Prof. Riley commonly attached to the bags, always externally near the neck, whence the young larvæ, upon hatching, worked their way into the case. They frequently failed, however, to reach their victim, as was proved by a number of empty egg-shells upon bags in which the larva was not parasitized.

Remedies.

Undoubtedly, either of the arsenical insecticides applied to their food-plants would destroy the young larvæ; but the best method of arresting the depredations of this insect, when it abounds to an annoying extent, is to collect the cases by hand when they have attained a size to permit of their easy discovery, and crush or burn them. This is a very effectual method with this species, for as the female has not the power of flight, being without wings, and never leaves its case even for the deposit of its eggs, a tree which has once been completely de-caterpillared (to translate a French word), can only become re-infested from contact of its branches with another infested tree, or from such a proximity to it that the intermediate space of ground could be traversed by caterpillars driven to migration for their food. The inconvenience of dragging their rough cases over the ground would prevent their travel to any great distance.

An instance is recorded of two barrels of the cases of this insect having been gathered and destroyed at one time from some young trees in a public park in the city of St. Louis, Mo.*

Tolyte laricis (Fitch).

The Larch Lappet.

(Ord. LEPIDOPTERA : Fam. BOMBYCIDÆ.)

Planosa laricis FITCH : in Trans. N. Y. St. Agricul. Soc. for 1855, xv, 1856, pp. 494-501, pl. 2, figs. 5, 6; 1st and 2d Rept. Ins. N. Y., 1856, pp. 262-269, pl. 2, figs. 5, 6.

Gastropacha laricis. MORRIS : Synop. Lep. North Amer., 1862, p. 234 (description).

Gastropacha vellea (Stoll), var. *minuta* GROTE : in Proc. Ent. Soc. Phila., ii, 1863, p. 433.

Tolyte laricis. PACKARD : in Proc. Ent. Soc. Phila., iii, 1864, p. 387; Ins. Inj. Forest and Shade Trees, 1881, p. 254.

Tolyte laricis. GROTE : in Proc. Amer. Philosoph. Soc. for Nov. 1874, xiv, p. 263.

Tolyte laricis. GILBERT : in Papilio, ii, p. 25 (food-plant and date of collection).

The common name of the larch lappet-moth given to this species by its original describer, Dr. Fitch, was in consideration of the par-

* First Report on the Insects of Missouri, 1869, p. 151.

ticular food-plant, upon which, up to that time, it had only been observed: it is, however, now known to occur upon the pine and hemlock, and will doubtless be met with upon other of the evergreens. The designation of lappet is borrowed from English writers who have employed it for those caterpillars which are characterized by lappets or leg-like appendages, placed in line on their sides, from which many long hairs are given out, which nearly or entirely conceal the legs by forming a lateral fringe to the flattened body.

Protective Mimicry.

The generic name of *Planosa*, meaning, in the Greek, a deceiver, which Dr. Fitch proposed for this species, referred to the deceptive appearance which it presents in both its caterpillar and moth stages, and which is a prominent characteristic of its associated lappet caterpillars. Dr. Fitch has so ably and so faithfully described this feature, that we transcribe what he has written:—

“The modes by which nature has endowed many insects to enable them to elude the search of birds and other enemies are truly wonderful. Among the insects thus endowed, the lappet-moths and their caterpillars have often excited the admiration of the curious. The latter, when in repose have the body flattened, somewhat like that of a leech, and on each side of each segment projects a little lappet or flat lobe. These lappets are pressed down upon the surface of the limb on which the worm is at rest. The sides of the body are also fringed with hairs which are similarly appressed to the limb. Thus all appearance of an abrupt elevation or an interstice to indicate the ends and sides of the worm is obliterated, and it resembles merely a slight swell of the natural bark, the deception being made complete by the color, which is commonly identical in its hue with the bark. And when there are spots or marks upon the caterpillar, they imitate the glandular dots, scars, and other discolorations which will be seen upon the bark around it. Even upon the closest scrutiny, the eye fails to detect any thing by which we can be assured this elevation is not a tumor which has grown in the bark. * * * *
The cocoons which they construct upon the limbs are equally exact counterfeits of the bush. One of these upon a limb of the wild black cherry is now in the museum of the State Agricultural Society. It is placed longitudinally in the slight angle formed exteriorly where one limb branches from another, and a piece of putty could not be more perfectly moulded into this angle and smoothed off so as to leave no inequality. The bark of the cherry is blackish with transverse whitish streaks, and this cocoon presents the same colors and of tints almost

the same, and what is most remarkable, it in one place shows a whitish streak continued from the bark upon the surface of the cocoon. And finally, in their perfect state, the moths imitate appearances which are common upon the particular trees on which they dwell; those upon deciduous trees, in the colors and scalloped margins of their wings resembling a tuft of withered leaves; those upon evergreens resembling a scar where the turpentine has exuded and conereted into a whitish mass."

The above statements are not too highly drawn. On the occasion of my rearing a colony of the caterpillars, noticed below, I called the at-



FIG. 14.—Cocoon of *TOLYTE LARICIS*, attached to a twig.

tention of an entomological friend, who prided himself on the possession of naturally keen sight so trained by long experience in collecting, that few caterpillars could escape his eye, to four of these larvæ upon a small twig before him. They were extended at length upon the side of the twig toward him; they were within reach of his extended finger; but he was unable to discover them until their presence was revealed to him, by my touching them one after the other, and eliciting unmistakable evidence of life. Their cocoons which I have met with abroad, wonderfully borrowed the hue of the bark where they rested, and simulated excrescences upon the twigs. One of them, more conspicuously placed than many, is shown in Fig. 14.

The Species Usually Rare.

The insect is probably not rare in nature, but for the reason above given, it usually eludes observation. The caterpillars remain motionless during the day upon the bark, which they only leave on the approach of night for feeding on the leaves. The flight of the moths is almost confined to the male sex; their colors are dingy and obscure; they take wing after night-fall, and we may venture to assert that their flight extends but little beyond the "bee-line" in which they are unerringly drawn to their mates. The species is a rarity in our collections. Its history has never been written, and I am therefore glad, through the opportunity recently presented of observing its transformations, to be able to contribute the account to the still small number of life-histories of our insects which we possess. Such contributions, however humble, are always appreciated by true naturalists, and they form the foundation of our best economic work.

Oviposition of a Moth.

A female of *Tolype laricis* was taken at Bath, near Albany, on September 6th, resting on the trunk of a pine. Near it, upon the bark and but slightly raised above its rough surface, was the flat cocoon from which the moth had apparently but lately emerged. Under the presumption that its escape from the cocoon had occurred during the day, and that it had not therefore been visited by a mate, it was thought useless to attempt to procure eggs from it for rearing by confining it in a box, as is frequently done by collectors with many of the *Bombycidae*. With a feeling of regret that the capture of so rare a species could not be made to contribute to the knowledge of its earlier and unknown stages, it was dropped in the cyanide (poison) bottle, preparatory to its pinning for the cabinet.

After lying in the collecting bottle for several minutes it was taken out and pinned. The box containing it and the other collections of the afternoon (*Catocala cara*, *C. concumbens*, *C. pialrix*, etc.), was set aside, from want of time for their preparation, until the following day. When the box was opened the *laricis* was found to have recovered from the effects of the cyanide, and to have commenced oviposition; it had already deposited about twenty eggs in an irregular cluster. In the hope that the eggs may possibly have been fertilized, they were carefully preserved. Oviposition was continued during the two following days, and on the third, the moth was found dead—her abdomen shrunken to about one-fourth of its original size, the terminal tuft of hairs entirely removed (they were distributed over the eggs), and with the anal aperture distended to so remarkable a size as to make the insect an interesting specimen for the cabinet.

The Eggs.

The eggs, about fifty in number, remained in a cool room during the winter, and in early spring were placed upon my table.



FIG. 15.—
TOLYPE
LARICIS
eggs.

They proved to have been fertilized, and I was so fortunate as to detect their first hatching. It occurred on the 5th day of April, when two larvæ emerged. They hatched very unequally, and up to the 17th of April, thirty had appeared. The following are the observed dates of the hatching of additional larvæ: On the 17th, four; on the 22d, four; on the 24th, one; on the 25th, two; on the 28th, three; on the 29th, two; on the 30th, one, and the last—forty-seven in all: thus eggs deposited during three days (Sept. 7-9), were twenty-five days in giving out their larvæ (April 5-30).

The eggs are a glossy reddish-brown, broadly oval, somewhat flattened upon their attached side, about 0.05 inch long, by 0.04 inch broad; the surface, under a magnifying power of fifty diameters, shows irregular hexagonal reticulations, of which the elevated lines are divided by a fine impressed line. The shell is moderately thick. The larva eats an opening in one end of sufficient size for its escape, but in some instances a large portion of the shell is subsequently eaten. The eggs laid under my observation have been so covered with the anal hairs of the moth as almost entirely to hide them from sight. Fig. 15 represents a cluster of them.

The Larvæ in their First Stage.

The larva, on emerging from the egg, measures one-tenth of an inch in length, is of a dull green color, with a black dorsal line. The head, shown in Fig. 16, enlarged to six diameters, is brown, crossed centrally by a white horizontal line, another shorter one beneath parallel to it, just above the mouth-parts, and two nearly perpendicular ones on the superior front of the head, obsoletely united below by a curved line. Rows of tubercles traverse the body, from which long hairs proceed, of which those of the first segment are longer than the body, and those on the terminal segment are as long as the body. The legs are long, and project laterally — more conspicuously so when the caterpillar is walking. Twelve of the larvæ died during this stage before attaining their first molting. Their greatest length was one-fourth of an inch. This stage was of varying duration, extending from sixteen to thirty-three days.

Second Larval Stage.

The first molting commenced on April 21st, and terminated on the 8th of May, extending over seventeen days — a considerable less range than that shown in the hatching of the eggs (17:25). The following is the record of the observed moltings:

April 21.....	2 larvæ.	May 2.....	3 larvæ.
“ 22.....	7 “	“ 3.....	1 larva.
“ 23.....	8 “	“ 5.....	2 larvæ.
“ 24.....	5 “	“ 7.....	2 larvæ.
“ 26.....	1 larva.	“ 8.....	1 larva.
“ 29.....	1 “		—
			33 larvæ.

On emerging from its first molt, the larva measured 0.3 inch. The frontal lines of the head, before nearly perpendicular and parallel, now converge below, resembling the letter U; the brown portions, under a

FIG. 16—
Head of
caterpil-
lar of
TOLYPH
LA RICIS
in first
stage.

lens, show indistinct mottlings (see Fig. 17). The body tapers regularly from the first to the last segment. The dorsal line is brown, with pale borders. On the summit of the third segment is a fuscous patch, behind which, extending over the incisure, is a pale patch, convex in front and straight behind, bounded by the four tubercles of the fourth segment. On the seventh segment is a small pale patch. The sides of the body are gray, with irregular linings. A subdorsal row of black tubercles bear several long black hairs, beneath which is a dull orange interrupted line. The tubercles of the substigmatal row bear numerous shorter white hairs.



FIG. 17.—
Head of TOLYTE LARICIS in its second stage.

During their rests from feeding the larvæ resort to the stems, where, with flattened body pressed to the surface and with head extended, they can scarcely be discovered.

At the close of this stage, which ranged from seven to eighteen days, the larvæ measured one-half an inch in length.

Third Larval Stage.

The second molting commenced seven days after the earliest of the first, and continued until May 9th, thus overlapping the first molt. The molts recorded (eight not observed) are as follows:

April 28.....	1 larva.	May 5.....	4 larvæ.
“ 29.....	1 “	“ 6.....	1 larva.
“ 30.....	4 larvæ.	“ 8.....	1 “
May 1.....	5 “	“ 9.....	2 larvæ.
“ 2.....	6 “		—
Total.....			25 larvæ.

Immediately following this molting, the larva measures 0.55 inch. The frontal white lines of the head are more convergent, approaching a V, and some confluent lateral lines are seen resembling a B (not well shown in the figure), the brown portions are distinctly mottled, and numerous white hairs are given out from beneath the white transverse band (Fig. 18). The color and markings



FIG. 18.—
Head of TOLYTE LARICIS in its third stage.

of the body are nearly as in the preceding stage. The subdorsal tubercles are more prominent and are slate-colored apically; two or three long black hairs proceed from each in a horizontal direction. The short gray lateral hairs are now so numerous, that they form a fringe to the body, which, as the larva rests on a leaf of the pine, curve downward and inward, so that some of the tips meet underneath. The subdorsal stripe is geminate, marked with orange opposite each tubercle. The tubercles of the third segment are more prominent than the others.

Fourth Larval Stage.

The third molting, as in the second, commenced seven days after the earliest of the preceding molt, on May 5th, when but about two-thirds of the larvæ had undergone their second change. Of the duration of this molt, or of the dates of molting, no record was kept.

The larvæ show the following dorsal markings. Resting on segments 3 and 4, a sublenticular yellow spot, bordered with velvety black, and bisected by a narrow brown mesial line; on segment 7, a yellow spot of which the anterior portion is split by a wedge-shaped brown projection — its greatest breadth between the tubercles, extending on segment 8 and terminating in a point between the tubercles of this segment. In some examples, a somewhat similar shaped spot of paler yellow is seen on segment 9, extending a little on segment 10. The yellow lateral markings which in the former stage formed an interrupted line below the tubercles are reduced to a series of indistinct ochreous spots at the base of each tubercle. The cylindrical tubercles on segment 3 are quite projecting and rounded at the tip; the subdorsal tubercles present the following ratio of size in the order of their occurrence: 1, 2, 7, 9, 6, 10, 5, 4, 12, 11, 8, 3 (that on segment 1 being the largest, and on segment 9 the smallest). The subjoint of segment 12 has two elevated black points. The barbed gray hairs composing the fringe have some barbless ones mingled with them. The legs are luteous, marked with black exteriorly, and are nearly hidden by the overlapping fringe.

Beneath, on segment 2, are three small mesial spots; on segment 3 are two spots; on the following segments, an obscure larger one mesially on each ring; the body ventrally is marked with crinkled lines.

Previous to the fourth molting, the larvæ measure 1.2 inch. The 8th tubercle in the subdorsal row is conical; the 11th has a broad base, extending anteriorly to the incisure. Upon the first five segments the barbed hairs of the fringe are more numerous.



FIG. 19.—Head of *TOLYTELARICIS*, female, in fourth stage.

This stage, as was ascertained later, was the last larval stage of a portion of the brood; a part entered upon a fifth stage. The head of these, taken from cast head-cases at their fourth molting (enlarged to six diameters as the preceding ones), is represented in Fig. 19.

Mature Larva.

The largest attained a length of nearly one inch and a half. The color is a dull brown, resembling that of the bark of the pine twig. The head is covered with black hairs superiorly, and with gray hairs

anteriorly. When extended, the front of segment 1 is pale green, and the incisure of segments 2-3 is shining black. The three dorsal spots are pale greenish-yellow; the central spot, on segment 7, has a *fleur-de-lis* form; the following one, on segment 9, is small and geminate; and on segment 11, in a number of the larvæ, is a fourth spot, usually smaller than the preceding. Of the tubercles, arranged in subdorsal rows, those on segment 8 are the largest, exceeding in height and diameter of base those on segment 2, and are directed somewhat backward. A lens shows short hairs over the body, and on the summit of the tubercles are larger ones, curving inward; the body is lined with short, black streaks. From the tips of the lappets long, black hairs of an unequal length are given out, while their margins and intervening portions of the body bear numerous shorter gray hairs, many of which are barbed; these form a fringe directed downward when the larva is resting on a small branch, wholly concealing the legs and nearly hiding the long prolegs. In addition to these lappets (a sub-stigmatal row), there is a single one of a little larger size on the first segment, in front of the first spiracle, the hairs of which project along the side of the head. All the lappets are margined with a black line which is more distinct upon the anterior one: the first three point forward, the others backward. The larva has the power of elevating or depressing one or more of the lappets at pleasure: when in motion, they are borne horizontally; at other times, all but the thoracic ones are depressed. The prolegs are obscure greenish. The ventral region is of the same color, with a lenticular blackish spot on the first five segments.

The Cocoon.

The first cocoon was spun on the 17th of May, forty-three days after the earliest hatching of the larvæ. Within two days, seven cocoons were made: in all, thirty-three were obtained. For the reason that the twigs upon which the larvæ had been fed were of a small size and without the branches at the giving off of which the cocoons are usually placed, nearly all were spun upon the flat sides of the feeding cage, where they presented the appearance shown in Fig. 20: none were placed in the angles or corners. Their ground-work usually extended at some distance beyond the cocoon proper, for while its average length was less than one inch, that of the ground-work often exceeded one inch and a half. The cocoon is of a pale gray color, elongate oval, quite flattened beneath, its elevation being but about one-half its breadth, rough-



FIG. 20.—Cocoon of *TOLYTE LARICIS*, spun upon a flat surface.

ened externally, smooth interiorly, moderately firm and thick but diaphanous, composed of two layers of silk, which are usually more closely united than represented in Fig. 21, which shows the under surface with the thin lower layer forming the ground-work removed, disclosing the pupa-case from which the moth has emerged through the ruptured upper part of the cocoon.

The Pupa.

The pupa is dark-brown, about 0.60 inch long, from 0.27 to 0.30 inch broad across the wing-cases, and only about 0.18 inch thick, being much flattened beneath. The incisures are deep and the segments well rounded, and continuing broad in the female, as shown in the figure, until their abrupt termination. The anal segment is tipped upon its upper side with two minute sharp teeth or by a bifid tubercle having a small granulation (shown under a lens) on each side. The male pupa is readily recognizable by its narrower terminal segments, and the well-defined antennæ cases showing at the point of the antennal twist a sensible contraction, and above it a broad lobe-like expansion, outwardly beyond the regular curve of this portion of the pupa. The features of the female pupa are essentially shown in the pupa-case, represented within its cocoon, in Fig. 21.

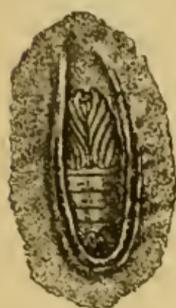


FIG. 21. — Pupa-case of *TOLYTELARICIS*, within its cocoon, seen from beneath, with lower surface removed.

Pupation.

The pupation was quite brief—only twelve days, if three days be allowed for the change within the cocoon of the larva to the pupa. The first moth emerged June 1. The following is the record of dates of emergence of the thirty-three examples obtained: it is of interest in not showing the priority in the time of the male, which is found in many lepidoptera, but a singular alternation between the sexes of the first half of the brood:—

	♂	♀
June 1.....		1
“ 4.....	1	
“ 5.....		3
“ 6.....	3	
“ 7.....		3
“ 8.....	2	
“ 9.....		3
“ 11.....	1	2
“ 12.....	2	
“ 13.....		1

	♂	♀
June 14.....	2	1
“ 15.....	1	
“ 16.....		2
“ 17.....	1	
“ 18.....		1
“ 19.....	1	
“ 20.....	1	1
Total.....	15	18

The Moth.

Dr. Fitch has given an excellent detailed description of the moth, which, in consideration of the small edition of the Report published and its scarcity at the present time, we herewith present:—

“The MALES [represented in Fig. 22] measure 0.60 inch in length to the tip of the abdomen and of the wings, and one inch across the latter when they are spread. The head is densely clothed with white



FIG. 22.—Male of the
Larch lappet-moth—
TOLYTE LARICIS.

hairs in front and with blackish ones upon each side around the eyes. The feelers are minute and are wholly enveloped and concealed by fine long hairs, their ends forming a slight projection, like the point of a camel's hair pencil. These hairs are blackish on their outer sides and ash-gray within. The antennæ are short, about a third of the length of the body and are abruptly bent near their middle,* or with the ends straight in both directions from their crook near their middle, when they present the shape of an inverted V. They are furnished with two rows of coarse branches, which are long from the base to the crook, where they are abruptly shortened to half their previous length, and continue thence to gradually diminish in length to their tips. Each branch has a row of very fine hairs along one side resembling eye-lashes. The mouth has only the minute rudiments of a spiral tongue, and this not coiled as we see it in moths generally. The thorax is clothed with long hairs of a dark gray color, those at its anterior end white, and on its posterior part is an oblong crest of glossy scales, slender and hair-like, with their ends dilated into an oval, flattened knob, in shape resembling a spoon, of an auburn-brown color, arranged like the hairs of a moustache, and jutting up from the surrounding prostrate hairs, forming a large tuft or protuberant oblong spot, broadest posteriorly and narrowing to its anterior end. The abdomen tapers slightly from its base to the tip, and is clothed with blackish hairs above, whitish ones beneath, its apex having a dense tuft of long, pure white ones. The wings are quite small for such a thick-bodied, heavy moth. They are semi-transparent, being thinly covered with brown scales which are commonly denuded, the wings then appearing perfectly transparent, like glass. Their veins are robust and white, with darker, irregular bands. The hind margins of both pairs of wings are entire and not in the least

*This feature is not shown in the figure.

toothed or scalloped. When at rest they are pressed against the sides of the abdomen, in the form of a steep roof, the outer edges of the hind wings protruding more or less from under the outer edge of the fore ones. The legs [which are stretched forward at rest] are heavily clothed exteriorly with tufts of long, snowy-white hairs, the forward shanks having a tuft of blackish ones on their insides at their base.

The female, shown in Fig. 23, is quite unlike the male, being much larger and differently colored. It has a peculiarly delicate or mellow appearance, from the softness of its colors and the thinness and translucency of its wings. The latter, when extended, measure an inch and a half or slightly less. Their hind edge is occupied by a slender white band or line. Forward of this is a narrow, pale, dusky band which is abruptly widened near its middle to double its usual breadth, this widened part occupying two of the interstices between the veins. This band is margined on its anterior side by a white line, by which it is separated from a much broader and more dusky band, which is waved in its middle in conformity with the dilation in the narrow band behind it. Forward of this the wings are milk-white, crossed by four very faint, equi-distant, wavy bands of the same delicate, pale, dusky hue with those behind, these bands being often obsolete on the middle of the wing and distinct at their ends only. The veins are prominent and white, forming slender lines of this color crossing all the bands. The hind wings are of the same soft, dusky tint as the bands on the fore-wings, but more pale; on their hind margin is a white line or slender band. The hind edge of both pairs of wings is perfectly entire as in the male, and their fringe is pale dusky on the fore-wings, crossed with white lines at the tips of the veins. The body is clothed with incumbent milk-white hairs, the tip of the abdomen having a pale brown tuft, and the crest on the base of the thorax appears like a large, elevated, blackish spot. The antennæ in this sex are very slightly crooked in their middles, and their branches, though equally thick with those of the males, are much shorter, being about four times as long as the diameter of their stalk. These branches are longest in the middle, and are gradually shorter from thence, both toward the base and the tips."



FIG. 23.—Female of the Larch lappet-moth.

Sexual Difference in the Larval Moltings.

It has been my habit to preserve all the head-cases cast off at the several moltings of the lepidopterous larvæ reared by me from the egg, to serve as a tangible record of the number of molts undergone, and for the further reason that they usually present interesting specific features which render them valuable for illustration, and for preservation in a biological collection. In collecting the head-cases of the above brood of *T. laricis*, I was at a loss to account for the great deficiency in number of those of the fourth molt. There were fifteen less than in the preceding molt. When the moths had all emerged — equal in

number to the number of the cocoons—it was found that there were fifteen males and eighteen females. The mystery of the deficient head-cases was solved. The fifteen male larvæ had spun up in their cocoons after three molts, and the females had undergone an additional molt before maturing and forming their cocoons.

That a female moth may undergo one molting more than the male had been before noticed. Prof. Riley records it as the rule in the development of *Orgyia leucostigma*, the white-spotted tussock moth, which deposits the white froth-coated egg-masses upon the trunks of the elm and horse chestnut trees, which its caterpillars injure so seriously and often defoliate in Albany and other of our cities. Of this species he states* that the male caterpillars spin up in cocoons about six days before the females, which continue their growth until they attain about twice the size of the males.

An additional molting of the female *Orgyia antiqua* Linn., in England, has recently been recorded (*Ent. Month. Mag.*, xix, p. 210).

Observations made by me during the last summer render it almost certain that this same sexual difference in the moltings exists also in *Callosamia Promethea* (Drury). The cocoons which I have in my possession, obtained from a brood of larvæ raised last summer, will permit of a positive determination on this interesting point.

Annual Broods.

There are two annual broods of this species. The hibernating eggs produce moths in June and July, which at once deposit eggs to give the second brood of moths in the month of September. I have captured them, at rest upon trees, at different times between the 1st and 6th of September. Eggs of the first brood, obtained during the first week in July, showed some black spots on the 9th, depressed sides on the 12th, and changed to a pearly-white color a day before their hatching on the 19th.

Distribution.

It does not appear to be a widely distributed species. It is known to me only from New York and the New England States. It seems to be much more rare and limited than its longer known congeneric species, *Planosa velleda* Stoll, which is occasionally met with upon apple, elm, and a few other trees, throughout the Eastern and Middle States, extending into Georgia (Smith-Abbot), Kansas (Snow), and Illinois (French).

Remedies.

The rarity of this insect renders it unnecessary to indicate means for its destruction. It probably will never appear as a pest, unless a

**First Report on the Insects of Missouri*, 1869, p. 145.

colony should take possession of a small evergreen prized as an ornament. In this event, its presence would be shown by the closely eaten leaves, when the larvæ should be sought for resting upon the trunk during their repose by day, and *if discovered* (which is extremely doubtful, for reasons previously shown), if they could be induced to release their hold to the bark, they might be boxed and sent to some entomologist, who would gladly undertake to arrest all further injury from them or their descendants for all future time.

Nephelodes violans Guenee.

Larva : *The bronze-colored cut-worm.*

Moth : *The Violet Nephelodes.*

(Ord. LEPIDOPTERA : Fam. NOCTUIDÆ.)

- GUENÉE: Sp. Gén. Léop. v. — Noct., i, 1852, p. 130, no. 204 (original description).
- LINTNER : in 23d Rept. N. Y. St. Cab. N. H., 1872, p. 191; in 26th Rept. N. Y. St. Mus. N. H., 1874, p. 180; Ent. Contrib., iv, 1878, pp. 34, 46, 49, 119 (dates of collections, etc.); in 7th Rept. Adiron. Surv. St. of N. Y., 1880, p. 385; in St. Lawr. Repub., June 8, 1881; in Country Gent., June 9, 1881, xlvi, p. 375; in Albany Eve. Journ., July 1, 1881.
- SNOW : in Trans. Kans. Acad. Sci., iv, 1875, p. 45 (common in Kansas).
- NORMAN : in Canad. Entomol., viii, 1873, p. 69 (moth common in Ont.); Id. vii, 1875, p. 6.
- THAXTER : in Psyche, ii, 1877, p. 36 (occurrence in Mass.).
- FRENCH : in Prairie Farmer, April 6, 1878; in Thomas' 7th Rept. Ins. Ill., 1878, pp. 99, 220 (description of larva and moth and habits); in Canad. Entomol., x, 1878, p. 61 (description of larva and pupa).
- FORBES : in Amer. Entomol., iii, 1880, p. 231 (larva from blue bird).
- RILEY : in Amer. Nat., xv, 1881, pp. 575-577 (larval habits and description); in Amer. Entomol., iii, 1880, p. 205 (habits, etc.).
- OSBORN : in Iowa Homestead, June 17, 1881 (diseased larvæ).

The caterpillar of this species was associated with that of *Crambus vulgivagellus* in its attacks upon the pastures of St. Lawrence county, N. Y. (noticed in the following pages), and probably, in other of the adjoining counties. The association, however, was rather one of time than in depredations, for, from the habit of the caterpillar of concealing itself by day under some object lying upon the ground, and coming out at night for feeding, it is not at all probable that its injuries would extend to any distance from its hiding place or embrace the entire area of a pasture or meadow, as did those of the *Crambus* larva. Its favorite hiding places seem to be pieces of wood, such as fence-rails, and the excrementa of cows. In proportion as these abounded in grass-land, in a like proportion might its depredations be distributed.

The Caterpillars in St. Lawrence County.

A few of the caterpillars (not more than four or five examples) were among my collections in the towns of Canton and Potsdam, on May 19th and 20th. Upon my return to Albany, when it was found that nearly all of the *Crambus* larvæ which I had collected, had died, and it was doubtful if any would mature, in compliance with my request for additional specimens, a box of fifty or more larvæ was sent to me, with the following interesting statement of their abundance, under date of May 23d.*

"Last Saturday (21st), the farmers reported that the caterpillars were dying, as they found the dead skins *under the ground*. This morning I went to our pasture to see if this was so. I found comparatively few such as were seen last week, but under every stick I turned, except two, were larvæ, such as sent by express to you to-day, together with cast-off skins of last molt. It appears, therefore, that instead of dying, they were molting. Under about twenty sticks I found one hundred larvæ such as sent, some few of 2d and 3d molt [*C. vulgivagellus*], and three of other Lepidoptera."

They were large, stout, caterpillars, as represented in Fig. 24, of from one inch and a quarter to rather more than one inch and a half in length, with a yellowish head, a broad pale band upon the sides in which are the breathing-pores (spiracles), and in the most distinctly marked examples, with five additional lines upon the back and sides, more or less distinct. Their general color was of an olive-green.



FIG. 24.—Caterpillar of the Violet Nephelodes—*NEPHELODES VIOLETANS*,—natural size.

That it was thought at the first, both by my correspondent and myself that these might be but an advanced stage of the forms previously collected,† may find excuse in that it was expected that the latter had still one or two molts to undergo before attaining their maturity. Such extensive depredations as observed had been mentally associated with a species at least as large as *Leucania unipuncta*, and to attain this size two additional moltings would be required. It was not thought that they were near maturity; when, therefore, they so suddenly disappeared, and at the same time, another form was discovered in large number, together with their cast skins, it was but natural to accept the two phases as the

*For these examples, for additional sendings, for valuable observations, communicated to me from time to time, upon this species and *Crambus vulgivagellus*, and for first conveying to me the information of the abundant presence of these species, and for many other similar favors, I desire to express my deep obligations to Miss A. Clarkson, of Potsdam, New York.

† For an account of these collections see the pages upon *Crambus vulgivagellus* larvæ.

result of an intervening molt, particularly, as changes are known to attend the moltings of some species, quite as marked, in general appearance, as were these. The suddenness of the replacement of the forms is shown in this fact stated in a letter of Miss Clarkson to me: "When you were here (20th inst.), the striped larvæ were one to hundreds of the spotted, while on the Monday following (23d), it was just the other way."

A few days later (May 27th), my correspondent wrote me: "This morning I found fourteen of the caterpillars under a piece of fence-rail about four inches wide and four feet long. They are also found under leaves, stems and dried excrement. The grass around their hiding places is eaten off at the top."

Unsuccessful Attempt to rear the Caterpillars.

The caterpillars sent to me, as above stated, were received May 25th, and placed in a large tin vessel where they were furnished daily with a supply of fresh grass. On June 1st several of the larvæ had matured and entered the ground contained in the case for pupation, while others took position in shallow cells which they had excavated beneath a paper covering the surface of the ground. By the 8th of June all of the larvæ had ceased feeding. They were observed daily, but it was evident that the conditions of confinement were unfavorable to their development. Dead ones were removed from time to time from their cells beneath the paper, while others, but slightly changed in appearance, still occupied the cells on July 1st. At this time a large dipterous parasite, enveloped in some silken threads, was found upon the ground. Wishing to take the larvæ with me upon leaving home, on July 16th, the ground was turned out and examined, when, with a number of dead, one pupa was discovered, one still unchanged larva, four cocoons of a species of ichneumon, and one of apparently a different species. The pupa died, and I failed to secure a single moth.

With a second sending of fifty larvæ on June 4th, I was equally unsuccessful. Nearly one-half of the number were still feeding on June 8th, at which date one example passed its last larval molt. On the 25th those that survived were occupying cells within or on the surface of the ground, but were uncomfortable from the presence of a large number of a minute, white, agile species of the Podurinae which infested the earth and could be seen upon their bodies. The insect was believed to be *Campodea fragilis* Meinert, figured in the *American Entomologist*, vol. iii, p. 199, f. 104, but it was not positively identified. For the purpose of freeing the larvæ from these pests, they were removed to a box containing dampened paper. The moisture proved

insufficient for them, and two days later the larger number were found dead.

Some of the larvæ were sent by me to Prof. Riley, at Washington. They were at once identified by him as a species with which he had been familiar in Missouri, and from which he had bred the moth known as *Nephelodes violans* Guen. He had found it extremely difficult to rear in confinement, and only after repeated failures was he successful in carrying the caterpillars through to their perfect stage. In a recent reference to the caterpillar, as having been found in the stomach of a blue-bird shot in Normal, Ill., he had characterized it as "the bronzed cut-worm."

Description of the Larva.

Prof. Riley, in compliance with my request for such of his MS. notes as he might spare me for publication, has kindly sent me the following description of the early stages of the caterpillar:

"The larva in its *first stage* is bright green with the head pale gamboge-yellow, the cervical shield of the same color, and the three narrow dorsal pale lines and broader stigmatal pale stripe almost white, and not showing on the plates. The intermediate faint line between the subdorsal and stigmatal stripes is obsolete, and the space between all the lines is more nearly equal than in the last stage, the stigmatal stripe extending above the stigmata where later it becomes purely substigmatal. In the *second stage* there is little change, but in the *third* the lines show through the plates which become darker. The piliferous spots which subsequently become subobsolete are in the earlier stages dark and more conspicuous and normal, and the front prolegs are never atrophied."

The following description of the young larva, giving mainly colorational features not contained in the above, and also of the mature form, is published by Prof. Riley in vol. xv of the *American Naturalist*, pp. 576-7.

"The young larva is green but early shows the pale-stripes. When about one-third grown the general hue is olive-green with the cervical and anal plates but little darker. The head is pale greenish, faintly freckled, and with a few dark hairs; the sutures pale, the mandibles tinged with blood-red, and brown at extremities, and the ocelli distinct on a pale ground, the second and third from below, black, the others light. The three dorsal stripes and the narrower supra-stigmatal line are very pale greenish-yellow, the broader substigmatal stripe of a clearer cream-yellow with a faint caraneous tint.

"*Mature larva* :—Larger specimens fully 1.9 inch long, largest in the middle of the body and tapering slightly each way, especially toward anus. Color, brownish-bronze, the surface faintly corrugulate but polished, the piliferous spots obsolete. A darker, highly polished cervical shield and anal plate. A medio-dorsal and subdorsal stripe of a buff, or dull flesh-color, each stripe of about equal diameter (nearly 0.04 inch on middle joints), forming narrower, paler lines on the plates and nearly converging on the anal plate; a similar but somewhat broader substigmatal stripe which is wavy below; between subdorsal and

stigmatal stripes a faintly indicated pale line dividing the space nearly equally. Venter nearly of same buff color, with a tinge of green. *Head* perpendicular, immaculate, paler than body, rugulose, sub-polished, faintly translucent, pale dingy-olive, the jaws, and sometimes the mouth-parts, darker. *Legs* and prolegs of same pale olive color, the latter with a black band at outer base. *Stigmata* black.

"One of the most marked Noctuid larvæ, at once distinguished from all others known to me when full-grown by the pale immaculate head (recalling copal) and the polished, bronzy or umber color of body. The upper stripes are often obsolete or sub-obsolete in the middle of body, but are persistent on the plates. The bronzy color in paler specimens is due to brown and yellow mottlings, and in dark specimens becomes nearly black; while the spots are generally minutely mottled with carneous.

"*Pupa*:—Normal dark brown, the tip with two horizontal, almost parallel, spines."

Notes of the Occurrence of the Larvæ.

The following larval observations, made by Prof. Riley, in Missouri (except the last two), have also been placed in my hands for use in this notice of the species:

April 24, 1871. Found under rock, apparently feeding on clover. Tolerably common around Kirkwood and along the Iron Mountain Railroad, nearly full grown. Curls sidewise.

April 25. It feeds on grasses, clover, *Polygonum aviculare*, and appears to take most of the succulent plants.

May 5. Found the same rather common at Columbia, Mo., on sod, under plank and under shelter, in different sizes. Occurs with quantities of its pale bright green frass. On the 8th, others were found at Kirkwood.

May 19. One nearly full-grown was discovered high up on a stalk of blue grass, feeding in the hot sun (exceptional).

May 28. Of nineteen specimens placed in a vivarium and others under a sieve out of doors in a meadow, several proved to have been parasitized; one had nineteen *Tachina* eggs upon it; another gave forth *Microgaster* larvæ which had spun their white cocoons in a surface cavity in the ground made by the larva, and still another gave an *Ophion* cocoon. The healthy ones have all entered the ground but are still in the larval state.

June 22. The larvæ are still unchanged.

Sept. 3. Sieved the ground and found all changed to the pupæ. Two days later the first moth emerged, and others issued subsequently.

May 1, 1873. The season backward (apple blossoms just out). Found the larvæ of different sizes, — some quite young and others full-grown.

April 26, 1876. The larvæ are quite common on St. Louis Fair grounds.

June 29, 1880. One larva from the stomach of a blue-bird (*Sialia sialis*), received from Professor S. A. Forbes, of Normal, Ill.

April 30, 1881. The larvæ not uncommon in ground at base of rocks on High Island, near Washington, D. C.

Published Observations upon the Larvæ.

Very little has been published of the habits of the larva. Prof. Riley, in vol. iii of the *American Entomologist* (p. 215), in noting his identification of it in the stomach of a blue-bird, states:—

“We have been familiar with it for many years, having reared it in 1871, after many previous futile efforts. It is quite common in Northern Illinois and Missouri in early spring, when it may be found in blue-grass sod, generally concealed under some stone or board during the day, though we have occasionally found it feeding on grass stalks in the hot sun during the day time. The larva is found full-grown as soon as spring opens, so that it undoubtedly passes the winter, like so many other cut-worms, in the larva state and of different sizes. The insect is quite common and wide-spread, for we have found that the larva had been common in 1871 around Ithaca, N. Y., on blue-grass and under clover.”

The larva was first described by Prof. French, Assistant State Entomologist of Illinois, in the *Canadian Entomologist*, vol. x, April, 1878, from examples found by him during the last of April and through the month of May, in grassy places in Washington county, Ill. These changed underground, early in June, to dark brown pupæ, from which the perfect insects were obtained about the middle of September.

While in confinement they fed freely upon corn, grass and *Polygonum aviculare*, which they ate without seeming to prefer one more than another.

In Dr. Thomas' 7th *Annual Report on the Insects of Illinois*, Prof. French includes the species in an account there given of several corn depredators, stating: “As corn forms one of the food-plants of the caterpillar, it may be placed here among corn insects, though the extent to which it may injure corn is unknown, for I fail to find any record of the insect, except in its moth state.” He found it to possess, when fed in confinement, the same habits as those of the larvæ of *Agrotis* and allied genera, and therefore suggests the name of “the smooth cut-worm” for it. The first specimens were found April 28th, concealed in the grass, at which time it was almost an inch long and of nearly a black color. During the month of May, others and larger and of a lighter color were found, the features of which are described, and some observations upon their habits in confinement given. He adds in concluding: “Should they multiply so as to be destructive to

corn and grass, burning our meadows and fields late in the spring would doubtless destroy them."

In the same report, p. 220, Prof. French also devotes a page to the species, giving description of the larva and of the moth.— He adds : " I have no evidence that this insect ever becomes sufficiently numerous to be injurious, but as it seems to be a general feeder upon some plants that are beneficial to man, and as it is spread over a wide range of country, it may do so. In that case, we may judge from its cut-worm habits that the remedies that serve to keep them in check will also answer for this."

Prof. Osborn, of the Iowa State Agricultural College, has given an interesting account of a diseased condition of the larvæ, which came under his observation. He states (*loc. cit.*) :—

" *Nephelodes violans* has been quite numerous in localities around the college, though its damage has not been very perceptible. It is attacked by some epidemic disease, which causes the death of large numbers of them. The diseased worms will be found clinging to the grass as high up on the stems as they can reach, their bodies swelled to an unnatural size, and in the later stages exceedingly soft and ready to fall to pieces. If undisturbed, and the weather dry, they finally shrink away and only the dried skin and a mass of blackish matter within it, remains. If examined at any time after they begin to show the symptoms of disease, their blood will be found full of minute living organisms (*Bacteria*), which seem to increase in numbers as the disease progresses. They are also found even more abundantly in the fluid taken from the alimentary canal. We here meet with the great question which is so perplexing to the medical profession, whether the microscopic animals are the cause of the disease, or an attendant or consequent of it. * * * * We have the fact, and a gratifying one, that *some* disease destroys great numbers of this insect, which otherwise might cause great destruction to various important crops."

In a paper recently published by Professor Forbes, State Entomologist of Illinois, upon the *Regulative Action of Birds upon Insect Oscillations*, he records the larva of *N. violans* as constituting a portion of the food of robins (*Turdus migratorius*), catbirds (*Mimus Carolinensis*), and red-winged blackbirds (*Agelaius Phœniceus*), shot in an orchard in Tazewell county, Ill., during the latter part of the month of May, for examination of the contents of their stomachs. (*Bull. No. 6, Ill. State Lab. of Nat. Hist., 1882.*)

The Moth.

The moth is represented in Fig. 25. It is a stout, robust form, and rather above the average size of the *Noctuidæ*. In spread of wings it usually measures between one inch and a half and two inches. The general color of the front wings is brown, with a violet reflection. The two transverse bands, inclosing a darker space of brown traversed by the median band and having in its upper portion in paler color the two ordinary spots, and the subterminal line, are indistinctly visible. All the markings are obscure. The hind wings are brownish, paler at the base. More carefully noticed, the moth presents the following features:—

FIG. 25.—*NEPHELODES VIOLANS*
Guenée. Natural size.

The expansion of wings of the male is 1.65 inch; of the female 2 inches. The primaries are broad and stout, triangular, rather squarely cut at the apex, with the spots and lines indistinct. The two transverse lines are visible, of which the anterior (nearest the base) is undulated and arcuated, and the posterior one is rounded over the end of the cell; between the two is a median shadê, rather indistinct. The subterminal line is sinuous, angulated on each nervule, and sometimes forming a W on the upper nervules of the median vein as in *Hadena*. The color of the wings is brown (*chocolat-au-lait*), suffused with violet, with the space between the transverse lines (except upon the costal and internal margins) deeper brown, especially behind the reniform spot, which is of the usual kidney-shape; the orbicular spot is round; they are both illy defined, are concolorous with the subterminal space, and are often lost superiorily in the pale costal margin. The fringe is of the same color as the wing.

The secondaries are obscure gray-blackish in both sexes, of rather uniform shade, but a little paler at the base. The fringe in some fresh examples is reddish-violet. Their underside is of the latter shade with a median line and a lunule in the cell.

The abdomen is long, stout, carinated, tufted, and robust; quite large in the female, in which it is cylindrical, and terminates in an obtuse point. The thorax is square, stout, hairy, the breast is quite hairy. Legs, with the femora quite hairy, and the tibiæ stout, not spined, scaly rather than hairy. The antennæ are stout, demi-pectinated, *i. e.* furnished with pubescent teeth, and terminating in a stiff hair in the male; slender, filiform (with isolated hairs) in the female. Palpi obliquely ascending, the second joint thick, bristling-hairy, the third slender, short but distinct, directed forward. Proboscis short.

The above description is mainly drawn from the specific characters given by Guenée, combined with those characterizing the genus, which

embraces but two other species, viz.: *N. minians*, occurring with *N. violans*, and *N. rubeolans*, doubtfully from New Holland.

The moth is not numbered among the common species. Ordinarily, so far as my observation extends, it is rather rare, but in the year 1876 it was somewhat abundant in the vicinity of Albany, and Mr. W. W. Hill captured, at Bath-on-the-Hudson, forty examples between August 30th and September 15th, where it had not occurred during several preceding years. Mr. George Norman records it as "common at light and sugar," in his *Captures of Noctuidæ at St. Catharines, Ontario*, in 1874. In his paper on *Captures of Noctuidæ near Orillia, in the Province of Ontario, Canada*, he represents it as very frequent at light, rest, and sugar; the locality is near Lake Simcoe, in lat. $44\frac{1}{2}^{\circ}$. Mr. Hill, in his Adirondack collections during the years 1875-1878, captured but five examples (all males), occurring between Aug. 3d and Aug. 22d: in some of these years collections were not made during September when the species may have been more numerous. The earliest date at which I have taken the species is Aug. 2d — the latest, Sept. 11th. I had never found it otherwise than rare until the year 1877, when it was not at all uncommon among the very large collections made, by sugaring, at Center, N. Y.

An interesting fact in regard to this moth is the worn condition in which it always presents itself to our notice. I have never seen a perfect specimen — all have been rubbed more or less over portions of their wings, their fringes broken, and colors dulled. Not having reared the species from the larva, all have been flown examples, but, without doubt, some had been but a short time from the pupa. Of many other species, I have captured abroad and at sugar, hundreds of examples in such condition that the most critical collector would not hesitate to call them *perfect*. The uniformly worn condition of *N. violans* has often been remarked upon, but no satisfactory explanation has been given for it. Mr. Norman, in his list of one hundred and seventy-four species of Noctuids occurring at Orillia, says of this, as of no other species, "always in bad condition." Mr. Thaxter, in an extended list of species, also singles it out for the comment, "almost always in poor condition."

Guenée, in describing this species, suggests that it may possibly be but a local variety of the species which he describes at the same time under the name of *Nephecodes minians*. The two have been regarded as identical by some of our writers and they are catalogued as *N. minians*, and var. *violans* in the new check-list of Mr. Grote, but from the differences shown by examples in my cabinet and in those of Mr. Meske and Mr. Hill, in Albany, where they are arranged as distinct species, I shall regard them, for the present, at least, as distinct. In

N. minians, the darker space between the transverse lines is of a dull red color; the anterior transverse line is less curved and the front wings are broader and less produced apically than in *N. violans*.

Distribution of the Species.

The species appears to have a wide distribution over the United States. At present we know it from Massachusetts, Michigan, Wisconsin, Illinois, Missouri, Kansas, and some other of the Southern States. It probably occurs in Washington Territory, as *N. minians* is reported as having been taken there. In Ontario, the moth has occurred more frequently than in the United States.

Its Natural History.

The moth may be seen abroad as early as the first of August, in favorable seasons, and it continues until the latter part of September. According to Prof. Riley, it not infrequently hibernates as a moth in the Southern States, where it has been observed at different times during the winter months. We have no knowledge of its eggs. They are probably deposited upon the grass near some object which may serve as a hiding-place for the young larvæ. The time of their deposit is unknown, but from the facts given (see p. 103) of nearly full-grown larvæ having been seen as early as April 24th (in Missouri), and full grown ones on May 1st, we may safely infer that oviposition takes place soon after the appearance of the moth in August or September, and that the young larvæ, after eating sparingly, and having undergone at least two molts, retire to their hiding places wherein to pass the winter. Those that survive this perilous period of their existence — perhaps a small proportion of the original number — resume their feeding as soon as the grass starts in the spring.

The habits of this caterpillar place it in that destructive class known as "Cut-worms," of which so much has been written, and which are justly a terror to agriculturists from the secrecy of their depredations and extreme difficulty of arresting them. The name of cut-worms was originally given to those species which were addicted to cutting off the stalk of young cabbages, turnips and other plants just at or beneath the surface of the ground. As now extended, it embraces those numerous species which conceal themselves during the day either beneath some object lying on the ground, or buried just below the surface, and come abroad at night to feed upon garden vegetables and other low plants. Some of the species, not confining themselves to low vegetation, climb trees, grape-vines, etc., to feed upon the buds and tender leaves. Instead of the omniverous and ubiquitous *cut-worm* of early writers, upon which was charged vastly more than any one insect should be called upon to bear, we have now

perhaps three hundred species, each needing special investigation, and many showing habits differing so greatly from one another, that very different methods of treatment are required for their destruction, or for the prevention of their injuries.

In my own experience with the larvæ of *N. violans*, they developed no cut-worm habits, as they were fed in darkness under cover with cut grass furnished them. Prof. French observed them in an open rearing box and found them to display the same habits with the larvæ of the genus *Agrotis*, feeding mostly at night and keeping concealed during the day, either in the ground or under the loose material upon it. They were sluggish in their movements, except when disturbed, when they were quite active. In Illinois (see p. 104), the larvæ entered their pupal state in June; in Missouri, the larvæ had matured and buried for pupation previous to May 28th; in New York, the earliest matured June 1st and the latest about the 20th, giving for the average time, June 10th. On July 16th one was found to have pupated — how long previously is not known. The larvæ evidently, after burying in the ground, remain unchanged for a longer time than most of the *Noctuidæ*. Thus Prof. Riley found examples unchanged about a month after they had entered the earth, but it is possible that these may have been diseased or parasitized. It is probable that the interval between maturity and pupation does not exceed a month, and is less than one-half that which has been observed in its late associate, *Crambus vulgivagellus*.

They continue a long time in their pupal state — the moth not appearing until the end of summer, leaving no time for a second brood. Prof. French gives the species a pupation of between two and one-half and three months in length, but from other observations, it appears as if his statement of "they went into the chrysalis state in June," might properly be amended so as to read, "they entered the ground for their pupation in June," which would permit the period as above given to be shortened a month.

Parasitic Attack.

The larvæ appear to be very subject to parasitic attack. Those that I attempted to rear gave me quite a number of dipterous puparia, of which I have failed to secure the fly, although some of them have emerged. The puparium is quite small, measuring but 0.22 of an inch in length, and indicates a species smaller than any of the *Tachina* flies known to me. The larvæ must have been parasitized previous to their final moltings, as none of the egg-shells were observed upon them. A large hymenopterous larva which escaped from one of the caterpillars, died without forming its cocoon. Prof. Riley

mentions (page 103), that the species is parasitized by a Tachina fly, and by one of the Hymenoptera, of the genus *Ophion*, and by another minute hymenopterous insect—a species of *Microgaster*. These parasites have not, I believe, been specifically determined.

Preventives and Remedies.

It is not probable that this species will often occur in such numbers as during the last season, or that it will often prove very injurious. Whenever it shall do so, the means that are recommended for preventing the ravages of the vagabond Crambus will prove equally efficient against this insect. Some of the applications there proposed to be sown over the grass will doubtless serve to protect grass lands from their depredations. Deep plowing in the autumn after the usual places for harborage have been removed, would destroy the young larvæ. Simply burning over the surface might fail to reach many of the larvæ in their retreats beneath stones, logs, etc. The moths are attractable to sweetened substances, as collectors have found in their sugaring operations, and numbers of them, when just from pupæ, may be drawn by a light to a bait of molasses and vinegar, in which they will be caught and drowned. This lure for them should be used during the months of August and early September. Rolling the ground after nightfall would be destructive to them and to other associated nocturnal feeders.

Other means known to be effectual in destroying cut-worms in grass lands might be equally successful with this species.

Gortyna nitela Guen.

The Stalk-borer.

(Ord. LEPIDOPTERA : Fam. NOCTUIDÆ.)

- GUENÉE. Sp. Gén. Lép., v. — Noct. i, 1852, p. 124, no. 195 (original description).
 HARRIS. Ins. Inj. Veg., 1863, p. 440, f. 219 (larva figured and described but not identified); Entomolog. Corr., 1869, p. 315 (in potato stalks).
 RILEY : in *Prairie Farmer*, Feb. 23, 1867; 1st Ann. Rept. Ins. Mo., 1869, pp. 92, 93, figs. 35, 36; 8th Rept., 1876, p. 37, f. 23; in *Prairie Farmer*, Aug. 11, 1877; *Potato Pests*, 1877, p. 91; Gen. Ind.-Suppl. Mo. Repts., 1881, p. 56.
 WLSH.—RIL. : in *Amer. Entomol.*, i, 1868, p. 22, fig. 11 (food-plants and transf.); *Ib.*, 1869, p. 206, f. 140 (in peach); pp. 228, 249 (in tomato); p. 252 (in corn); *Id.*, ii, 1869, pp. 42, 64 (food-plants).
 PACKARD : *Guide Stud. Ins.*, 1869, p. 310, f. 241; in 9th Ann. Rept. G.-G. Surv. Terr. for 1875 (1877), p. 719, pl. 65, f. 6 (brief notice).
 LE BARON : *Second Rept. Ins. Ill.*, 1872, p. 141, figs. 1, 2 (in wheat).
 SMITH : in *Thomas' 7th Rept. Ins. Ill.*, 1878, p. 112 (general notice).

FRENCH: in Seventh Rept. Ins. Ill., 1878, p. 221 (in corn).

LINTNER: in Count. Gent., xlv, 1879, p. 503; xlv, 1880, p. 472; in 39th Ann. Rept. N. Y. St. Agricul. Soc. for 1879 (1880), pp. 48-52, figs. 1, 2.

An insect which had rarely, if ever, been known to exist in such numbers as to commit serious depredations, and which by its comparative rarity and the nature of its food-plants, had never been classed by entomologists among the injurious insects, may, from an inexplicable combination of circumstances and conditions, suddenly appear in so great number as to enlist general attention to its extensive ravages. No better illustration of this fact can be given than that afforded by recent demonstrations of the Orthopterous insect, *Diaperomera femorata* (Say), popularly known, from its long and attenuated body and limbs, as the walking-stick, skeleton-bug, spectre insect, etc. This species, which had long been regarded as harmless and comparatively rare, has within a few years past increased to such an amazing extent in certain localities in Vermont, New York, New Jersey, and elsewhere, as completely to devour the foliage of various kinds of trees over broad districts of woodland. In Yates county, New York, on the farm of Mr. G. C. Snow, their destructiveness, during the past six years, has been most remarkable, having entirely defoliated above twenty-five acres of hickory, oak, etc., and caused the death of a large number of trees. In their travels to obtain food, they covered the fences and the ground, and their closely packed bodies were a hindrance to their progress. For an extended and interesting account of their extraordinary multiplication at this locality, the report of Prof. Riley, contained in the *Annual Report of the Commissioner of Agriculture* for 1878, may be consulted.

Reference to the above insect has been made, prefatory to a short notice of occasional injuries to important crops, by the Noctuid moth, *Gortyna nitela* Guen., or the stalk-borer. This insect has not secured a prominent place in the list of insect pests, yet at intervals, in certain localities, complaints are made of serious depredations inflicted by it. More frequently, it falls under our notice as a borer in the pith of plants cultivated in our gardens, as in the stems of asters, dahlias, lilies, spinach, etc.

In the early part of July of last year, examples of the larva were sent to me for their name and best method of checking their injuries, from a gentleman residing at Monsey, Rockland county, N. Y. They had appeared in strong force in a potato field, and their burrows within the stems had caused a large number of the stems to wilt, and to break at holes which had been eaten into them, for the entrance of the larvæ or for the expulsion of the excrementa. The larvæ were fed by me some time in confinement.

They ate very greedily of the food furnished them, and having consumed the pith of a stem, they would emerge, and quickly eat their way through a round hole into another stem. They displayed remarkable activity in their movements. I failed in my efforts to carry them to maturity, through lack, doubtless, of a proper food-supply.

The habits of this insect, as a borer, in its larval state, in the interior of growing plants, were first brought to notice in the *Prairie Farmer*, of Feb. 23d, 1867.

Food-plants.

While many of our insects are confined to a single food-plant, and by far the greater number have a very limited range, this insect feeds on a large number of plants, differing greatly in character. In a notice of it by Miss Emma A. Smith (*loc. cit.*), the following list of plants, the stems of which it bores, is given: tomato, potato, spinach, wheat, corn, dahlias, asters, lilies, spirea, salvia, milk-weed, castor-bean, rhubarb, *Chenopodium* sp., peach twigs, currant twigs, cockle-bur (*Xanthium strumarium*), rag-weed (*Amorosa artemisiæfolia*), and a variety of hearts-ease (*Polygonum*). It also eats the fruit of the tomato and strawberry, and bores into the cob of ears of corn as well as the stalk.

Its Depredations.

Among the records of its most serious injuries are the following: In 1868, a potato field at Lacon, Ill., was observed to have about every tenth stem occupied by this borer.*

In 1869, at Fox Creek, Mo., it was discovered boring into and ruining great numbers of peach "buds" and shoots.†

In 1869 it was reported from Farmington, Conn., as doing great damage to corn in that vicinity.‡

It 1871 it occurred within the straw of nearly all the wheat fields in Wisconsin. A piece of two acres of early wheat near Madison was entirely ruined by it.§

In 1877, at Elmira, Ill., fifteen acres of corn were destroyed by its depredations. At Waterman, Illinois, serious injury was done to many fields of corn. At Athens, Ill., it thinned the corn on new lands and in foul fields to a considerable extent, proving to be quite destructive.||

In connection with the above notices of the depredations of this insect in Illinois, it is an interesting fact that the types of the American species of this genus described by Guenée—five in number—were specimens which had been collected in that State.

**American Entomologist*, i, p. 22.

†*Ib.*, p. 206.

‡*Ib.*, p. 252.

§*Second Rept. Ins. Ill.*, p. 141.

||*Seventh Rept. Ins. Ill.*, pp. 113, 221.

The Family of Noctuidæ.

The moth belongs to the *Noctuidæ*,* or owl-moths as sometimes popularly called, from their habit of coming abroad from their hiding places after dark to feed : a few of them, however, fly by day. The family is quite an extensive one, and although it has been but recently studied in this country, over fourteen hundred species have already been described.† Their caterpillars are among the most obnoxious pests of the agriculturist, as for example, the many species of "cut-worms." The moths are stout-bodied, with strong-veined wings, enabling them to fly quite swiftly. With the exception of the *Catocalas* (beautiful underwings) and some of the allied genera, as a rule, they are so plain in appearance, as rarely to attract attention.

Description of the Moth and Caterpillar.

G. nitela is one of the very plain moths, being without any conspicuous markings. It is shown in Fig. 26 at 1. It measures about one inch and



FIG. 26.—The stalk-borer, *GORTYNA NITELA* Guen. The moth and its caterpillar. (Riley.)

a half in expanse. Its wings are of a wood-brown color, sprinkled with yellowish dots. The only conspicuous ornamentation is a yellowish white line at the outer third of the front wings, bent at nearly a right-angle, near the front margin ; between this line and the outer border the wing is paler.

The caterpillar, shown at 2, measures over one inch long when fully grown. It is purplish-brown above, with three white lines on the back, of which the central one is continuous, and the other two interrupted from the fourth to the seventh segments inclusive. The first two segments have a white stripe on their sides, and above the third and fourth fleshy legs (prolegs) there is another white stripe. The head and a corneous plate on the top of the first and last segments are shining yellow, bordered on the sides with black. In its walking, which is quite rapid, the caterpillar arches its back somewhat like the *Geometridæ* (measuring worms), as it does not use its first pair of prolegs.

In the *Harris Entomological Correspondence* (*loc. cit.*), a detailed description of this caterpillar is given. It is described under date of July 8th, 1848, as a caterpillar on potato-stalks — not referred to any

**NOCTUÆ* Linn. (of Grote); *NOCTUELITÆ* Latr. (of Packard); *NOCTUELITES* (of Guenée); *NOCTUIDÆ* Stephens.

†The New Check-List of North American Moths [north of Mexico], by A. R. Grote, contains 1420 species of "Noctuæ."

species, as it was unknown to the writer; but it evidently pertains to this insect. The description is as follows:—

With ten prolegs and six true legs, a corneous plate on first and last segments; four black, shining points, two and two, on the back of each segment; a lateral row of much larger ones on the sides (of which there are three on the side of each segment, one large and two small, besides the black spiracle making a fourth black point), and also below the lateral line two more black points on each side of every segment, those on the segments furnished with prolegs, being on the sides of the prolegs themselves. Length nine-tenths of an inch. Elongated, slender, pale purplish-brown above, with three dorsal white lines, the central one continuous, the others interrupted on the middle of the back, from the fourth to the seventh segments inclusive (these three lines begin on the second segment.) On the sides of the first and second segments there is an abbreviated white stripe and above the third and fourth prolegs another white stripe. Head, dorsal and anal plates wax-yellow and shining, edged laterally with shining black. Legs black. Prolegs and body beneath pale yellow. The head of this caterpillar is large, subquadrate, not retractile. The legs and prolegs long, and the motion very active. The livid brownish color of the intermediate segments extends more or less in different specimens under the body of these same segments. Motion somewhat like that of a Geometrid, the back arched, and the first pair of prolegs, though as long as the others, not used in creeping.

Found one also in pigweed-stalk, July 5, 1851.

Natural History of the Species.

The history of the species so far as known, is this. The egg has not been observed. It is doubtless deposited by the moth during the early part of June, in our latitude, on the stem of the food-plant, near the ground. As soon as it hatches, the larva eats into the stem to its pith or heart, and burrows in an upward direction. The hole through which it entered and the lower portion of its burrow is enlarged from time to time, with the growth of the larva, to admit of the rejection of its excrement. If the stem should not afford it a sufficient amount of food for the completion of its growth, it eats a hole outwardly for its release, or escapes through the original opening, and passes to another stem within which it burrows. It attains its growth about the middle of August, when it changes to a pupa, either within its burrow, if affording it suitable conditions, or by deserting it, and entering the ground to a slight depth. The pupation is a short one, and the perfect insect makes its appearance during the latter part of August or in September. My earliest date of the collection of the species is September 5th. It is believed to survive the winter in the winged state and to reappear in the spring, to deposit its eggs on the young plants.

This species seems to be a rare one in the vicinity of Albany. Among the scores of thousands of the Noctuids which during the last few years have been collected by the Albany entomologists, by the *sugaring* method (attracting the moths to a bait spread upon trees), I have no knowledge of the occurrence of a single example of the species.

Allied Species.

A closely allied species is recognized in our lists, *Gortyra nebris* of Guenée, differing mainly in the presence of white reniform, orbicular, and claviform spots on the front wings, and in slightly longer and more ascending palpi. Prof. Riley has reared *G. nebris* from the horse-weed, *Ambrosia trifida* L., and expresses a confidence that the two forms (?) intergrade, and are simply varieties of one species. I have no knowledge of any description of the larva of *G. nebris*. Prof. French states that it differs from that of *G. nitela*, in that it pupates in the ground. About twenty-five species of North America *Gortyna* are at present known.* Of these, the larvæ of the greater number, from their concealed habits, are unknown. The larval habits of the species are not uniform, for while those which Guenée includes in the genus *Hydrocia*, are represented by him as "not living inclosed in stems and feeding on the pith, as those of *Gortyna*, but only concealed among the roots or the basal leaves of the plants" (of which are *nictitans* Linn., *immanus* Guen., and *stramentosa* Guen.), others in addition to *G. nitela* are known to be stalk-borers, as *G. rutila* Guen., in the Columbine, *G. cataphracta* Grote, in thistle-stems, and *G. flavago* W.-V., of Europe, in thistle-stems and burdock. It is not a little remarkable, that of the old Linnæan species, *G. nictitans*, so very common both in Europe and the United States, the larva has not, so far as we have any record, been identified in this country. Our ignorance of the larva of the common *G. sera* Gr.-Rob., is scarcely less remarkable.†

Remedies.

When this insect occurs in the potato, its presence can be readily detected by the withered stems before they have become broken down. By placing the point of a penknife in the opening and slitting the burrow upward, the caterpillar may be found and killed. If the field be large and too badly infested to permit the employment of this method, then, if the vines can be collected and burned before the month of September, all the larvæ or the pupæ which may be undergoing their change within the stems will be destroyed. As early potatoes are more liable to be infested by this borer than the later ones, the burning method may be easily resorted to. The same method of treat-

*The genus, for some reason, is a very unfortunate one in regard to its definition. It appears to have been closely studied by Mr. Grote, but no two of his several publications upon it agree in the species which it should embrace. In his latest publication, the New Check List, several of the long recognized Gortynas, such as *purpuripennis*, *sera*, *nictitans*, *stramentosa*, etc., are withdrawn from the genus and placed under *Apamea* of Treitschke.

†For comparative remarks on several of our Gortynas, which will prove of service to the student in the separation of species, the paper by Mr. Grote "On North American Moths," in the *Bulletin of the U. S. Geological and Geographical Survey*, vol. vi, 1881, at pp. 268, 269, may be consulted.

ment will be available for the destruction of the caterpillar in several other of the food-plants which it infests.

Heliothis armiger* Hübn.

The Corn-worm.

(Ord. LEPIDOPTERA: Fam. NOCTUIDÆ.)

- HÜBNER: "Eur. Schmett., Noct. p. 370."
- GUENÉE: Sp. Gén. Léop., vi.—Noct., ii, 1852, p. 181 (references and localities).
- GROTE: in Proc. Ent. Soc. Phila., 1862, i, p. 219 (as *H. umbrosus*): in Bull. Buff. Soc. N. S., i, 1873, p. 123 (distribution).
- GLOVER: in Rept. Commis. Agricul. for 1865, p. 43 (destruction by crows); Id. for 1866, p. 30 (inj.); Id. for 1870, p. 84 (food-plants); Id. for 1871, p. 84: MS. Notes Journ.—Cotton, 1878, plates 17, 18 (operations on cotton and different stages); in Rept. Commis. Pat. for 1854, pp. 64, 65, 69, 71, plates 3, 4; Id. for 1855, pp. 282-285 (habits, descriptions, and remedies); the same republished in Monthly Rept. Dept. Agricul. for July, 1866, pp. 282-285, with figures.
- WLSH.-RIL.: in Amer. Entomol., i, 1869, pp. 212-214, figs. 150, 151 (habits, history, food-plants, etc.); Id., ii, 1869, pp. 42-44, f. 29 (food-plants, injuries, remedies).
- TREAT: in Vineland [N. J.] Weekly, of Aug. 21, 1869 (injuries to corn).
- RILEY: in Amer. Entomol., ii, 1870, p. 172 (tomato as a food-plant), p. 329 (associated species); 3d Rept. Ins. Mo., 1871, pp. 104-109, figs. 42, 43 (distribution, habits, description, remedies, etc.); 4th Rept. do., 1872, p. 129 (parasite); in Rept. Commis. Agricul. for 1881-1882, pp. 145-149, pl. 1, and pl. 12, f. 1.
- LINTNER: in 30th Rept. N. Y. St. Mus. Nat. Hist., 1878, pp. 165, 166; Entomolog. Contrib., iv, 1878, pp. 52, 53 (carnivorous habits in Patagonia); in Count. Gent., lxvi, 1881, p. 759 (occurrence in N. Y., etc.); in Ontario County Times, Nov. 9, 1881 (history, habits, etc.).
- THOMAS: 7th Rept. Ins. Ill., 1878, p. 4 (in Illinois); in Count. Gent., lxvi, 1881, p. 583 (description, habits, etc.).
- FRENCH: in Thom. 7th Rept. Ins. Ill., 1878, pp. 102-106 (habits, description, remedies); pp. 231-233 (description); in 11th Rept. do., 1882, pp. 82-104.
- COMSTOCK: in Rept. on Cotton Ins., 1879, pp. 287-315 (habits, description, history, remedies, etc.).
- CLAYPOLE: in Amer. Entomol., iii, 1880, p. 278 (feeds on hard corn).
- COQUILLET: in Thom. 10th Rept. Ins. Ill., 1881, p. 150 (figures and larval description).
- MOFFAT: in Ann. Rept. Ent. Soc. Ontario for 1881, (1882), p. 30 (occurrence in Ontario).
- KELLCOTT: in Bull. Buff. Soc. Nat. Sci., iv, 1882, p. 61 (occurrence in Michigan).
- JOHNSON: in Rept. Commis. Agricul. for 1881 and 1882, 1882, pp. 150-152 (its history in Miss., enemies and remedies).

*Originally named *armigera* but changed to *armiger* for conformity to the gender of the genus.

This well-known pest of the cotton and corn fields of the Southern States has, during the past year, made its appearance for the first time, as an injurious insect, in the State of New York. Examples of the caterpillars, nearly full-grown, eating into ears of corn beneath the husks, both at their tips and at their base, were first received by me from Ontario county, where their abundance and destructiveness were exciting considerable alarm. A communication from the editor of the *Ontario County Times* accompanying examples of the caterpillar for identification, stated: "It has attacked the growing corn when the corn is soft, entirely devouring patches of the kernels, and when the kernels harden, reducing them to a state resembling coarse meal." My reply to the request for information in relation to the depredator was published in the *Ontario County Times*, as above cited.

The "Boll-Worm" of the Southern States.

The caterpillar is the notorious "boll-worm" of the Cotton States, which annually commits such serious depredations upon the cotton crops, by burrowing into the bolls and destroying them. It is very common throughout the south, where it is present in every cotton field to a greater or less extent. In some years, over large districts of the south, the losses resulting from it have exceeded those of the "cotton-worm," *Aletia argillacea* Hübn.

The eggs of the moth, shown in Fig. 27 at *a* and *b*, which are very similar to those of the cotton-worm moth, and of which the female lays about 500, are placed, according to the latest and most reliable observations, not generally upon the involucre of the blossom, as represented by Mr. Glover, but upon the leaves, on both surfaces, oftener upon the lower. The newly hatched caterpillars from these eggs feed at first upon the leaves, but only for a short time, when they migrate to the flower-buds or boles. Entering a bud through a round hole eaten therein, they feed upon the interior, destroying the organs, and causing the bud to fall. In this manner a single caterpillar may destroy a large number of buds. Later, the bolls are similarly entered, and their entire interior eaten away, or spoiled through the entrance of rain causing decay.

There are probably five annual broods of this insect in the Southern States, of which the last two, appearing in August and September, are the most injurious to cotton. The eggs of the first three broods are usually laid upon corn.

From observations made in Alabama, it appears that the eggs of the first brood are laid in early May; of the second brood, during the first half of June, and of the third brood, about the 1st of July; of the fourth brood, upon the cotton bolls by the 1st of August, and of the fifth brood, early in September.

Description of the Caterpillar and Moth.

The caterpillar is thick-bodied and almost cylindrical, tapering but slightly toward the head.

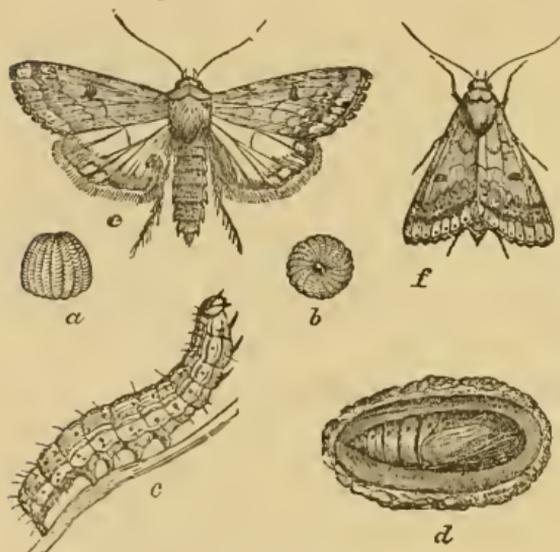


FIG. 27.—*HELIOTHIS ARMIGER*.—The corn-worm; *a*, the eggs; *b*, the caterpillar; *c*, the pupa within its cocoon; *e*, the moth; *f*, moth at rest (Riley).

When full-grown it measures almost one inch and a quarter in length. It varies in color, in different individuals, from pale green to dark brown, striped in darker shades of the same colors. The dark caterpillars have on each side a distinct, rather narrow yellowish stripe, upon which is the row of oval breathing-pores (spiracles). There are several black, shining, elevated spots or tubercles on each segment, each of which bears a short brown hair. One of these spots is placed just behind the spiracle, making two conspicuous spots on the yellow lateral band of the more central segments (at least, those bearing the four pairs of prolegs). This characteristic feature, appearing like a pair of spiracles, is shown in nearly all the illustrations which have been given of the caterpillar.

The average expanse of the moth is about one inch and a half. It varies greatly in color, from a yellowish-gray to a clayey-yellow, often tinged with olive-green. The most distinctly marked examples have two often interrupted, brown bands crossing the fore-wings, and a broader and better defined one near to, and parallel with, the outer margin, upon which is a line of black dots upon a whitish spot, placed on the nervules. A black border defines the discal spot, which is often crescentiform. The hind-wings are of a paler shade, and have a broad blackish outer band, which toward the apical portion incloses a pale spot resting on the margin and throwing the black bordering inward toward the center of the wing. Beneath, the band and the discal spot of the upper surface are quite conspicuous.

The Moth a Day-Feeder.

Mr. J. A. Moffat, of Hamilton, Ontario, records (*loc. cit.*) its feeding in the day time on the flowers of the golden-rod (*Solidago*), and in the gardens of that place. He states of it: "A night-flyer properly, or in the dark of the evening, it seemed to have been tempted from its hid-

ing place by that peculiar dull, smoky weather of the first three weeks of September, when even the *Sphinxidæ* forgot their usual caution and came forth boldly to feed at mid-day, having taken a tomato sphinx (*M. quinquemaculata*) at 2 o'clock in the afternoon of the 14th, feeding on petunias, whilst the white-lined sphinx (*Deilephila lineata*) could be seen by the half-dozen among the flowers at any time of the day. The *Heliothis* moth, being about an inch and three-quarters in expanse of wing, was quite a conspicuous object while feeding, more especially as it seldom rested, but kept its wings moving the while."

That its visit to flowers during the day time is not an unusual occurrence, appears from an observation made by Mr. C. G. Barrett, of Pembroke, Eng., who states: "While working the clover fields, I discovered the (to me) novel fact that *Heliothis armiger* flies most actively in the sunshine, feeding at the clover blossoms exactly like the swarms of *Plusia gamma* around it, and that it soon becomes in this way miserably worn." (*Ent. Month. Mag.*, xiv, p. 151.) Nor is the flight by day incidentally noted of *Deilephila lineata* at all uncommon. Prof. H. W. Parker records it, in August of 1880, as the most conspicuously common moth in the vicinity of Grinnell, Iowa: "At all hours of the day one or more might be seen hovering over nearly every flower of the innumerable weeds, mostly thistles and *Helianthus*, by the roadsides. In places, the moths might be estimated by the hundreds" (*Psyche*, iii, 1882, p. 342).

Carnivorous Habits of the Caterpillar.

An interesting account of the carnivorous habits of the caterpillar is given by Professor Berg, Director of the Museum of Natural History of Buenos Ayres, as it came under his observation during some collections of Lepidoptera made by him, in Patagonia, in 1874.* The species occurred only upon those portions of the coast to which cultivation had extended, from which it seemed probable that it had been introduced through commercial intercourse with other countries. Large numbers of lepidopterous larvæ were collected and their transformations and food-plants observed. He writes as follows of a remarkable peculiarity in their habits:—

"It still remains for me to note a peculiarity of the caterpillars, viz., their extreme ferocity—their cannibalistic propensities. All of them, irrespective of family or group, manifest the liveliest desire to kill their fellows. While confined, they ate one another, seldom, if ever, touching the food-plants. The caterpillars of the *Bombycidæ* completely devoured others of the same family, leaving absolutely no fragments of them. They even tore open the cocoons, from which they dragged out the pupæ and ate them. In like manner, the larvæ of the *Noctuidæ* acted among themselves and toward the *Bombycidæ*, and the latter

**Bulletin de la Société Impériale des Naturalistes de Moscou*, xlix, 1875, Partie ii, p. 192.

toward the former. Among these last, *Heliothis armiger* was *gluttonous beyond all measure* — one of them devouring in twenty-four hours from six to seven others. They would not touch the plants after having once tasted flesh.”

Professor Comstock records its carnivorous habits.* He states that when several larvæ were mailed to the Agricultural Department in the same box, only one would arrive alive, the others having been destroyed, even when the box contained cotton leaves and bolls, or corn leaves, in fresh condition. When rearing the larvæ in breeding-cages, although supplied with an abundance of fresh food, they seemed as hungry as ever for their companions, and eagerly devoured one another: it was impossible to rear them otherwise than singly in a cage.

Mr. Trelease reports (*loc. cit. sup.*) that he repeatedly saw large boll-worms catch small ones and either devour them entirely, or bite into them and suck their juices, rejecting the empty skin. In many instances he discovered boll-worms occupying the webbed-up leaves which the *Aletia* cotton-worms had prepared for their pupation, for the purpose of feeding upon the pupæ. Remains of pupæ were found which had been fed upon by the larvæ.

A gentleman from Mississippi states that he has seen in that State the *Heliothis* caterpillar eating the pupæ of *Aletia*.†

Judge Johnson, of Holly Springs, Miss., reports that the caterpillars of this species are the most ravenous and cannibalistic of vegetable feeding larvæ. They manifest a decided preference for the pupæ of other Lepidoptera. The large caterpillars would leave everything for the *Aletia* pupæ when they were to be found in abundance.‡

Professor French has found dead *Heliothis* larvæ in their burrows beneath the husks of corn, under conditions that convinced him that they had been bitten and killed by their associates in the ear.§

The Food-plants of the Caterpillar.

An unusually large number of food-plants have been recorded upon which the larva is known to feed, in addition to the two which it prefers, viz., cotton and corn. It has shown itself as a destructive tomato-worm, boring into both the fruit and the stem; it eats into the pods of peas and different kinds of garden beans, as string-beans and Lima beans; it burrows into pumpkins, squashes, and peppers, and in the stems of gladiolus. Mr. Trelease has found it feeding abundantly upon the cow-pea of the Southern States, boring from the outside into one chamber after another to eat the contents. It is recorded in Europe upon the chick-pea (*Cicia arietinum*), where also, according to M. Gourcan, it feeds upon heads of hemp, leaves of tobacco, and

* *Report upon Cotton Insects*, 1879, p. 503.

† *Amer. Entomol.*, iii, 1880, p. 253.

‡ *Rept. Commis. Agricul.* for 1881 and 1882, pp. 150, 151.

§ *Thomas' 11th Report Ins. Ill.*, 1882, p. 92.

of lucerne (*Medicago sativa*). Another writer gives henbane (*Hyoescyamus niger*) as one of its European food-plants.

Geographical Distribution of the Species.

Few of our moths have so extensive a distribution as this, occurring as it does, in the four quarters of the globe. It is found in Great Britain,* France and elsewhere in Western Europe, but not abundantly; in Turkey, more commonly.†

It has been captured in the Cape de Verde Islands, and on the west coast of Africa (N. Lat., 23°.) †Guenée cites it from "Europe méridionale, Amérique du Nord et du Sud, Indes orientales, et Nouvelle-Hollande." It was found by Professor Berg in Patagonia, as before noticed, and examples have also been brought from Japan. According to Mr Moffat (*loc. cit.*), it was observed for the first time in the Province of Ontario during the past year (1881). It is not stated that the caterpillar was discovered, but the moth was "quite plenty" at Hamilton during the early part of September. Its unusual occurrence in the State of New York will be noticed hereafter.

Its Operations as a "Corn-Worm."

The caterpillar is known as the "corn-worm" throughout the South when it occurs on corn, as it often does in immense numbers, to the serious injury of the crop. Other names sometimes applied to it, are the "ear-worm," the "tassel-worm," and the "terminal bud worm." As the caterpillars of the species show a great range of variation in markings and color—some being green and faintly striped, and others brown with dark stripes—the "corn-worm" was for a long time, and is still by the uninformed, believed to be distinct from the "boll-worm;" but during late years, when they came to be studied, it was discovered that the two were the same species, and that it occurred on a number of greatly differing food-plants as above noticed.

The injuries committed by this species have, in certain seasons—usually such as are very warm and dry—been enormous. In Kentucky, entire fields of corn have been ruined by it. In 1860, in Kansas, during a protracted drought, the corn crop throughout the State was nearly destroyed. In a single county, which perhaps was not an exceptional one, the product was cut down from 436,000 bushels, the preceding year, to 5,000 bushels.‡ In Southern Illinois, it has been very

*Its occurrence in England is usually deemed worthy of record. Thus we find the following: "On September 24, 1881, I took *Heliothis armiger* resting on a flower in the Rectory garden at Guestling.—E. N. B."—(*Entomol. Month. Mag.*, xviii, 1881, p. 141.) "On the 20th of June, I captured flying in a clover field in the bright sunshine, a fine *Heliothis armiger*, female.—A. H. J."—(*Id.*, xvi, 1879, p. 99.) Mentioned among rare Lepidoptera captured near Dartmouth, Eng., during 1874-1877, by Mr. G. F. Mathew.—(*Id.*, xiv, 1877, p. 157.)

†*Ent. Month. Mag.*, xviii, 1881, pp. 12, 99. †*Ib.*, pp. 81, 258.

‡*Prairie Farmer*, of Jan. 31, 1861.

destructive. Occasionally it has extended into the northern portions of that State, but only in comparatively moderate numbers.

At the meeting of the American Association for the Advancement of Science, held in Cincinnati, in August, 1881, Professor Cook, of the Michigan State Agricultural College, communicated the fact that it had attacked corn in Michigan, in 1880, for the first time. (*Canad. Ent.*, xiii, p. 215.)

Prof. D. S. Kellieott, of Buffalo, N. Y., reports it as abundant during the month of July, 1881, at Corunna, Michigan, where the early corn was considerably damaged. In one field observed, more than half the corn had been eaten into by it.

In reporting upon its operations in Illinois, in 1877, Professor French states: "It has not been so destructive during the past season as it is sometimes, but in one field of late corn I found nearly every ear eaten by them, there being from one to half a dozen worms to each ear."

Method of Attacking Corn.

It has not been ascertained when the first eggs are laid upon corn, in New York. If the parent is a native of the State, from having hibernated as a moth or a pupa, the eggs would be laid upon the leaves of the young corn during the month of June, and the young larvæ would feed upon the leaves, eating irregular holes into them. When about half grown, they would be in condition to attack the tender terminal leaves, which they would seriously injure or wholly destroy. But as this injury has not been noticed in this portion of the United States, it seems more probable that our corn-worms are the progeny of moths which have flown hither from the south—probably of the third southern brood, and which had reached our State sometime in July. To the south of New York, in Southern Pennsylvania and Ohio, there may have been an earlier generation, proceeding from the second southern brood. In this manner, through successive broods, the northern progress may be presumed to have been made.

The operations of the caterpillars in New Jersey, during the month of July (?), have been observed by Mrs. Mary Treat. She states as follows: "They ate into the staminate flowers of the corn before it tasseled out, commencing their depredations while the tassels were still enfolded in the leaves. I have examined considerable corn, and in some gardens this worm has done much damage." In a communication under date of Aug. 25, 1869 (*Amer. Entomol.*, ii, p. 43). Mrs. Treat writes: "The other day I passed through a large field of corn, where the depredations of this worm were visible on almost every stalk. They had done the work weeks before, eating through the leaves while they were folded around the staminate flowers, before the ears had begun to make their appearance. It is difficult to find an ear free from their depredations."

The caterpillars infesting the corn fields in New York during October and November are of a later brood than those noticed above, although an earlier one may have escaped observation. The eggs which produced them were probably laid upon the young ears of corn near their tips, where the young caterpillar would be in position to reach the silk as soon as it developed. Upon this they feed at first, and as their desire for food becomes more ardent, they penetrate to the young kernels and devour them. The appearance of an ear of corn eaten by the caterpillar is represented in Fig. 28. When the corn is in the milk, it seems to be most palatable to them. They then burrow into and through the ears, often confining themselves to their apical portion. When the portion near the base is eaten, as shown in the figure, the caterpillar has penetrated the husks through a round hole of a size barely large enough to admit the body, as seen in some examples received by me from Ontario county. Occasionally the ear has been irregularly burrowed throughout its entire length.* Mould often follows the attack, to the serious detriment of the corn; and other insects are attracted, and continue the work that the corn-worm had commenced.

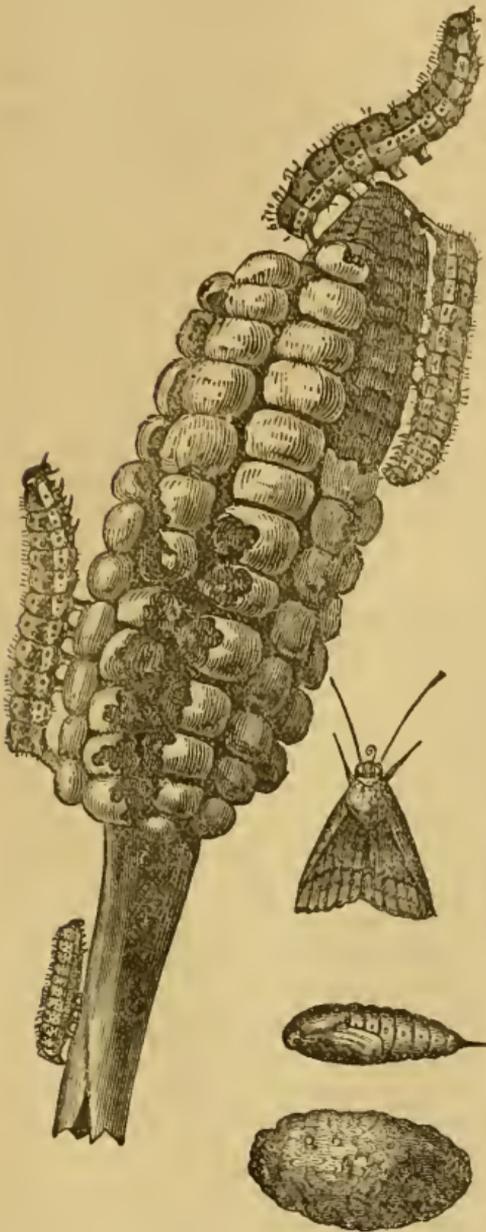


FIG. 28.—Corn eaten by the corn-worm; also the caterpillar at different stages of growth, the pupa, the cocoon of earth and silk, and the moth at rest (Riley).

Not only is the corn eaten while in the milk, but the nearly mature caterpillars are capable of continuing their feeding even after it has become quite hard, as shown by caterpillars which I have fed in confinement, and as recorded by Prof. Claypole (*loc. cit.*).

*Forty-first Ann. Rept. N. Y. St. Agricul. Soc. for 1881 (1882), p. 153.

Its Occurrence in New York.

Subsequent to the announcement of the appearance of this insect at South Bristol, Ontario county, information was received by me of its injuries in other towns of the county, in Livingston county (*Country Gentleman* of Nov. 24th), and in Albany and Schoharie counties. It has probably been distributed over all of the southern and middle portions of the State. Happening to mention to a friend in Albany the interesting occurrence of this southern species in the State of New York, he recalled the fact that some green corn which had been purchased perhaps two weeks previously for his table was found unfit for use from the gnawing of caterpillars contained within the husks. Believing them to be identical with examples of the corn-worm which I was able to show him, he proposed to verify their identity. A severe frost had cut off the green corn in the vicinity of Albany, and comparatively few lots of surplus stock could be found at this date (Nov. 1st), at the vegetable stands and groceries, but in every one examined, the injuries were discovered in a large proportion of the ears: in some of them dead caterpillars were lying within the husks (with some still living), which had doubtless been killed by the frost. It could not be learned that this attack upon corn in the neighborhood of Albany had been previously noticed. It is strange that depredations so general and so extensive as were these, could exist and still fail to arrest attention.

The occurrence of this insect in injurious numbers in the State, for the first time, the past season, is undoubtedly the result of the unusually warm and dry summer and autumn months — conditions highly favorable to the increase of many of our insect pests, and to the extension northwardly of southern forms. It had been numbered among New York species, and examples of the moth have been taken by collectors, although very rarely, in the extreme southern part of the State — on Long Island and elsewhere, but I do not know of its having been seen abroad, so far north in the State as Albany.

There need be no apprehension that the species will continue its injuries to corn in our State. Experience elsewhere has shown that its northern extension is only exceptional, resulting from unusual conditions. Very many of the later caterpillars were killed by the early frosts, while those that had matured and entered the ground for pupation, will not, to any great extent, be able to withstand the severe cold of our northern winter. There may, therefore, be no survivors of the recent invaders, and whether they are to reappear the coming year in our corn-fields, may depend entirely upon the repetition of last summer's heat and drought, and the attendant flight hither of moths from the south.

Remedies.

Wherever this species occurs in large numbers, it seems to be practicable, by the use of the proper means employed in time, to prevent its becoming very destructive. As in other injurious species which have more than one annual brood, it is of the greatest importance that the remedial measures should be directed against the insect at its earliest appearance.

Hand-picking.—Experience has shown that the “corn-worm” may be controlled by collecting by hand the caterpillars of the first brood and destroying them. Even within the “cotton-belt,” in Georgia, where it abounds, it has been found that when “the corn was carefully ‘wormed’ on two or three plantations, the boll-worms did not make their appearance that season on the cotton, notwithstanding that on neighboring plantations they committed great ravages.” Their presence in the stalks can readily be detected by the holes eaten into the leaves; and later, when they have migrated to the ear, their hiding places are shown by the eaten and blackened silk mingled with their excrementa. If the husks of such ears be partly opened at the top, the worm may be found and destroyed.

Attracting by odor and drowning.—Another method which has given excellent results, where the insects occur abundantly, is to attract the moth when they are just from the pupa and before they have deposited their eggs, to a mixture of molasses and vinegar. The odor will draw them from quite a distance, and in their eagerness to feed upon the sweet substance, they are caught in it and drowned. As this method is equally serviceable for the capture of many of our injurious night-flying species, we quote the experience of Col. Sorsby, of Georgia, as given in the Patent Office Report (Agriculture), for the year 1855 (p. 285):—

“We procured eighteen common-sized dinner plates, into each of which we put half a gill of vinegar and molasses, previously prepared in the proportion of four parts of the former to one of the latter. These plates were set on small stakes or poles driven into the ground in the cotton field, one to about each three acres, and reaching a little above the cotton plant, with a six-inch square board tacked on the top to receive the plate. These arrangements were made in the evening soon after the flies had made their appearance; the next morning we found eighteen to thirty-five moths to each plate. The experiment was continued for five or six days, distributing the plates over the entire field; each day’s success increasing [? decreasing], until the numbers were reduced to two or three moths to each plate, when it was abandoned as being no longer worthy of the trouble. The crop that year was very little injured by the boll-worm.”

Attracting to light.— Another method of collecting the moths is to attract them to lamps so constructed that the insects flying to them shall fall into a reservoir arranged for the purpose, where they will be destroyed, as illustrated in Fig. 38 on page . Many styles of lamps have been devised which have been experimented with by the U. S. Entomological Commission in the cotton-fields of the South, and illustrated and explained in the Annual Reports of the Commission. The simplest form is that which is constructed as a torch, the oil reservoir being soldered to the center of a broad tin dish containing water with a small quantity of kerosene oil floating upon it, and fastened on the top of a stake thrust in the ground.

Benefit of Destroying the First Brood.

To illustrate the great importance of destroying the insects which would produce the first brood of a many brooded species, and the ease with which subsequent multiplication may at this time be prevented, we present the following calculation, showing the results which would follow the above experiments conducted *for a single night*, upon the supposition that each female of five successive broods* would have deposited its full quota of eggs, and that each egg would have produced a moth. It is scarcely necessary to add that not even a near approach to such an *entire* exemption from loss in the four distinct stages of insect life can ever occur in nature.

The average number of moths to a plate, as given above, being twenty-six, the entire number captured during the night would have been four hundred and sixty-eight. Assuming one-half of these to have been females, and each to contain five hundred eggs,† the caterpillars of the first brood would number one hundred and seventeen thousand. By the same method of calculation, we have for the second brood, twenty-nine and a quarter millions of caterpillars; and continuing the computation until we reach the fifth and last brood, we have the amazing number of 457,031,250,000,000 caterpillars, or exceeding four hundred and fifty-seven trillions.

To present this computation in a more convenient and comprehensible form, — under the above conditions and by the same progressive increase, a corn-moth emerging from its pupa in May would be represented by a progeny of nearly two trillions of caterpillars (1,953,125,000,000) in its last annual brood in November, — a number fourteen hundred times greater than that of the entire human population (as estimated) of the globe.

*In all but the extreme southern portion of the cotton-belt, there are, normally, five annual broods — the last appearing early in September. In exceptionally fine seasons, it is probable that there is also a sixth brood. (*Rept. Commis. Agricul.*, for the year 1879, p. 342.)

†A boll-worm moth, dissected by Dr. Jno. Gamble, contained upwards of five hundred eggs (Glover — *Rept. Commis. Pat. (Agricul.)*, for 1855, p. 282).

Crambus vulgivagellus Clemens.*The Vagabond Crambus.*

Order LEPIDOPTERA; Family PYRALIDÆ.

- CLEMENS: in Proc. Acad. Nat. Sci. Phila., 1860, p. 203 (original description).
 ZELLER: Beitr. Kennt. nordamer. Nachtf., i, 1872, p. 93 (539), (comparative observations, as *C. chalybistrostris*).
 GROTE: in Canad. Entomol., xii, 1880, p. 17 (Vancouver locality); *Ib.*, p. 79, (list of *Crambus* species).
 LINTNER: in Alb. Eve. Journ., of May 23, 1881* (ravages of "army-worm"); *Ib.*, of July 1 (*Crambus* species and *N. violans*); *Ib.*, of Sept. 8 (cocoon, imago, and predictions); Courier and Freeman [Potsdam, N. Y.], of May 26 (distribution, alarm, etc.); St. Lawrence Repub., of June 8 (ravages, habits, etc., with *N. violans*); *Ib.*, of Sept. 14 (eggs and moths); *Ib.*, of Sept. 28 (reprint from Ogs. Daily Journ., of Sept. 21); The Husbandman [Elmira, N. Y.], of Sept. 14 (ravages, habits, description, transformations, etc.); Ogdensburg [N. Y.] Daily Journ., of Sept. 21 (remedies proposed); Count. Gent. [Albany, N. Y.], of June 2, xlvi, p. 359 (from Alb. Eve. Journ., of May 23); *Ib.*, of June 9 (identified as *N. violans*); *Ib.*, of Sept. 29 (abundance, predictions, etc.).
 —: in Cincinnati Commercial, of Aug. 20; Cin. Daily Gazette, of Aug. 20; Science [N. Y. city], of Oct. 1, ii, p. 467 (abstracts of paper at A. A. A. S.).
 ADAMS: in Watertown [N. Y.] Daily Times, of Aug. 22 (history, etc.).
 RILEY: in Amer. Nat., xv, p. 574 (associated with *N. violans*); *Ib.*, p. 750; *Ib.*, p. 914 (abundance, description, and eggs).
 SAUNDERS: in Canad. Entomol., xiii, pp. 181-3, 199, 200; in Ann. Rept. Ent. Soc. Ontario, for 1881-1882, (1882), pp. 6, 13 (general notice).
 RILEY: in Ann. Rept. Com. Agricul. for 1881-1882, (1882), pp. 179-183 (injury, natural history, description, remedies, and bibliography).

The history herewith presented of the insect which suddenly appeared in such countless numbers in the pastures and meadows of Northern New York the past year (1881) is of such unusual interest, from the extent of its distribution, its serious ravages, the alarm excited by its advent, the probability of its recurrence, and also as affording an illustration of a phenomenon not unfrequently observed by entomologists — of the sudden multiplication of a hitherto harmless insect into formidable and destructive hosts — that no apology is required for presenting it in more than ordinary detail, or for the repetition of much that has been already published by me (see references above) in several newspapers and other journals.

First Notice of its Occurrence.

On the 18th of May last, letters were received by me from Potsdam, N. Y., and also by Mr. T. L. Harison, Secretary of the State Agricultural Society, announcing a formidable invasion of the grass-lands of several of the towns of St. Lawrence county by the army-worm.

*All the following citations (except the last two) are of the same year (1881).

The ravages had only been observed during the preceding ten days, but already had they increased to such magnitude that many extensive pastures had been completely ruined. The entire destruction of both the pastures and meadows was threatened, and serious detriment to the important dairy interests of the northern counties of the State was anticipated. My advice was asked as to the best means of arresting the ravages. I had never witnessed an army-worm invasion, fortunately of rare occurrence in the State of New York, and as the present one seemed to promise unusual interest from its northern locality and early period of the year, I left Albany on the evening of the reception of the above information, in company with Secretary Harison, that, after personal observation, I might return more satisfactory replies to the inquiries addressed to me.

Narrative of its Observation.

Inquiries made at Rouse's Point, Clinton Co.—the extreme northeasterly portion of the State—failed to elicit any information of an attack in that vicinity. Our route thence, *via* the Ogdensburg and Lake Champlain railroad, traversed, for the most part, the wild and uncultivated parts of Clinton and Franklin counties, where but little grass occurred to invite grass-feeding insects. Leaving the railroad at Madrid, St. Lawrence county, and proceeding southward, the appearance of a pasture two miles from the station, on the farm of Mr. Fay, gave indication of attack such as had been described to us. Upon examining several brown patches, it was found that the grass had been closely eaten off, and slowly traveling over the surface were a number of apparently sickly caterpillars, which were evidently the authors of the injury. In one low, wet spot, a large number of dead caterpillars were lying on the ground. Perhaps twenty-five could have been counted in an area of a square foot, which, from their condition, we believed to have been killed by the heavy rains of the three preceding days. In the entire absence of caterpillars feeding, it was questioned if the attack had been arrested by weather unfavorable to them, or had they been otherwise destroyed. A well-



FIG. 29.—*CALOSOMA CALIDUM*, slightly enlarged, with further enlargement of antenna and maxillary palpus.

known "caterpillar-hunter" was present in unusual numbers, and had undoubtedly rendered good service in checking the depredations, for under one small stone turned up we found no less than five of the pretty Carabid beetle, *Calosoma calidum* (Fabr.)—a valued ally in our warfare against the hosts of injurious insects. That it may be recognized and protected whenever discovered (together with other species of the genus and family, nearly all of which have similar predaceous habits, and are very important agents in checking the

excessive increase of our insect enemies, and of which it may serve as a representative form), it is shown in the accompanying figure.

Observations at Morley.—In many of the pastures lying upon the road to Morley, patches, some of considerable extent, were seen where the grass had been destroyed, as we were told, during the past week. On entering Morley, a long stretch of a number of acres of pasture land sloping down to the west bank of Grass river was pointed out to us as an infested district. No shade of green could be seen upon it, and it looked, at the distance, like a barren, sandy surface. Upon reaching the residence of Secretary Harison, the unwelcome intelligence was communicated to him that the “worm” had made its appearance in his pastures. An examination of them showed their depredations, not extensive, but quite unmistakable, on many of the little knolls where most of the grass had been eaten off nearly to the crown, leaving only the dead and bleached blades of last year’s growth. A few caterpillars were discovered here, by turning over stones and pieces of decayed wood, but none were seen feeding or in travel.

The farms of Mr. Lorenzo Fenton and Mr. John Rutheford were next visited, where the “worms” had been reported in force. Upon each of these, several acres of elevated pasture land were almost as brown as in mid-winter, or, if showing any living vegetation, it was only sorrel or some other wild growth. Two weeks previous the same fields were entirely green and already affording fair pasturage. It was a strange sight to see these desolated fields—some having only portions destroyed, but the browned areas daily enlarging—and almost an entire absence of the destroying agents. We were told that the caterpillars were in the ground, and that large numbers could be taken from every piece of sod lifted in a certain portion of the field. We examined the place, which was almost stripped of its grass, but only a few larvæ were found in the sod. The interesting discovery, however, was here made of the subterranean retreat of the caterpillar, at about a half-inch beneath the surface, within a tube closely investing its body, composed of fresh bits of green grass, closely compacted and fastened together by silken threads, which at first sight seemed to be excrementa, but on closer examination showed unaltered vegetable structure.* Passages from the surface of the ground seemed to lead to the cases, and it appeared to us that they might serve for the abode of the caterpillar during the day, which they would leave for feeding above ground at night. It was stated to us, but on rather doubtful authority, that the caterpillars had been observed feeding in the day-time, when cautiously ap-

*The correctness of this observation has been questioned, and the material of the case pronounced excrementa. Its true character can be determined beyond dispute another season.

proached, but as soon as alarmed they quickly withdrew beneath the surface.

Observations at Potsdam.—I next visited Potsdam, St. Lawrence county, where the "worm" was reported as very abundant, and as having been very destructive. The reports had not been at all exaggerated. Hundreds of acres of pasturage in the town of Potsdam had been destroyed, and not a single farm, it was believed, had escaped attack. Under the kind escort of Mr. E. Clarkson, I was able to examine the pastures and meadows upon several of the farms where the injuries had been the most severe. My observations upon the farm of Mr. L. Benson may serve to give an idea of the seriousness of these injuries, not much exceeding what was seen by me elsewhere. An upland pasture, containing fifty acres, which, ten days previous to my visit, had afforded good pasturage, was now entirely brown. No grass could be seen in glancing over its whole extent, except over a narrow strip which had been used as a roadway when farming purposes necessitated occasional passing from one field to another. This, from some unknown cause, had remained green.* Upon stooping down and carefully examining the surface, amongst the sorrel and other weeds which had not been eaten, an occasional blade of grass, overlooked by the caterpillars, could be discovered, averaging perhaps one blade to the square foot, so completely had the grass been destroyed. Hundreds of dead and dried, or nearly dead larvæ, attached to stems and stalks of weeds, or last year's grass, at a height of from six to twelve inches above the ground, could be seen at one glance of the eye, by placing the head near the ground and looking over the field. In all probability most of these were victims to starvation, and not to parasitism, as at first thought, for no parasites were subsequently obtained from a large collection made of them.

A meadow belonging to Mr. Benson, adjoining the above pasture, and bearing a fine growth of grass, was seen to present a few spots having a suspicious appearance. One of these was examined, and in a small piece of sod six inches square cut by a spade, about twenty of the caterpillars were found, several of which (perhaps all, previous to their disturbance by tearing the sod apart) were contained in the green tubular cases previously mentioned. As a test of the distribution of the caterpillars throughout the meadow, pieces of sod were taken up at random in several places, by walking two or three rods with closed eyes and then inserting the spade in the ground. In each instance, larvæ were discovered. In view of this discovery, not previously suspected, Mr. Benson proposed at once turning in his stock and feeding off the grass before it should meet with the destruction to which it

*Perhaps the larvæ had found the soil too much compacted from even the moderate amount of travel over it, to permit of its penetration for the construction of their subterranean galleries.

seemed doomed. I counseled a delay of a few days, until some experiments could be made of means which might perhaps prevent farther depredations. It was suggested that strips of about ten feet in width should be staked off in the meadow, and that some harmless substance (not daring to recommend poisonous ones on meadow land), which might render the grass unpalatable for food to the larvæ, be scattered over each strip. Upon one plaster might be used, upon the next lime, upon another ashes, on another salt, and on a fifth road-dust. These applications were to be made when the grass was wet with rain or dew, and renewed if washed away by the rain. The relative effect of the several applications was to be noticed, and if effectual in arresting the depredations, that which gave the best result should be employed at large.

Upon another farm, that of Mr. R. C. Green, I examined a side-hill pasture of several acres, of which about two acres had been destroyed. A line separating this portion from the uninjured part, running down the hill, was distinctly traceable, but no cause for its existence could be discovered, either in the character of the soil or conformation of the ground. Perhaps it marked but a temporary limit, which may have shown an advance the following day. Another field below, on quite low ground, was so entirely browned that I could not convince those with me that it had not been winter-killed, until by stooping down and parting the dead grass of the preceding year, I was able to point out a thick growth of new grass closely eaten to the surface of the ground.

Characteristics of the Attack.

Several interesting features characterized this attack. It was in most instances observed first on upland and old pastures,—differing in this particular from the invasions of the northern army-worm, *Leucania unipuncta*, which ordinarily commences on low grass lands, working thence upward.

Its progress was remarkably rapid. A brown patch first observed in a pasture would rapidly extend its area, and often embrace the entire field in from ten to twelve days. Whether this was the result of the spreading of the larvæ from certain points where the eggs had been deposited, or the unequal hatching of the eggs distributed over entire fields, as influenced by various conditions of warmth, moisture, etc., I could not ascertain, for the brief time which I was able to devote to my observations did not permit of the detection of the eggs or their empty shells.

The secrecy with which the depredations were conducted was unusual and surprising. The extension of the infested areas could be observed from day to day, seemingly as causeless as a blight. Only a few

persons had seen the larvæ, and fewer still had witnessed their feeding. They were, for the above reasons, believed to be nocturnal feeders. An informant, who had observed the movement of a blade of grass, which, retaining its attachment to the root, had its tip bent downward and carried into a hole in the ground, inclined to the belief that most of the feeding, and all of that done during the day, was subterraneous, the larva gradually drawing the blade in its concealed retreat as it fed upon it. Objections to this theory were found in that the grass was usually eaten closely down to the crown of the root, and that holes in the soil which should lead to such retreats were very rarely seen.

Local Gatherings of Caterpillars.

No migration, like the hunger-impelled marches of the army-worm had been seen, or any common progressive movement of the caterpillars. In two instances, as narrated to me, immense numbers were observed in assemblages so large as to give countenance to the prevalent idea of an army-worm invasion. In both cases they had collected about the base and upon the trunk of a tree (a maple and an oak), to the height of two or three feet above the ground. They not only entirely covered the surface, but were piled upon one another so that, as stated, they could have been scooped up by handfuls. This occurred at Potsdam, three days previous to my visit to the place. That I might, if possible, verify these statements, I visited one of the localities of these gatherings, on the farm of Mr. L. D. Partridge, upon an island in the Raquette river. The caterpillars had evidently been here in force, for all the grass upon the island had been eaten. The oak tree which had been mentioned as the gathering point was readily found, as it was the only oak in the field. It was evident that their number had not been misrepresented, for the trunk was found enveloped to a height of eighteen inches, with a firm web of silk which had been spun by the hosts of larvæ, as was also a decayed stump of about two feet in height, standing a few inches from the tree. Upon the upper surface of a prostrate log adjacent, and extending thence a short distance over the ground in the direction of the tree was a similar web, and some large stones lying at the base of the tree were also coated in the same manner. The web, especially that upon the tree, was of so firm a texture that it could be stripped from the bark in a continuous sheet like a piece of woven silk. There were no excrementa mingled with it. Throughout the sheet were little openings of various sizes, averaging perhaps one-fourth of an inch, for which I was unable to account. They could not have been places of egress, for the construction of the web clearly did not permit of such immense numbers of caterpillars as were necessary to its formation, to have been massed beneath it.

A few stragglers of this host had been left behind and were aimlessly, it appeared, traveling slowly over the web. They were secured and, on comparison, were ascertained to be identical with those which I had elsewhere observed. The object of the assemblage at this particular point can only be conjectured. It was not for feeding, for the closest scrutiny failed to give evidence that the larvæ had ascended the tree even to the height of the lower branches. It is possible that there may have been a migration at this time and place from the desolated pasture, and the shade of this, the only large tree in the vicinity, may have been sought as an agreeable refuge from the hot sun suddenly appearing after one of the "April showers" which characterized this portion of the month of May.

Alarm Excited by the Attack.

As previously stated, the insect — the abundance and the ravages of which have been recounted — was generally accepted, throughout the district invaded, as the "army-worm." The local papers contained notices of its appearance at different points, and gave statements of the number of acres of grass already destroyed on several farms. The *Courier and Freeman*, of Potsdam, of May 26th, in an extended notice which it gives, states: "So far as we have heard, farmers are making no general effort to check the pest. An occasional furrow is turned or a piece of land rolled, but no combined and effective work is being done." The editor records sales of cattle that had been made in the vicinity, during the week, of ninety-four head, at low prices quoted, in anticipation of the entire destruction of grass in both pastures and meadows. Long extracts were made from the writings of Dr. Fitch and Prof. Riley, of the appearance and habits of the army-worm with methods for fighting it, so that it might be properly met when the existing demonstration should have developed into those migratory armies of which such graphic accounts have been given. Throughout St. Lawrence county, where the ravages had been the most serious, general consternation prevailed, not confined to agriculturists, for there was well-founded apprehension that every lawn and grass-plot would be invaded. It became the common topic of village conversation. At a meeting of the Ogdensburg Board of Trade, on the 23d of May, resolutions were passed, requesting from the State Entomologist such information and recommendations as might be of service to the farmers and the public generally. The Secretary wrote at this time: "Hundreds of acres in the towns of Oswegatchie, Lisbon and Morris-town are completely ruined. If an army of Rebels or Fenians had invaded our frontier, the people could not have been more excited than just now over the ravages of this pest. Time can only tell what dam-

age St. Lawrence county may be obliged to sustain on its account. Acres of pasture can be seen without a spear of grass upon them."

Description of the Caterpillar.

The caterpillars which I collected in the towns of Morley and Potsdam, and which I saw at those places slowly traveling over the herbage, lying dead upon the ground, attached to spears of dead grasses,



Fig. 30. — Caterpillar of the Vagabond
Crambus—
CRAMBUS VUL-
GIVAGELLUS—
twice the nat-
ural size.

or taken from their retreats among the roots of the grass, were, beyond doubt, the authors of the above-noticed ravages, although at no time detected in the work. Their appearance is shown in Fig. 30, and may be described as follows: They were of a slender, cylindrical form with the normal number of legs—sixteen. Their color was usually sordid or obscure greenish, with a shining black head of rather more than one-half the diameter of the body, and the upper part of the following segment, brown. Their markings were in spots, and not in lines. On the upper side of the principal segments (differing always on the front ones) there were four glassy, slightly elevated, brown spots, each bearing a black hair of about the length of one-third the diameter of the body; of these the anterior pair of each segment are broadly oval and two-dotted, the outer dot having the hair, and the posterior pair elongate-elliptical with the hair upon its outer portion. On the side of the body, immediately over the small black spiracle or breathing-pore is a subtriangular brown spot (also bearing a hair), an arm from which extends downward behind the spiracle, partly surrounding it. Beneath the spiracle is a less conspicuous, elongate-oval, brown spot, in which are two short hairs. Below and somewhat back of these is an oblique-oval, brown spot with a long hair. Still downward and directly over the base of the prolegs is an obscure crescentiform spot, in which some black points (four or more), bear minute, blackish hairs. The joints of the thoracic legs are marked with brown outwardly, and the plantæ of the prolegs (the small prehensile hooks encircling their tips) are blackish.* The average length of the larvæ was about three-fourths of an inch. It was subsequently found that they had at this time about attained maturity.

The Species not Determined at the Time.

I was unable, at the time of my visit, to determine whether or not the depredator was that of *Leucania unipuncta*. If that species, it

*The details of this description and the figure are from alcoholic examples.

differed greatly from its appearance at maturity, in not showing the characteristic stripes and in other particulars. But I had never seen the latter in its immature stages,—the published descriptions were not sufficiently full to remove all doubt,—and from the small size of the former, two moltings would be required in order to attain to the mature size of the army-worm, and even in a single molting very great change in appearance and form is often developed. The observed habits differed in important particulars from those ascribed to that species, and, above all, the time was nearly two months in advance of the proper season for its presence in Northern New York. Moreover, I could find no record of its occurrence in destructive numbers in that portion of our State, which lies outside of the limits of its serious ravages in the map given by Dr. Packard.*

Observed in Jefferson and Oswego Counties.

On my return from Potsdam, *via* the Rome, Watertown, and Ogdensburg railroad, the ravages of the caterpillars could be readily detected from the windows of the moving train at various places in St. Lawrence, Jefferson, and Oswego counties, by the brown patches, usually of small extent, on knolls and in the more elevated portions of the pastures bordering the road. Near Richville, several large infested patches were seen. None were noticed at Keen's Station. At about a mile south of Sanford's Corners, in Jefferson county, and continuing for some distance farther, traces of the attack were visible in small browned spots in the pastures. Within about two miles of Watertown, it became quite noticeable, and for a few miles beyond, several pastures showed the higher portions infested, and a grain field was also believed to be suffering from it. It was again noticed as we approached Adam's Center, and after leaving Sandy Creek, in Oswego county. South of this point, it was suspected in places, but I could not be positive of its presence.

Additional Collections of Larvæ at Potsdam.

A number of the larvæ which I had collected were placed in a box with sod, and brought home with me. They were objects of interest to many of my fellow passengers en route, as the hitherto unrecognized authors of the injuries with which they were familiar. The larvæ proved difficult to rear in confinement, and although as near an approach as was convenient to their natural condition was given them, most of them died within a few days; a few escaped. Two of their cocoons only were subsequently taken from the sod. One of the cater-

* *Ninth Ann. Rept. U. S. Geolog.-Geograph. Surv. Terr.*, for 1875 (1877), map 3.

pillars, after the death of the larger number, was removed and placed in a separate box, with some blades of grass for food. Here it shortly went into the pupal state within the grass, without forming a cocoon, and after sixteen days of pupation disclosed its imago, which proved to be *Crambus exsiccatu*s.

In consideration of the poor success attending my attempts at rearing the larvæ, I wrote to a friend at Potsdam, requesting additional examples at their present more advanced stage. A large number were collected from beneath sticks, pieces of rails, leaves, stones, dried excrements, etc., and sent to me. They presented quite a different appearance from the previous collections, but the difference was ascribed to additional moltings. They, however, proved to be a distinct species — one of the *Noctuidæ*, known as *Nephelodes violans*, the caterpillars of which had been named by Prof. Riley as the bronze-colored cut-worm.

Cessation of the Ravages.

My visit to St. Lawrence county must have been at about the time of the greatest depredations of the caterpillars, perhaps a little later for from that time they seemed to diminish: by the 25th of May they were nearly completed, and by the end of the month it is thought that they had entirely ceased. Reports published in the *St. Lawrence Republican* from several of the county towns, under date of June 6th and 7th, mention their disappearance, and that the pastures which had been eaten off were beginning to look green again — a gratifying evidence that the roots had not been injured.

Abundance of Cocoons, at Watertown, N. Y.

On the 1st of July, a communication was received from Mr. J. Q. Adams, of Watertown, N. Y., accompanied by material which gave the first clue to the identification of this destructive pest. It undoubtedly belonged to the *Pyralidæ*. Its injuries had not been so serious in Jefferson county as in St. Lawrence, yet in a pasture near Watertown which had been infested by them, its cocoons occurred so numerous, that a half-dozen could be taken from a piece of sod of the size of one's hand. The cocoons were found with one end (the more loosely constructed one) at the surface of the ground, and the other perpendicularly beneath it among the roots of the grasses. A hundred or more of these cocoons were kindly sent to me by Mr. Adams. Those that I opened for examination confirmed the statement of Mr. Adams that the transformation to the pupal state had not yet taken place, although the cocoons had been formed at least a month before.

The caterpillars which they contained were identical with my Potsdam alcoholic examples, although notably of a paler color than were

those in nature — the result, doubtless, of their long exclusion from the light during their cocoonage. They gave no evidence of having been parasitized, but were, to all appearance, in a healthy condition, displaying, when disturbed in their retreats, a facility of locomotion fully equal to that manifested during their active stage of six weeks before.

The Cocoon.

The general appearance of the cocoon is represented in Fig. 31. It however varies considerably in size and form. The figure is taken from one of the largest size, while others are but half so large. The average of thirty examples gives a length of 0.9 inch, and a diameter at the broadest part of 0.24 inch. The shape is subcylindrical, but varying from an almost uniform diameter, to an enlargement of the lower portion to twice the diameter of the upper part. The interior consists of a closely spun sheet of silk, to which is connected the rather thin outer covering of earth, mixed with the finer rootlets of the grass. Nearly all the cocoons show curvature similar to that represented in the figure.

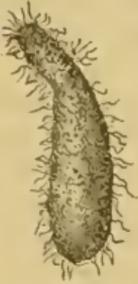


FIG. 31.—Earth cocoon of CRAMBUS VULOIVAGELLUS, — natural size.

Delayed Pupation.

Early in July (precise date not noted), upon opening several of the cocoons for examination, the caterpillars were found within them still unchanged, although they had at this time been in this inactive state for a period of from one and a half to two months. The change to the pupa state in the Lepidoptera usually takes place within a week after the caterpillar has made its cocoon. The delayed pupation of this species is an interesting feature in its life-history. A similar prolongation of the larval stage is well known to those who are in the habit of rearing Lepidoptera, to pertain to at least several species of the *Ptilodontinæ* among the *Bombycidæ*, which pass the winter in this condition, pupating only a short time before the disclosure of the imago in the spring.* It has also been observed in some species of the *Noctuidæ* as in *Xylina antennata* Walker (*X. cinerea* Riley), in which the larva lies unchanged in its earthen cocoon from June to Octo-

*I have observed this frequently in *Edemasia concinna* (Sm.-Abb.) and in *Celodasy unicornis* (Sm.-Abb.). Dr. H. S. Jewett informs me that *Cerura borealis* [? *occidentalis*] makes cocoons late in summer and pupates the following spring; and *Heterocampa marina* (Packard), after making its cocoon just below the surface of the earth or of bits of leaves, twigs, etc., lies dormant through the winter, and pupates in the spring.

All the Notodontians (together with *Limacodes*) remain a long time in their cocoons, or in earth, before turning to pupæ (Harris, *Ent. Corr.*, p. 242).

ber, until within a few days of its appearance as a moth.* I had never known it to occur among the *Pyralidæ*, nor could any notice of its occurrence be found in a thorough search through the literature of the family, both European and American. Professor Riley, however, has informed me, that he had observed it in some species of *Botys*. That it was not a family characteristic, or that it does not necessarily control all the species of a numerous genus, appears in the fact above stated of the prompt transformation to the pupa and thence to the imago of *Crambus exsiccatu*s — a species in which the larva so closely resembles those of which we are writing, that, when seen apart, it was believed to be the same. †

On the 8th of August ten of the cocoons were opened. Of these four were empty — the larvæ probably having deserted them in consequence of the disturbance attending their removal from the soil and their transportation to me, for, when received, several of the larvæ were wandering among the cocoons. The other six cocoons contained pupæ; and the pupation of all the rest at this time was accepted, in preference to sacrificing a larger number in further examination.

The Pupa.

The pupa, in each instance, was lying in the upper and loose end of the cocoon, in convenient position for its egress. Fig. 32 shows its general appearance, but gives too great a relative breadth across its wing-cases. In length it measures from 0.35 inch to 0.45 inch — average of six examples, 0.408 inch; average greatest diameter, 0.1 inch. Its color is pale brown. The females are ovoid in form, with the segments showing indistinctly; the males are cylindro-conical with well-defined and rounded segments. Head-case projected at the tip, and eye-cases prominent. Tips of wing-covers rounding over the segment, the inner wing-cover showing its margin over more than three segments. The stigmata appear as minute tubercles. Anal tip, dark brown, blunt and slightly excavated beneath.



FIG. 32.
—Pupa of
CRAMBUS
VULGIVA-
GELLUS,
enlarged.

The Species Determined.

On the 6th of August the first moth was disclosed from my Watertown cocoons. Professor Riley, at Washington, had obtained examples

*According to Mr. S. L. Elliot, of New York city, this species matures and enters the ground in June, where it remains as a larva until in October, when it pupates, and the moth is disclosed twenty days thereafter.

†In some of the other orders, there are interesting cases of delayed pupation. In the Diptera, *Diplosis tritici* and “all the numerous willow gallgnats belonging to the same genus [*Cecidomyia*], remain in the larva state without eating all through the winter, and until a few weeks of the time when the perfect midge is destined to appear, *i.e.*, with this particular species [*D. tritici*], until some time in May (Walsh, *Practical Entomologist*, ii, 1887, p. 99).

Among the Hymenoptera, *Cimbex Americana*, the largest of our saw-flies, occurring on the elm and willow, spins up in July and remains as a larva until the following spring. (Id., *ib.*, p. 101.)

two days before, from cocoons which he had also received from Watertown. It proved to be the species known as *Crambus vulgivagellus* Clemens, identical with that, it is believed by our best authorities, subsequently described by Professor Zeller, as *Crambus chalybirostris*. The interesting and perplexing question of the preceding three months — to which of our insect depredators was chargeable the ravages in Northern New York, more serious in the extent of territory embraced than an army-worm invasion — was decided. The new enemy — the latest addition to our list of formidable insect pests — was found to be a modest, inconspicuous, and hitherto unobtrusive *Crambus*.

The species has been known to entomologists for many years. It has been rather a common insect, having had name and place in most of our collections. Nothing was known of its life-history, and it had never been recorded as in the slightest degree injurious. Now that it has so suddenly achieved notoriety, a popular name seems to be needed for it, for the use of those who would find it more convenient and agreeable than any of the class that they delight to stigmatize as “jaw-breaking Latin names.” It is not always easy to select a common name which shall be both correct and distinctive, especially in a group where there are many species almost identical in appearance and habits. In view of this difficulty existing in the present instance, we have resorted, as has often been done, to a translation of the scientific name, and have designated the species as the *Vagabond Crambus*. If there is ever satisfaction in a resort to objurgatory epithets, this one may afford to the farmer, who contemplates its fearful ravages in his pastures, a measure of relief akin to that which might be experienced in a free translation of the scientific name of the wasp, *Vespa diabolica*, by one who had just experienced its venomous sting.

Family Characteristics.

To those who are not familiar with that division of the pyralid moths to which this species belongs — the *Crambidae* — it may be of interest to state that they are small moths, usually less than an inch in spread of wings, and presenting in general the following features: The antennæ are thread-like; the palpi projecting like a beak for some distance in front of the head; body and legs long and slender; the front wings are narrow and long and are often ornamented with dots and lines in silver or gold; the hind wings are semicircular and plain, and in repose are folded like a fan under the front wings; both pairs, when the insect is at rest, are wrapped tightly around the body in cylindrical form. They frequent meadows and pastures during the latter part of summer, and when driven up by approaching footsteps, they fly for a short distance with a staccato flight, when they alight

and hide beneath a leaf or upon a blade of grass, head downward, where, from their manner of folding their wings about them, they almost escape observation. This attitude, at rest, is the explanation of the name "*Close-wings*," sometimes applied to them in England.

Sixty-four species of North American *Crambidae* are catalogued by Mr. Grote, more than half of which belong to the genus *Crambus*. A common termination which usage has authorized for their specific names, is *ellus*; while in another division of the *Pyralidae*, viz., *Phycidae*, the termination of *ella* has been adopted, and in the remaining divisions, *Pyralididae*, etc., *alis* (unfortunately shared by the *Deltoides* of the *Noctuidae*).

Abundance of the Moths.

But few additional moths emerged from my cocoons prior to the 15th of August; from that time to the 25th by far the larger number were disclosed.

About the middle of August they were abundant in the localities where their caterpillars had swarmed in May. Under date of August 19th, Mr. Adams wrote me from Watertown: "The meadows and pastures are now filling up with the moths, and in places they fly out in small clouds." In a communication to the *Watertown Daily Times*, of August 22d, he writes: "At this date, any farmer of the county can walk his meadow or pasture and drive up moths in countless numbers, or, in places, in a small cloud." This, it should be remembered, is from a locality where the injuries done were moderate, compared to portions of St. Lawrence county. They may, therefore, be presumed to have been much more abundant there, but my only information relating to their appearance in that portion of the State is from Miss A. Clarkson, of Potsdam, who, under date of September 6th, writes: "The moths for the last three weeks have been flying in quantities, though much more abundant a few weeks ago than now. At West Stockholm, a means was devised for destroying them. Barrels were placed in the fields with water, on which was poured kerosene which was set on fire. The moths were attracted to the light and vast numbers killed."

Professor Riley, in a notice of the species, in the *American Naturalist* of November last (p. 914), states: "The moth has been excessively abundant all over the Eastern States this year, and as Mr Henry Edwards informed us, proved a positive nuisance in collecting in the neighborhood of New York city."

Description of the Moth.

The moth, shown in Fig. 33, has a slender body, and measures, on an average, one inch across its expanded wings. Its front wings are of a dull, yellowish color, and are only marked with rows of blackish scales between the veins, and with a black dot at the end of each vein on the outer margin; the fringe of the wings has a golden reflection. The hind wings are pale yellowish, with long, paler fringes. The thorax and abdomen are of the color of the wings. From the front of the head the two long, scaly palpi, folded together, project like a proboscis or beak, or, as in many cabinet specimens, diverge in a V, as in the figure.



FIG. 33.—The Vagabond Crambus moth—*CRAMBUS VULGIVAGELLUS*, natural size.

From the front of the head the two long, scaly palpi, folded together, project like a proboscis or beak, or, as in many cabinet specimens, diverge in a V, as in the figure.

The original description by Dr. Clemens (*loc. cit.*) is as follows: "Labial palpi luteous, dark fuscous externally. Head and thorax luteous; tegulæ with a fuscous stripe. Fore wings luteous, with numerous fuscous streaks in atoms along the veins, and two in the disk. Hind margin with a row of terminal black dots; cilia golden-hued. Hind wings yellowish; cilia whitish."

The Eggs.

From some of the moths from the Watertown cocoons which I had confined in a box with a piece of sod, eggs were obtained the last of August. Some of them were adhering slightly to the grass, but most of them were lying on the surface of the ground. It is, therefore, probable that the eggs are dropped at random in the grass—the larger number reaching the ground. At first they are of a pale yellow-green color, but later, as they approach the time for their hatching, they assume a pink shade. According to Professor Riley, who "found the egg-shells quite common in the earth of some sward, sent September 12th, by Mr. Adams, from a field that had been devastated by the larvæ, the eggs are pale yellow when laid, but become orange afterward; they are elongate-oval, very slightly broader at base than the top, and ribbed as in those of various butterflies, there being about twenty longitudinal, rather sharp ridges, and about thirty less marked transverse ones. The average length is 0.7 mm. and diameter 0.3 mm."*

*I am unable to reconcile with the above description some memoranda and rude figures that I had made of the egg, noting forty-four distinct longitudinal striæ, and the height (figured as an oblate-spheroid) to the diameter as two to three. Can my memory be at fault in referring these notes to *C. vulgivagellus*? The egg of a British species, *C. culmellus*, is thus described: "Elliptical, with an elongate depression on part of surface, very closely ribbed and finely reticulated; when first laid it is of a whitish-straw tint, changing in two days to flesh color, again onwards to salmon color, and then to deep pink, when it begins to hatch."

An enlarged view of the egg, represented in accordance with the above description, is given at *g* in Fig. 34, in connection with other phases of the insect. For the use of the figure, I am indebted to the Department of Agriculture at Washington, it having been one of the illustrations of the Report of the Entomologist for the year 1881-82.

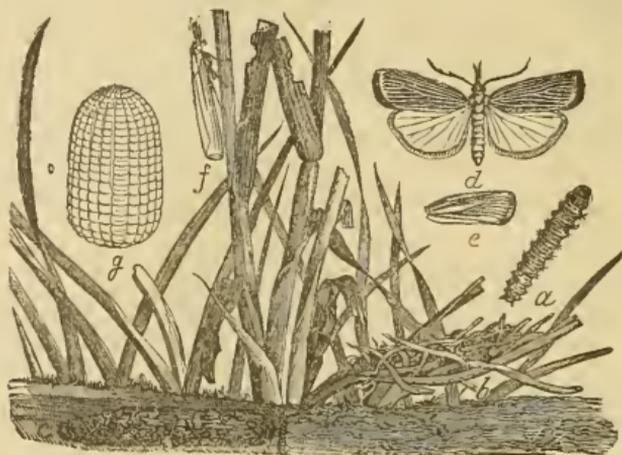


FIG. 34.-- *CRAMBUS VULGIVAGELLUS*: *a*, the larva; *b*, the larval case in grass; *c*, the cocoon in the ground; *d*, the moth, a dark specimen; *e*, wing of a lighter specimen; *f*, the moth at rest; *g*, the egg enlarged, its natural size shown beside it.

The Young Larvæ.

Some of the eggs which I took on September 1st, from the sod, and placed in vials for convenience of observation, gave out their caterpillars on the 7th. They were supplied from time to time with fresh and tender grass, in which they ate irregular holes, but without any evidence of appetite. All but one died within two or three weeks. The single survivor, after feeding sparingly, at long intervals, underwent a molting about September 15th. The greater part of the time was passed at rest, and whenever the drying of a blade of grass gave it a cylindrical form, the hollow thus made was chosen for its resting place.

The appearance of the young larva, a fortnight after its molting, when so little progress had been made in growth that it did not exceed one-tenth of an inch in length, was as follows: The head was elongate and shining black, with some white hairs projecting forward about one-half the length of its diameter; collar broad and shining black. Body dark brown, with a long lateral white hair on each segment, longer than those on the head and exceeding the diameter of the body; gradually tapering backward from the first segment; on each segment, two subdorsal verrucose spots.

Without farther progress, the larva died during the month — the

result, it is believed, of its not having been given the needed conditions for its hibernation. The period at which the hatching occurred, and the conduct of the larvæ during the time that they were observed, leaves scarcely doubt that their habit, in nature, is to feed but sparingly during the autumn, and to pass through one or two moltings, after which they retire to suitable quarters for their hibernation, remaining in a lethargic state until the starting of the new grass in the spring furnishes them with food.*

Present Condition of the Devastated Pastures.

Through the kindness of Mr. Adams, I am enabled to give the present appearance of the injured pastures in the vicinity of Watertown, N. Y. Under date of December 28th, he has written me: "The effects of the late raid still show in the absence of any blades of grass of *length*. Every thing is cropped short, except in small bunches here and there where manure was dropped. The grass has shown greenness this fall to a much less extent than would otherwise have been the case. There are evidently many dead roots as well as some live ones. Another raid in these pastures would probably prove fatal to the present sod."

It will be remembered that the depredations in Jefferson county were not nearly so serious as in St. Lawrence county.

*Professor Riley has recently published in the Annual Report of the Department of Agriculture for the year 1881, observations made upon the young larvæ occurring in large numbers, in the District of Columbia. They are given here, as supplying an important part in the life-history of the species which I have endeavored to present:—

"The larvæ, if not too numerous, are difficult to find, on account of their nocturnal habits, but more particularly from their secluded mode of life. From the time of hatching to the assumption of the pupa state they remain nearly in the same spot. The newly-hatched larva spins a delicate white web, near or among the roots of the grass, and commences at once to feed upon the softer parts of some leaf near at hand, or to bore through the surrounding sheaths into the stem itself, near its base. Whenever they have settled they protect themselves by a delicate web, which they gradually cover with their greenish frass, forming a tube, in which they are entirely hidden from view. They are very sluggish, and, if the tube be disturbed, curl up into a helix-like roll. As they increase in size, the tube is extended either upward, when upon the ground, or downward, if somewhat above the surface, and the opening is often lined with bits of green grass."

Some interesting observations upon the tube of the mature larva are also given in connection with the above:—

"When the larva is full-grown its tube measures often, nearly 50 mm. (two inches) in length. A half-inch at the lower end is thicker than the rest, is rounded and closed, serving both as a retreat for the larva and as a receptacle for excrement. The upper or open end is usually very delicate, and is generally so constructed that if the larva is disturbed it closes entirely. When full-grown and ready to transform, the larva leaves its tube and commences to spin among the roots, and near or just beneath the surface of the ground, an elongate club-shaped cocoon, similar in appearance to the lower end of the larval tube. It is composed of smooth and delicate white silk, gummed over with earth. Both ends are rounded, the thicker end being about 6 mm. in diameter, and the narrow end about 4 mm."

Résumé of the Life-History of the Species.

The following is a résumé of the history of *Crambus vulgivagellus*, as it occurs in Northern New York, so far as we are prepared to give it:

The eggs are deposited in dry upland pastures and meadows during the latter part of August, and hatch in about ten days.

The young larvæ feed sparingly, and after one or two moltings they retire to winter quarters.

The hibernated larvæ commence feeding in the spring with the starting of the grass. When unusually numerous, their depredations attract attention during the second week in May, by rapidly-extending brown patches in pastures, from which the grass has been eaten down to the crown, but leaving the roots unharmed.

Their principal food-plant is grass (June-grass preferred). They also eat oats and wheat.

They feed principally by night, having rarely been seen engaged in feeding.

When not feeding, the larva occupies a cylindrical case or tube just beneath the surface of the ground, the upper portion of which is composed of bits of green grass cut for the purpose (possibly of excrementa), and fastened together by slight spinning.

The depredations, when serious, are conspicuously noticeable when the larvæ are about three-fourths grown — about the middle of May.

When nearly mature, the larvæ, from some unknown cause, sometimes congregate in immense numbers on the trunks of trees, near the ground.

When mature, about the 25th of May, they abandon their green cases, and build long and subcylindrical earthen cocoons, placed upright in the ground just beneath the surface.

They remain unchanged in the cocoons for two months or more, through June and July, when they transform to pupæ.

The pupal state continues for about two weeks.

The moths commence to emerge during the first week in August, and are abundant about the 20th of August in pastures and meadows where the larvæ abounded.

The larva is not subject to serious parasitic attack during its later stages; the proportion of parasites obtained from the cocoons is very small. In the earlier stages, continued rains, deficient food-supply, ants, and carabid beetles destroy many larvæ.

Natural Enemies.

It is not to be expected that the first year of insect attack should be marked by the presence of many natural enemies. Successive years at-

tract new foes, and continued observations bring them to our notice. Our long experience with the Colorado potato-beetle, *Doryphora decemlineata*, has made us acquainted with at least twenty-five species of other insects which prey upon it, and many species of Vertebrates which also destroy it. Thus far, only Carabid beetles and different species of ants have been noticed among insects, as devouring the Crambus larvæ. Mr. Adams has seen many of the former, eagerly exploring the pastures of Watertown for their natural prey. He has also informed me that while digging for cocoons, several species of Ichneumons were observed by him, which he presumed were parasitic on the larvæ. From the large number of cocoons received from him, only two species of parasites have been obtained by me, and these in but three examples.

LAMPRONOTA FRIGIDA Cresson.—The first of these has been kindly determined by Mr. Cresson as the species described by him as *Lissonota frigida*, in the *Canadian Entomologist* for 1868, v. i, p. 36, but subsequently referred to the genus *Lampronota*, of Curtis (*Trans. Am. Ent. Soc.*, iii, 1870, p. 161). It is shown in Fig. 35. It belongs to the subfamily of *Pimplariæ* of the *Ichneumonidæ*, and its original description is as follows: "♀ Black, somewhat shining; legs rufous, the coxæ, trochanters and posterior tibiæ and tarsi black; middle tibiæ and tarsi sometimes dusky; wings dusky hyaline, iridescent, nervures black, areolet small, petiolated; abdomen shining at tip; ovipositor longer than body; body densely punctured, most sparse on abdomen. Length \pm 1.2 lines." *Hab.* — Grimbsy, C. W.



FIG. 35.—LAMPRONOTA FRIGIDA, parasitic on CRAMBUS VULGIVAGELLUS: twice the natural size.

As the wings of the insect have not been faithfully represented in the above figure, an enlarged drawing of them, made with a camera, is given in Fig. 36

TACHINA ? sp.—The second parasite, of which three examples were obtained, is a fly, belonging to the *Tachinidæ*. Of this family a large number of species are parasitic upon caterpillars, attaching their eggs to the exterior of their body, not inserting them, as do the *Ichneumonidæ*. The larvæ which soon



FIG. 36.—Wings of LAMPRONOTA FRIGIDA Cresson, enlarged from the natural size shown beside them.

hatch from these eggs enter the caterpillar and feed upon it so slowly that it usually prepares for pupation, and frequently undergoes the

change, before the maturity and final development of the Tachina flies. In appearance these flies resemble several of our common species of house-flies, having short and broad wings, stout and bristly bodies,

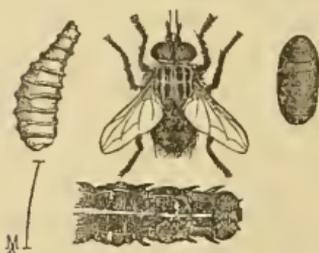


FIG 37.—NEMOREA LEUCANÆ; the larva, fly and puparium; also, its eggs placed upon the forepart of an army-worm, on which it is parasitic.

and large eyes. Fig. 37 represents a species of the family, *Nemoreia leucanæ* Kirkp., which is of great benefit in checking the ravages of the army-worm, *Leucania unipuncta*, for when the pest abounds it is usually accompanied by its parasite, which follows the hosts and deposits its eggs upon them near the head, as shown in the figure, and causing the death of the larger number of the invading army.

The Tachinid reared from the Crambus cocoons is one of the smallest that I have seen, surpassing but little the common house-fly, *Musca domestica*, in size. Its eyes are large; its thorax bluish, striped with black; its abdomen quite bristly and presenting changeable patches of gray and black as viewed in different lights. It has not been specifically determined. Many of the species are so similar in appearance, and there appears to be so great a range of variation in a single species, that their correct determination, in some of the genera, is a very difficult task, involving an amount of study which has not been given to them.

The above Tachina has given an illustration of secondary parasitism, which is always interesting, although not infrequently met with among the insects which prey upon one another. The Tachina fly, while destroying the Crambus, has, in its turn, been attacked and destroyed by a hymenopterous insect — one of the *Chalcididæ*. Of the three Tachinid puparia found among the Crambus cocoons, one gave out the fly noticed above, from another a Chalcid emerged, and the third was discovered with a hole eaten in one end, through which the head and front pair of legs of another example of the same species was projecting, evidently caught and fastened by some means in the act of emerging, and dying in this position.

PERILAMPUS VIOLACEOUS Dalm. — The Chalcid, as determined by Mr. L. O. Howard, is *Perilampus violaceus* Dalman. It is a beautiful little insect in its brilliant deep violet color throughout, except its dusky feet. Its short antennæ, not so long as the transverse diameter of the head, are closely jointed. The head is short and broad, with ovate eyes. The deeply punctured thorax is large, longer than the abdomen, protuberant, and ending in a blunt point behind. The abdomen is smooth, with short downy hairs, and is trigonate in form. The front wings

have a stout vein running into the costal margin at its middle, throwing off a short branch inwardly; their expanse is 0.42 of an inch.

The insect was found dead in the box with the cocoons and puparia, and it is not known, therefore, when it emerged. An example of the same species in my collection bears the label, "May, 1875, from some lepidopterous pupa."

CRYPTUS MUNDUS *Provancher*.—A third parasite upon the Crambus is mentioned by Professor Riley,* as an undetermined *Cryptus*. It has recently been determined by Mr. Cresson as *C. mundus*.

Probabilities of Future Attacks.

Questions of great interest to those who have suffered from the recent depredations of this destructive insect, and to those who have been studying its history, are these: Will it reappear the coming season and repeat its injuries? Will the injuries be largely increased, from the immense number of eggs that have been deposited by the "clouds" of moths? Will the species hereafter continue as a serious grass-pest? The first two of the above queries will have been practically determined before these pages can reach the public; and furthermore, they are virtually covered by the last.

Our knowledge of the history of this species compels us to look upon the recent demonstration as an exceptional one. It had never, so far as we know, occurred before, and the records of similar attacks by other species enable us to say that it will not necessarily be repeated the present year and in following years. Further, we may venture to record our belief that they will not continue hereafter. Indeed, many years may pass before we shall see it again in injurious numbers. Had it been, as at first supposed, a visit from the "army-worm," we could have predicted that it would not recur the following year, for the immense hosts of that species are always attended by their parasitic foes which so effectually destroy them that it seems impossible that two "army-worm years" can follow, in the same locality. Unfortunately, the vagabond Crambus has not invited such parasitic attack. Predictions of its future, therefore, may only rest on probabilities.

The immense numbers of this species in its recent occurrence was simply the result of a combination of circumstances which had not occurred before. For reasons unknown to us, all the conditions had been favorable to the development of the perfect insect. Of the eggs laid by the parent moths the preceding year, nearly all produced their young. The tender larvæ were exempt from attack or disease during their autumnal growth. During their hibernation they escaped the mortality which ordinarily attends this stage; and the weather of early spring

**Ann. Report of the Dept. of Agriculture for 1881, p. 181.*

and other attendant circumstances were just that best adapted to their need. A combination existed, in which heat, cold, drouth, rain, dews, snow, frosts, other insect and animal life, were factors, in such association, as, on the doctrine of chances, may not be again presented for many years to come.

Were we to base an opinion upon seasonal conditions, we would predict that the unusual high temperature of the month of December last, has been unfavorable to the lethargic repose, during the early winter-time, of the young *Crambus* caterpillars, which repose we believe to be essential to their safe hibernation; and that an almost entire absence of snow has exposed them in their retreats to destruction from a prolonged activity of predaceous insects, from birds, and from other enemies. It seems, therefore, probable that from the above causes, the number of the hibernating brood has already been greatly reduced.

Preventives and Remedies.

Burning.—If grass lands which the *Crambus* has infested can be burned over, either by setting fire to straw scattered over them, or otherwise, in the late autumn or early spring, before the starting of the new growth, a large proportion of the caterpillars hibernating among the roots or blades of grass would be destroyed.

Application of ashes, lime, plaster, dust, etc.—As soon as an examination shows that the young caterpillars have commenced feeding in the spring, the recommendations made on page 131 should be resorted to and their efficacy tested.

Rolling the ground.—The question should be settled as soon as possible, if the caterpillars feed only by night. This can be done where they are abundant, by an examination with a lantern. If nocturnal only, large numbers could be killed by rolling the ground after dark.

Attracting and drowning.—The moths may be attracted to lights and destroyed—perhaps in larger numbers if a bait of molasses and vinegar or beer be used with the light. Fig. 38 shows an arrangement which has been successfully used for destroying similar insects, and which will doubtless prove serviceable with this species, as experiments at Potsdam have shown it to be readily drawn to light. A bright-burning lantern is placed upon a block of wood in the center of a pan containing the liquid for attracting and drowning the moths, fastened to the top of a post or stake inserted in the ground. The cost of such an arrange-

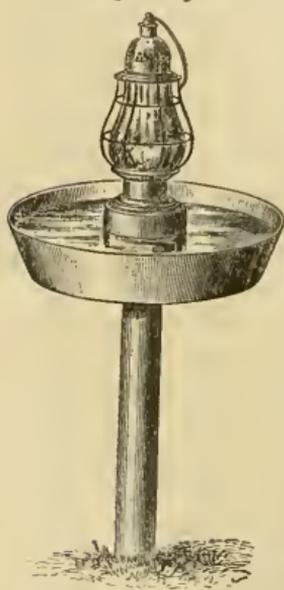


FIG. 38. LANTERN AND PAN, for attracting and killing moths.

ment would be so inconsiderable that several lanterns might be used in each field.

Deep plowing.—A recurrence of an attack in a pasture or meadow may be prevented by deep plowing in the autumn, at any time after the middle of September. The eggs or the young larvæ would be crushed or so deeply buried that their death must necessarily follow.

Use of gas-lime.—It is believed that a liberal dressing of the pastures during autumn or winter with gas-lime (as suggested on page 53) of strength and quantity not sufficient to destroy the roots, will be very efficient in killing the young larvæ.

Crambus exsiccatus Zeller.

The Dried Crambus.

Ord. LEPIDOPTERA: Fam. PYRALIDÆ.

- ZELLER: *Chilonidarum et Crambidarum gen. et spec.*; in *Programm der Koenigl. Realschule in Meseritz*, 1863, pp. 37, 38 no. 88.
 LINTNER: in *Atb. Eve. Journ.*, of July 1, 1881; in *Husbandman* [Elmira, N. Y.], Sept. 14, 1881; in *Science* [N. Y. City], for Oct. 1881, ii, p. 467.
 RILEY: in *American Naturalist*, Sept. 1881, p. 750 (mention).
 GROTE: in *Canad. Entomol.*, xii, 1880, p. 78 (habitat).

The caterpillar of this species, of which the moth is represented in Fig. 39, was collected in St. Lawrence county, N. Y., on or about the 20th of May, in company with examples of *Crambus vulgivagellus*, which abounded then in the pastures of Northern New York, as noticed in the preceding pages. The larvæ collected at that time were not observed with sufficient care to detect more than



FIG. 39 — CRAMBUS EXSICCATUS—twice its natural size.

two species (those subsequently ascertained to be *C. vulgivagellus* and *Nephelodes violans*), but it is probable that but little difference could have been detected between the two Crambids. They were confined in a box with sod, and a few days thereafter, when a number had died, and all but two or three had disappeared from the blades of grass, one of the larvæ, not distinguishable at the time from the others, was removed to a small tin box with some tender grass for its food. It ate but little after its confinement, for on the 31st of May, it was found to have made a slight cocoon between the blades of grass, of so few threads that it could be distinctly seen in its somewhat contracted form, indicating approaching pupation. It was observed daily, and on the 20th of June it had thrown off its caterpillar covering and changed to its pupal state. The cocoon, if such it might be called,

was so slight that the pupa, unattached, rolled from its shelter while being examined, and was easily replaced.

The pupa is three-eighths of an inch long by rather more than one-third as broad. Its color is reddish-brown, with its flattened, broad anal tip blackish, and bearing two diverging microscopic hairs. The stigmata are elevated, broadly oval, of a dark brown color. The incisures of the segments are well marked; the last three segments rounding rather abruptly to the tip. The wing-covers reach to the eighth segment, and occupy more than two-thirds of the entire pupal length. The eyecases are prominent; the antennæ cases extend to nearly the tips of the wings.

The moth emerged from the pupa on the 19th of June, giving for its pupation a period of fifteen days. The brief period required for the transformations of this species is quite interesting from the contrast which it presents to the prolonged larval stage, preparatory to pupation, of *Crambus vulgivagellus*. This latter feature seems not to be characteristic of the *Crambidae*, if we may judge from the various times during the spring and summer when the moths are known to emerge from their pupæ. From a paper, by Mr. E. L. Ragonot, of Paris, giving the period of apparition of nineteen species of *Crambus* occurring in Great Britain,* we find as follows: May to July, one species (*C. craterellus* L.); May to September, one species (*C. perlellus* Sc.); June and July, four species; † June, July and August, three species; ‡ July and August ten species. §

There may be a second brood of *C. exsiccatus*, as of some of the earlier appearing European species, for an example in my collection bears as the date of its capture by me, September 3d. It has been taken in the Adirondack Region of New York, by Mr. W. W. Hill, on the 7th of July. ||

It is probable that the larval life of the species is similar to that which has been given of *C. vulgivagellus*, and that it is passed in a tubular gallery, spun by the caterpillar, such as is constructed by the several species of *Pyralidæ*, recently observed and recorded by Mr. W. Buckler. Whether the gallery is built above or within the ground remains to be seen, for the habits of the several species differ in this particular. Thus, while the adult larval gallery of *C. vulgivagellus* is found within the soil, in another species, of which Mr. Buckler has

* *Entomologist's Monthly Magazine*, xvii, 1889, pp. 15-17.

† *C. dumetellus* Hb., *C. uliginosellus* Z., *C. pascuellus* L., *C. myellus* Hb.

‡ *C. silvellus* Hb., *C. margaritellus* Hb., *C. culmellus* L.

§ *C. alpinellus* Hb., *C. verellus* Zk., *C. ericellus* Hb., *C. Warringtonellus* Stt., *C. hamellus* Thunb., *C. furcatellus* Zett., *C. latistrius* Haw., *C. inquinatellus* S. V., *C. contaminellus* Hb., *C. lithargyrellus* Hb.

|| *Seventh Ann. Rept. Survey Adirondack Region of N. Y.*, 1880, p. 391.

given the life-history,—*C. Warringtonellus* (*Ent. Month. Mag.*, xviii, 1881, pp. 129–131), the larva, “when near full growth, inhabit tubular galleries, two inches long, of irregular figure, firmly attached to the grass in an upright position with the lower end touching the ground.”* Of the case occupied by the young larva, in the autumn, of this species, it is stated: “By the middle of November, the case or gallery it has constructed is a quarter of an inch long, composed outwardly of finely comminuted grassy particles firmly attached to the grass, about three-quarters of an inch above the ground.” Of some other English species, Mr. Buckler makes the following statements: *C. culmellus* hibernates in little tubular galleries spun in an upright position among the grass. *C. contaminellus* has its hibernating gallery attached to the whitish sheaths of grass or to stones, covered with fine greenish frass, or grass and earth. *C. geniculus* hibernates in a gallery close to the earth or partly beneath the surface, composed of dirty brown silk.

Crambus exsiccatus was originally described by Professor Zeller from a number of examples (three males and seven females) received from Illinois. It also occurs, according to Mr. Grote, in Canada, Maine and Vancouver. A closely resembling species, *Crambus undatus* Grote, has been described from California (*Canad. Entomol.*, xiii, 1881, pp. 35, 66), differing mainly in its smaller size and absence of the indentation of the outer band below the middle of the wing, just above the submedian fold. Professor Zeller compares *C. exsiccatus* in size and shape to *C. fascinelinus*, and states that it is the *C. fuscisquamellus* of Kollar, *in litt.*

Should this species ever multiply so as to become obnoxious, the same remedies may be employed against it as recommended for the Vagabond Crambus.

Anarsia lineatella Zeller.

The Peach-twig Moth.

Ord. LEPIDOPTERA: Fam. TINEIDÆ.

ZELLER; in *Isis*, for 1839, p. 190 (original description).

CLEMENS; in *Proc. Acad. Nat. Sci. Phila.*, for 1860, p. 169 (described as *A. pruinella*); also the same in *Tineina* of N. America, (Stainton ed.), 1872, p. 128; *Ib.*, p. 36 (*in litt.* to Stainton, identified with *A. lineatella*).

CHAMBERS; in *Canad. Entomol.*, iv, 1872, p. 208 (identical with *pruinella*); in *Bull. U. S. Geolog.-Geograph. Surv. Terr.*, iv, 1878, pp. 112, 129 (food-plants and references).

*The cocoon of this species differs also from that of *C. vulgivagellus*, in that instead of being subcylindrical, it is “oval, half an inch long and a quarter of an inch wide, made of similar materials to those of the gallery, but is more tough and stronger and sunk partly in the earth.”

SAUNDERS; in Ann. Rept. Ent. Soc. Ontario, for 1872, (1873), p. 15 (infesting strawberries).

GLOVER; in Ann. Rept. Commis. Agricul. for 1872, (1874), p. 112, f. 1 (habits, etc.).

COMSTOCK; in Proc. West. N. Y. Hortical. Soc. for 1878, p. 13 (description, depre-dations, and figures); in Rept. Commis. Agricul. for 1879, (1880), p. 255 (in peaches).

LINTNER; in 38th Ann. Rept. N. Y. St. Agricul. Soc. for 1878, (1879), pp. 69-72; the same in Report on Some Inj. Ins. of the Year 1878, pp. 12-14.

Examples of the above insect with twigs infested by it were sent to me, in the month of June, for examination and identification, accom-pañied by the following note: "The inclosed insects are very inju-rious to the terminal branches of the peach-tree. They deposit their eggs, either very early in the spring, just as the buds are swelling, or the fall previous. The terminal buds of all the higher and outer branches are so stung, and although these buds develop into seem-ingly fine branches, in a few weeks they wither and drop off. The centers of the twigs are first destroyed by these insects while in the larva state. I placed several of the twigs in a large bottle, and secured the inclosed specimens from them. One of the pupæ seemed to be de-stroyed by some parasite, as it looks as if it was filled with eggs."

From the above statement of the habits of the insect, and the effect of its operations upon the twigs, the specimens of the moth received, although in too poor condition for identification if they had been sent alone, were readily referable to the insect popularly known as the peach-twig moth. From its small size and structural characters, it is numbered among the Microlepidoptera (small lepidoptera), of the family *Tineidæ*.

Description of the Moth and Larva.

In 1860, Dr. Clemens bred the moth from larvæ which he had found on the 16th of June, infesting plum-trees, and described it (*loc. cit.*) under the specific name of *pruinella*, doubtfully referring it to the genus *Anarsia*. The description is as follows:—

"Head and face pale gray; thorax dark gray. Labial palpi dark fuscous externally, and pale gray at the end; terminal joint gray, dusted with dark fuscous. Antennæ grayish, annulated with dark brown.

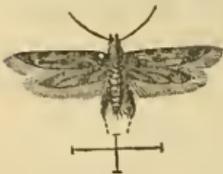


FIG. 40.—The Peach-twig Moth — *ANARSIA LINEATELLA* Zeller.

Fore wings gray, dusted with blackish-brown, with a few blackish-brown spots along the costa, the largest in the middle, and short blackish-brown streaks on the median nervure, subcostal, in the fold, and one or two at the tip of the wing; cilia fus-cous gray. Hind wings fuscous gray; cilia gray, tinted with yellowish." The moth, enlarged, is shown in Fig. 40.

Later, it was ascertained by Dr. Clemens that the insect occurred also in Europe and had been previously described as *Anarsia lineatella*, thereby adding it to the long list of insect pests which Europe has given us. Professor Riley obtained specimens of the same moth from peach twigs, and on submitting examples to Professor Zeller, they were pronounced identical with the European insect.

The larva has been described by Mr. William Saunders, as follows: "The head is rather small, flattened, bilobed, pale brownish-yellow, darker in color about the mouth, and with a dark brown dot on each side. The body above is semitransparent, of a reddish-pink color, fading into dull yellow on the second and third segments; anterior portion of second segment smooth and horny-looking, and similar in color to the head. On each segment are a few shining reddish dots (yellowish on the anterior segments), or faintly elevated tubercles, from each of which arises a single, very fine, yellowish hair, invisible without a magnifying power: these dots are arranged in imperfect rows, a single one across the third, fourth and terminal segments, and a more or less perfect double row on the remaining segments. The under surface is of a dull whitish color, becoming faintly reddish on the hinder segments, with a few shining whitish dots; those on the fifth, sixth, eleventh and twelfth segments, being arranged in transverse rows, in continuation of those above. The feet and prolegs are yellowish-white, the former faintly tipped with dark brown. It spins a slight silken thread, by which it can suspend itself for a time, at a short distance from its place of attachment.

Operations of the Larvæ.

The first published notice of the operations of this insect in this country which we have met with, appears in the Report of the Entomologist (Mr. Glover) of the Department of Agriculture at Washington, published in the Annual Report of the Department, for 1872. Mr. Glover states:—

"In examining peach orchards in the neighborhood of the Maryland Agricultural College, about the first week in May, almost all the young twigs of the trees were observed to be killed at the extreme end for a distance of from one inch to two and a half inches, and the terminal buds entirely destroyed. On cutting open the dying twigs, the injury was found to be caused by a minute caterpillar, which, entering a twig near the bud, had entirely eaten the pith and the interior, leaving only its 'frass' and the exuding gum to mark the spot where it had entered. When confined in a glass case, after about a couple of weeks, several of the larvæ left the injured twigs and formed very loose cocoons on the sides of the box or among the rubbish and old leaves

lying scattered on the earth, and in about six to ten days the perfect moth appeared [laſt of May]. * * * * The tail of the pupa is attached to a little button of silk in an exceedingly ſlight cocoon. There was ſcarcely a ſingle young tree in the peach orchard examined that was not more or leſs injured by this little peſt, and at leaſt as many as from twenty to fifty injured twigs were found on ſome very young trees. After the inſect leaves the twig, the injured part dries up and breaks off. This inſect was alſo ſeen, though in much ſmaller numbers, laſt ſeaſon, in Maryland and Virginia. Apple-trees are alſo ſimilarly injured in a like manner in Maryland, and it is probable that the damage was done by the ſame worm.

“The larvæ are about 0.25 inch in length; head black; body dark reddiſh-brown, with lighter rings—the third ring being more conſpicuous and whitish. The moth is quite ſmall, and meaſures from 0.40 to 0.60 of an inch in expanſe of wings, and is of a pale gray color with a few blackiſh ſpots on the upper wings.”

Profeſſor Comſtock has written of the ravages of this inſect in Weſtern New York. His ſtatement of its habits differ in ſome particulars from that of Mr. Glover, above quoted. According to his obſervations, “it deſtroys the terminal leaf-bud, and ſometimes the lateral buds, in the following manner: The young caterpillar begins its work in the ſpring at the time, or ſoon after, the ſhoots begin to grow. Theſe, when from one-half to one inch in length, are punctured at the baſe and eaten off. The leaves of the bud unfold and then wither. The twig, although ſevered, does not drop off, but is held in place by a gummy ſubſtance. All the twigs on ſome trees are deſtroyed, eſpecially on the two-year old trees. Mr. Green, of Clifton, N. Y., had one hundred trees infeſted. The larvæ became full-grown during the latter part of May or early in June. Specimens collected June 10th, were found to have changed to pupæ June 14th.” The time of their emerging as moths was not obſerved, as they were found dead in their breeding-cage ſome time during the ſummer.

Writing later of this ſpecies, Profeſſor Comſtock records the intereſting fact that he has found the larvæ within peaches grown in Blackſtone Iſland, Virginia, and alſo in peaches on the grounds of the Department of Agriculture at Waſhington. The larva leaves the peach before transforming, and ſuſpends itſelf to the outside of the fruit, ſpinning no cocoon at all. It was aſcertained that the ſpecies was double-brooded, the early brood which feed in the terminal twigs and buds, maturing, in the latitude of Waſhington, during May and June, and the later brood—the fruit-inhabiting—found during the latter part of July and Auguſt and maturing during September.*

* *Rept. Commiſ. Agricul. for 1879, (1880), p. 255.*

New York Localities.

The localities in New York where injuries by this insect have been recorded are Ithaca, Rochester, Lockport, Clifton and Jordan Station. Its operations at large have not come under my personal notice, but its presence, to an injurious extent, in the eastern portion of our State is very probable, from statements made to me three years ago, of an affection of some peach-trees in Schenectady and Albany. The moth has been captured by me in Schoharie, N. Y., on June 5th.

Like many of our New York *Tineidæ*, it occurs also in Texas. It extends northwardly into Canada, where it is believed by Mr. Saunders to have been introduced in strawberry roots from the United States.

Injurious to Strawberries.

In the *Annual Report of the Entomological Society of Ontario for the Year 1872*, published in 1873, we learn that the ravages of this insect are not confined to the peach, plum and, perhaps, the apple, but that it also occurs under very different conditions and affecting a very different food-plant. In this report, Mr. Wm. Saunders, the editor of the *Canadian Entomologist*, describes the insect under the name of the *strawberry-root or crown borer*. During the years 1868 and 1869, it was very destructive in certain grounds at St. Thomas, Ontario, the caterpillar eating irregular channels in various directions through the crown and larger roots of the strawberry plants, causing them to wither and die, and thus destroying a large proportion of the plants. Mr. Saunders gives a minute description of the caterpillar, narrates its history and states that it probably has two annual broods.

Specimens of the larvæ obtained late in the season were found alive within their silken cocoons on the 12th of January, rendering it probable that this brood hibernates in the larval state and transform to pupæ in the spring, a short time before their reappearance in their perfect state.

Another "Strawberry-crown Borer."

The above strawberry-root or crown borer, of Saunders, should not be confounded with the strawberry-crown borer, of Riley,—an insect belonging not to the order of Lepidoptera, but to the Coleoptera, of the family commonly known as snout-beetles or weevils.

This latter insect has been described and figured in its larval and perfect stages by Professor Riley (*Third Report on the Insects of Missouri*, p. 42, fig. 14, 1871) as *Analcis fragariæ*.* So far as known, it is confined to the Mississippi valley, and has not, to our knowledge, been reported from the Eastern States. Its habit of boring down

*Now known as *Tyloderma fragariæ* (Riley).

through the crown of the strawberry plant into the pith and eating through the more woody portions is very similar to that recorded of the *Anarsia lineatella*, and the ravages of the two insects, in localities where they conjointly occur, are liable to be confounded. The general use of common names for our insects, birds, fishes, mammals, etc., very often results in serious confusion, when, with little difficulty, the scientific name, which always indicates the object referred to, could be acquired.

Parasitic Attack.

It is gratifying to know that, in all probability, this destructive pest has already been attacked by a parasite which promises to perform an effective part in checking its ravages.

The "pupa apparently filled with parasitic eggs," referred to in the communication accompanying the examples sent to me, was the dead body of a caterpillar, distended to its utmost capacity by the presence of no less than fifty-one pupa-cases of apparently some Chalcid species.* They had been crushed in their transit through the mail, preventing the perfect insect being taken from them, or even an approximate reference of their relationship.

Remedies.

Should the increase of this insect not be prevented by parasitic agency, then the most effectual means of arresting it will be the cutting off of the infested terminal twigs of the trees upon which it occurs—readily to be distinguished by the drying up of the leaves—and burning them with their contained borers. This must be done during the month of May, or early in June, before the larvæ have attained their maturity, after which they leave their burrows to seek some sheltered place beneath the loose bark of the trunk, leaves upon the ground, or elsewhere, where they may construct their cocoons and undergo their final transformation.

Strawberry plants giving indication of their presence should be promptly uprooted and burned.

*Mr. L. O. Howard (our authority in the *Chalcididæ*) expresses the belief (*American Naturalist*, xiii, 1882, p. 150), based upon the mode of occurrence, that these were the cocoon-like cells of a Chalcid species belonging to the genus *Copidosoma* of Ratzeburg, and congeneric with others found by him, distending to the utmost the larval skins of another example of *A. lineatella*, and also of *Lithocolletis Fitchella* Clem., *Gelechia pinifoliæ* Chamb., and *Plusia brassicæ* Riley. From a single example of this latter species the almost incredible number of two thousand five hundred and twenty-eight parasites, by actual count, emerged.

Bucculatrix pomifoliella Clemens.*The Apple-leaf Bucculatrix.*

Ord. LEPIDOPTERA: Fam. TINEIDÆ.

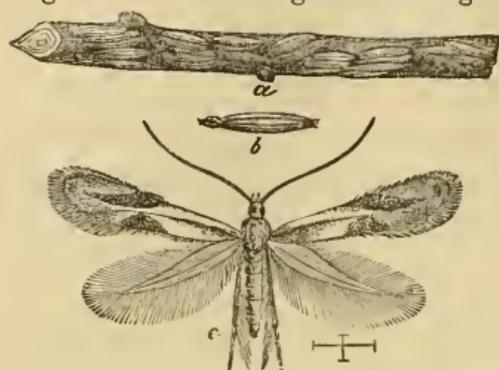
- CLEMENS: in Proc. Acad. Nat. Sci. Phila., 1860, p. 211 (original description); re-published in Tineina of N. Amer. (Stainton ed.), 1872, p. 146.
- PACKARD: Guide to Study of Ins., 1869, p. 354, pl. 8, f. 16 (description as *Lithocolletis curvilineatella*); Ib., 7th edit., 1880, (as *Bucculatrix pomonella*); 1st Rept. Ins. Mass., 1871, p. 24 (description).
- RILEY: 4th Rept. Ins. Mo., 1872, pp. 49-51, f. 23; in Amer. Entomol., iii, 1880, p. 23 (habits, remedies, etc.).
- CHAMBERS: in Canad. Entomol., v, 1873, p. 150 (brief description); in Bull. U. S. G.-G. Surv. Terr., iv, 1878, pp. 112, 132 (references, etc.); in Amer. Entomol., iii, 1880, p. 50 (habit).
- ZELLER: Beitr. zur Kennt. nordamer. Nachtf., iii, 1875, p. 147 (critical remarks).
- LINTNER: in Connt. Gent., lxx, 1880, p. 263 (general notice).
- BARNARD: in Amer. Entomol., iii, 1880, p. 76 (cocoon).
- WALSINGHAM: in Trans. Amer. Ent. Soc., x, 1882, p. 204 (synonymy, etc.).

It is but recently that this species has attracted attention as an insect pest, and as yet its injuries have not become very serious; but as it appears to be upon the increase, it is quite important that a knowledge of it should be diffused in order that means may be resorted to that its distribution may be checked before it shall become decidedly noxious.

Its Several Stages.

It first arrests attention during its pupation when its numerous small white cocoons may be observed thickly clustered upon the smaller twigs of the apple-trees. The cocoons, which, from their small size, are often mistaken for insect eggs, are spun by a little caterpillar which makes its appearance upon the young leaves soon after they unfold, in the month of May. The caterpillar is said, by Chambers, at first to mine the inner substance of the leaf, and later to operate as an external feeder. It is sprightly in its motions, and readily disturbed, when it drops from the leaf and hangs suspended by its silken thread, until the cause of its alarm has ceased. It is described by Dr. Clemens as of a cylindrical form, tapering somewhat at the ends, with its joints so rounded as to resemble a series of strung beads, of a dark yellowish-green color, tinged with red on the front segments, and with scattered, short, black hairs, which are more numerous on the back of the first segment. Its head is small, of a brown color, and ellipsoidal in shape. It has the usual number of feet (sixteen), viz.: three pairs of true legs (thoracic), four pairs of very short abdominal legs and one terminal pair (prolegs). At maturity it measures about one-half of an inch in

length. It attains its growth during the early part of June, when it



spins its cocoon, usually upon the surface of the bark, and, unless it occurs very abundantly, at or near the branching of the twigs.

The cocoon, shown at *a* in its natural size, almost covering a small twig, and at *b* enlarged, is white or whitish, about one-fourth of an inch in length, of the diameter of

an ordinary pin, and is characterized by several prominent longitudinal ribs; in some examples before me, there are six of these ribs. When ready for its transformation, the amber-brown pupa, according to Riley, pushes itself partly out of the cocoon, and the little moth emerges during the month of April, and deposits its eggs on the young leaves. The moth is of so small a size — but a little more than one-fourth of an inch in expanse of wings — that it would not readily be noticed even when in flight about the apple-trees. Its appearance, enlarged, is shown at *c*, in Fig. 41.

There are two, and possibly three annual broods of this insect. In the latitude of St. Louis, Mo., the caterpillars have been observed more numerous during the month of September than at any other time. The cocoons of this brood were spun during the latter part of this month and in October, from which the moth would be produced the following April.

Geographical Distribution.

The insect appears to be local in its nature. Nearly all the notices of it within this State have come from its western portion. A correspondent of the *Rural New Yorker* (in 1870) states that in visiting an orchard of 800 apple-trees in Brighton, near Rochester, his "attention was directed to the branches of the trees, which were thoroughly lined with these insects inclosed in the silk-like cocoons, and tightly attached to the small branches." A correspondent of the *American Entomologist*, writing from Scottsville, Monroe Co., N. Y., records their introduction into his orchard: "They were first observed here last year [1879]. They are deposited on the bark near the forks, and number from two to twenty per tree." At Ithaca, N. Y. (midway between the eastern and western limits of the State), they have been observed scattered sparingly over the branches — not in groups, as in the western counties.

The species occurs in remote portions of the United States. Inquiries in relation to it have been received by me from Massachusetts. A specimen of it, collected in Texas, is in the Cambridge (Mass.) Museum, and it occurs also in Missouri, in the vicinity of St. Louis.

Parasites.

The ravages of this pest have already received quite a check from parasitic attack. Small as the insect is, there are insects still more minute which are specially adapted for seeking it out and preying upon it.

In the 4th Report on the Insects of Missouri, 1872, p. 51, mention is made of a minute Chalcis-fly, allied to the genus *Eulophus*, preying upon the apple-leaf Bucculatrix, many of the cocoons having been found with minute round holes at one end, through which the parasites had emerged.

A number of Chalcids were bred by me in 1880, from some Bucculatrix cocoons received from Western New York, which were believed to be the same as those above referred to. Some of them were accordingly forwarded to Professor Riley for comparison with the examples obtained by him. They proved to be identical, and to belong to the genus *Cirrospilus*; and as Professor Riley had been studying the species, he has kindly given me the manuscript of its description, together with an excellent figure of it, for publication in the present notice.

CIRROSPILUS FLAVICINCTUS Riley, nov. sp. (Fig. 42.)

Male.—Length, 1.3 mm.; expanse, 2.8 mm. Antennæ seven-jointed; scape originating low down, as long as three succeeding joints together, which are subequal; no ring-joints; club rather longer than preceding joint, one-third broader,

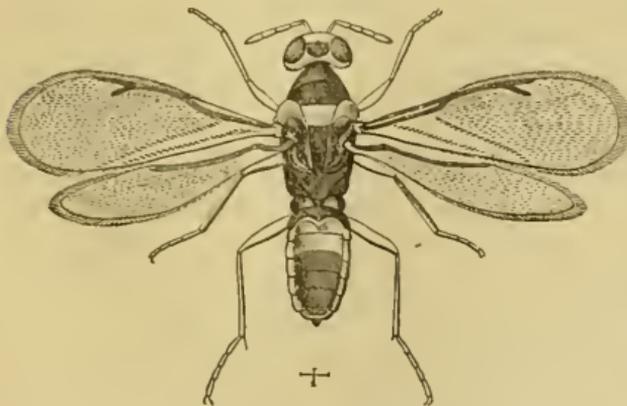


FIG. 42.—The *Cirrospilus* parasite of the apple-leaf Bucculatrix: the natural size shown in the hair-lines.

with the two divisions faint. Body polished and very finely imbricate above. Color bright yellow, prettily marked with black, having a blue metallic reflection, especially on the thorax as follows: antennal articulations, especially at the base of pedicel (joint 2); the eyes and top of head between them; the thorax above except

a broad transverse band including two joints next the base, the upper surface of the hind coxæ and (in one specimen) the terminal half of the hind tibiae. Tips

of all the tarsi slightly dusky. The yellow band on the abdomen and the antennæ less bright than the rest. Ocelli, brown.

Female.—Length, 1.6 mm.; expanse, 3.3 mm. Differs from male in having only a mesoscutal yellow spot, a narrow yellow line around inside of eyes and the legs yellow, except hind coxæ, femora above, and tips of tarsi. The antennæ are more hirsute, slightly shorter and yellowish-brown, with scape black. The thorax has a distinct bluish hue.

Described from one male and one female received from the late B. D. Walsh, bred by him, in May, from *Bucculatrix pomifoliella*; two males, from Professor J. A. Lintner, bred from same species, and two males and two females, bred by myself, between March and July, 1874.

Professor Riley has also bred another parasite from the *Bucculatrix*, also one of the *Chalcididæ*, belonging to the *Encyrtinæ*. This subfamily embraces a large number of small, active Chalcids, many of which are of special value to us from the predilection which they show for attacking the various and destructive species of bark-lice. Mr. L. O. Howard, of Washington, has recently described eleven new species of this group,* which are parasitic on *Coccidæ*; while in Europe a publication upon the group, by Dr. Mayr, in 1875, shows the following great preponderance of the bark-lice parasites: one species upon a hymenopterous insect, two upon Coleoptera, four upon lepidopterous eggs, and sixteen upon lepidopterous larvæ, four upon Diptera, one upon aphides, and *thirty-nine upon bark-lice*—these last being over fifty-eight per cent of all the known species.

This second parasite has been described by Mr. L. O. Howard, to whom I am indebted for the following description and figure and the permission to publish them:

ENCYRTUS BUCCULATRIX Howard, nov. sp. (Fig. 43.)

Female.—Length of body, 1.2 mm; expanse of wings, 2.5 mm. Greatest width of fore-wing, 0.35 mm. Antennal scape slightly widened below the middle;



FIG. 43.—The Encyrtus parasite of the Apple-leaf *Bucculatrix*; enlarged to about fifteen diameters.

pedicel as long as succeeding three joints; funicle joints gradually increasing in length and thickness; club, long, oval, as long as preceding four joints together. Wings, perfectly clear; marginal, post-marginal and stigmal veins extremely short. Ovipositor slightly exerted. Head slightly punctured, thorax very slightly shagreened; abdomen smooth. Color black, with a slight lustre, especially upon cheeks, mesoscutellum and hind coxæ. Middle legs with trochanters, femero-tibial articulations, a mesial tibial band and the distal ends of tibiæ, including spurs, whitish; front and hind legs the same, with the exception of the mesial tibial band; all tarsi whitish, often with a yellowish tinge; antennæ, except scape, yellowish-brown with gray hairs.

*Report *Commis. Agriculture* for 1880, pp. 360-367.

Described from many female specimens; male, unknown. Parasitic upon *Bucculatrix pomifoliella* Clem.

Mr. Howard also informs me that in examining a bottle of alcoholic specimens of the above species in Professor Riley's collection, he had found a number of examples of a Chalcid which he thought might be also parasitic upon *Bucculatrix pomifoliella*, or a secondary parasite. The material was in too poor condition for determination and description. One specimen of a Braconid had also been found in the collection, marked "parasitic upon *Bucculatrix pomifoliella*."

Psocus Bred from Bucculatrix Cocoons.

Two specimens of *Psocus* were also received by me from Professor Riley, which he had bred from the Bucculatrix. They were sent to Dr. Hagen for determination, and were found by him to be identical with *Psocus semistriatus* Walsh (*Proc. Acad. Nat. Sci. Phila.*, 1862, p. 361), as compared with types in the Museum received from Mr. Walsh. Possibly, *P. semistriatus* may prove to be the same as *P. quietus*, which had been previously described by Dr. Hagen from an example from the State of New York and another from Georgia (see *Proc. Ent. Soc. Phila.*, 1863, p. 167).

It is probable that this *Psocus* is not a true parasite upon the Bucculatrix, but is associated with it as a scavenger, feeding upon the exuvia of the larva. Dr. Hagen has written me as follows of these *Psocina*: "No Orthopteron nor Pseudoneuropteron has been observed to live as parasites, and I think that they are not parasitic. But certain species prefer to live as *inquilines*, and one species was described by Linnæus, more than a century ago, as Hymenopteron. Some species of *Cæcilius* and *Elipsocus* live here and in Europe in willow and oak galls. Two species were brought from Brazil by Mr. B. P. Mann, which he considered as parasites of the coffee-leaf miner. Such *Psoci* like to feed on cast skins; and, perhaps in the case of *Psocus semistriatus*, on the dry skins of the Bucculatrix caterpillar, as my experience has shown me the fondness of many *Psoci* for larval skins."

The *Psocidæ* are a low form of insects constituting a family in the division of Pseudoneuroptera. They are small forms, measuring in length from 1 mm. to 8 mm.: *Psocus venosus*, our largest species, which lives on apple and maple trees, has an expanse of wings of from 12 mm. to 15 mm. (about 0.5 to 0.6 in.). They occur in both the winged and wingless states, and somewhat resemble plant-lice in general appearance. The larger number feed on dry vegetable substances and lichens. They are quite common, and may be often found congregated in large companies on trunks of deciduous trees and among the herbage of some of the evergreens; they also frequently occur in houses. *Atropos divinatorius* (O. Fabr.), originally described from

Greenland, may often be found in books and in insect cases; it has been discovered in the Mammoth Cave, Kentucky, upon animal remains.* *Clothilla pulsatoria* (Linn.), known in England as the "death-watch," from the ticking sound made by it, and *Psocus domesticus* Burm., also infest collections of natural history. In Hagen's *Neuroptera of North America*, of the sixteen species of *Psocus* described, nine are credited to the State of New York. Later studies have changed the generic references of several of these, and other species of *Psoci* occurring in New York have since been described.

Remedies.

When the apple-leaf *Bucculatrix* occurs abundantly upon young trees, if the trees are given a sudden jar, when the caterpillars have about attained their growth, at some time during the months of May and September, large numbers of the caterpillars which drop from the leaves and hang suspended by their silken threads can be swept upon a broom and crushed, or scalded in hot water. The application of kerosene oil, diluted with hot soap-suds, to the cocoons, by means of a force-pump and spray-machine or atomizer, has been recommended. If applied during the month of March or April, when the circulation of the sap has commenced, the chance of injury to the tree will be less. Linseed oil might also be employed, but would not so readily penetrate the cocoons to the inclosed pupæ, which must be reached in order to prove effectual.

If the limited number of the cocoons admit of their removal by scraping them from the twigs, this would be the better method to employ. Their white color at once discloses their presence, and serves to show when their complete removal has been effected.

Mr. Chambers, in a late communication to the American Entomologist (*loc. cit.*), expresses his belief that the destruction of the pupæ within their cocoons upon infested apple-trees, by spraying them with oil, may not place the insect within our control, for the following reason: He had found as many as twenty of its cocoons in a cluster on elder (*Sambucus*), at least fifty yards distant from the nearest apple-tree, and there were no indications, or was it probable, that the larvæ ever fed upon the leaves of the elder. The species, therefore, shared the habit not uncommon in *Bucculatrix* larvæ of deserting their natural food-plant when mature, and wandering elsewhere to spin their cocoons. Mr. Chambers suspects that *Bucculatrix thuiella*, found by Dr. Packard on *Thuja*, may only have wandered thither from some other food-plant, as it was not observed as depredating on the cedar:†

*Hubbard: in *American Entomologist*, iii, 1880, p. 89.

†*American Naturalist*, v, p. 149; *American Entomologist*, iii, 1880, p. 50.

Coleophora malivorella Riley.*The Apple-tree case-bearer.*

(Ord. LEPIDOPTERA: Fam. TINEIDÆ.)

RILEY: in Ann. Rept. Commis. Agricul. for 1878, (1879), pp. 208, 253, 254, pl. vii, f. 1 (description, natural history, etc.): also, the same in Rept. of the Entomol., Aug. 1879, pp. 3, 48, 49, pl. vii, f. 1.

CHAMBERS: in Bull. U. S. G.-G. Surv. Terr., iv, 1878, p. 93 (as *C. multipulcella*, *auct.* Walsingham).

LINTNER: in 39th Ann. Rept. N. Y. St. Agricul. Soc. for 1879, (1880), p. 52, figs. *a-d* (history, etc.); in Count. Gent., July 6, 1882, xlvii. p. 533.

BARNARD: in Proc. Amer. Assoc. Adv. Sci., xxviii, 1880, p. 477, pl. "Insect Habits," f. 8 (case not identified).

WALSINGHAM: in Trans. Amer. Ent. Soc., x, 1882, p. 194 (synonymy, etc.).

This species has recently proved quite destructive to apple-trees in a portion of Pennsylvania, adjoining the western boundary of New York, where it has entirely destroyed the leaves of many trees. The first public notice that we have of it is that of Professor Riley, in his Annual Report as Entomologist of the U. S. Department of Agriculture, in 1879, where its history is given, partly from actual observation, and in part drawn from the known habits of a closely allied European species, *C. anatipennella*.

The Several Stages of the Insect.

The new depredator is the larva of a small moth belonging to the family of *Tineide*. The caterpillar, shown at *b* in the accompanying

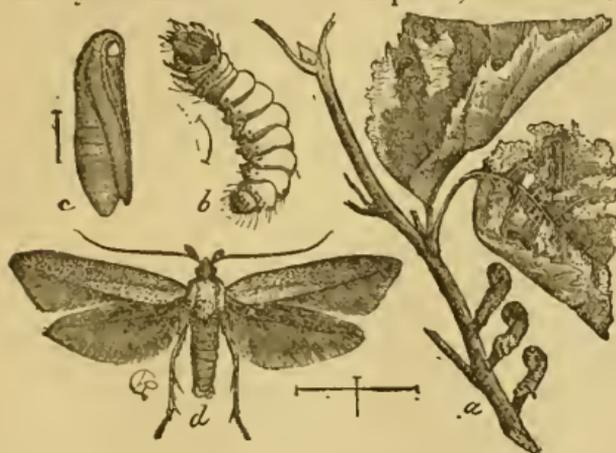


FIG. 44.—The apple-tree case-bearer, *COLEOPHORA MALIVORELLA*.—*a, a*, the cases containing the larvæ, shown in natural size; *b*, larva, enlarged; *c*, pupa, enlarged; *d*, the moth, enlarged. (Riley).

figure (its natural size indicated by the hair-line beside it), is about one-sixth of an inch in length, of a yellowish color, with a large black head, with its legs yellow and tipped with black, and its last two segments covered with brown granulations and bearing some long hairs. The moth represented at *d* (three times the natural size) is about one-half of an inch in expanse; its pointed and long-fringed wings are mouse-colored, with some white scales near the base. The tip of the abdomen and the legs are white. The pupal

form is seen at *c*. At *a*, *a*, *a*, are shown the peculiar pistol-shaped cases, sheltering the larvæ, composed of silk, bits of leaves and excremental matter, which the caterpillars construct for their protection, and which they carry about with them during their period of activity, serving also for a winter retreat and for pupation. The smaller cases upon the leaves show, in connection, the character of the larval injuries at different stages of growth.

The following detailed account of the caterpillar and of the moth is that of the original description:—

Description of the Larva and Moth.

Larva—Length 4 mm. Color pale yellowish, often with faint roseate hue. Head retractile, large, black, granulated, and with a few rather long hairs at the sides; median suture white; antennæ 4-jointed, yellow, with the base of each joint white, the two basal joints equal in length, the third and fourth each one-half as long and more slender; a long bristle arises from the apex of the second joint. Prolegs brown with the tips whitish; thoracic legs yellowish with the claws blackish. Thoracic joints each with a blackish, strongly granulate chitinous patch at the lateral projection, the mesothoracic joint having also two narrow black transverse dorsal spots posteriorly, and a subdorsal yellowish spot of a similar nature. The two anal joints are covered with brown granulations and furnished with rather long hairs.

Imago—Female:—Expanse 14 mm. Head, face, and palpi white. Antennæ white annulated with fuscous; basal joint with a long tuft of intermingled white and fuscous scales reaching to the sixth joint. Primaries fuscous (mouse-color more nearly), with many white scales at the base, especially behind the median vein. Cilia fuscous; secondaries fuscous; thorax white, with a few fuscous scales. Abdomen with the anal tuft whitish. Legs white with a ring of fuscous at the base of each tarsal joint.

Male:—Expanse 12.5 mm. Differs from the female in the head, face, and palpi being fuliginous, and in having no tuft on the basal antennal joint; also, in being somewhat darker, the wings usually lacking the white basal scales, and the legs being more grayish.

Natural History of the Insect.

The history of the insect, as given in the report above cited, is as follows: The parent moths appear abroad during the latter part of July, and deposit their eggs on the under side of the apple leaves. The larvæ hatch in September, and commence to feed upon the under surface of the leaves. They are of the kind known as case-bearers, as they construct for their protection and occupation cases composed of silk, bits of leaves, and their excrementa, which they carry about with them, thrusting out their anterior segments for the purpose of feeding. The cases have a peculiar curve at their posterior end, like the handle of a pistol. At the advent of winter they retreat within their cases, which they attach to the twig, and the less than half-grown caterpillar passes the winter in this condition. At this stage, the cases

measure about one-tenth of an inch in length, and are more curved at their end than the mature form. From their small size and a color almost the same as that of the bark to which they are attached, they are not readily noticed.

In early spring, the larvæ awake from their winter sleep, and transport themselves to the swelling buds, upon which they commence to feed. The leaves, as they develop, are attacked in turn, and where the insect abounds, they are rapidly devoured. The younger trees show branches which have been entirely defoliated, while others are left leafless from the destruction of the buds. The young fruit is also eaten into, until barely a shell of it is left.

About the middle of June, the larvæ attain their growth, when they cease feeding, and fasten their cases to the twigs, and, within them, transform to the pupal state. Their pupation lasts for about three weeks, when the perfect insects emerge, and deposit their eggs upon the leaves, as before stated.

Its Operations in an Orchard.

The operations of this insect pest were first noticed in 1877, in the orchard of Mr. William Fairweather, of the Densmore Apple Farm, at McLane, Erie county, Penn. In that year he reports that of the 8,000 trees in his orchard, there was scarcely one which was not more or less affected. On some of the smaller trees, the leaves were completely skeletonized. The following year, the ravages were still more destructive, and large numbers of trees were rendered nearly leafless. In 1879, as I learned from Mr. Fairweather, the injuries were less than in the two preceding years, but from the number of cases observed upon his trees at the time of writing (Jan. 17, 1880), he greatly feared that they would again be in full force the coming summer, and extend their operations "to an extent sickening to think of." A tree from which he sent me some twigs thickly studded with the cases, had, he thought, enough of the insects upon it to eat up every leaf as it appeared.

From a communication in relation to this insect subsequently received from Mr. Fairweather, he informed me that the fears above expressed were not realized. Its ravages were not increasing, and during the years 1880 and 1881, its depredations in his orchard had not been serious.

Attack of a Chalcid Parasite.

Mr. Fairweather ascribes the diminution of the injuries to the beneficial results of an attack which had been made upon the pest by a small parasite, examples of which he had hatched from some pupæ of the moths inclosed in a glass jar, and which he found to be "a small and lively insect like a black ant, but less in size, and with wings."

This parasite is probably the one referred to by Professor Riley, as "a minute Chalcid fly, which has increased to such an extent since the ravages of the *Coleophora* became apparent on Mr. Fairweather's place, that it bids fair to render additional remedies unnecessary. The specimens sent in 1877 were not parasitized; those sent in 1878 were about half of them affected, and of twenty-four specimens received in March, 1879, seventeen [over seventy per cent] had been destroyed by this little fly." The species has not, so far as I know, been determined.

It is somewhat strange that this insect does not appear to have extended its depredations to any of the orchards in the immediate neighborhood of the Densmore Apple Farm.*

Other Case-bearers.

In vol. xxviii of the *Proceedings of the American Association for the Advancement of Science* (1880), Professor W. S. Barnard has figured what is, without much doubt, the case of this insect, which had been found by him upon chestnut, near Ithaca, to which it may have strayed from the apple, after the habit of *Bucculatrix pomifoliella*. In the same paper, the singular cases of several other *Coleophora* are described, one of which, occurring on a species of rush growing on woody knolls, is illustrated and its interesting peculiarities described at length. Another case, which had appeared late in autumn very plentifully on some of the apple-trees about Ithaca, of which the insect hibernates on the lower side of the branches in a small, flat, obovate purse which is pendant to the bark by a small mass of silk, is the *Aspidisca splendoriferella* Clem., or the Resplendent shield-bearer. An extended account and full illustration of this species, by Professor Comstock, may be found in the *Report of the Commissioner of Agriculture* for the year 1879 (pp. 210-213, pl. 2, f. 2).

Remedies.

Whenever, from absence of parasitism, or other cause, this little pest (called by one of my correspondents, in consideration of its minute size and its serious ravages, the "*multum in parvo*") becomes injuriously numerous, it may doubtless be controlled by the use of Paris green or London purple. The former, Mr. Fairweather, thinks too expensive in cost of material and labor of application for employment in an orchard of the extent of his, numbering six thousand trees; but although the protection of large orchards necessarily involves large expenditures for material and labor, yet it should be borne in mind, that the percentage of cost to each tree protected is no greater when ap-

*As I learn from examples sent to me by Mr. C. E. Cook, of South Byron, Genesee county, N. Y., the insect, at the present time (June 20, 1882), is infesting the apple-trees of his orchards, to quite an injurious extent. He had not detected its presence previous to the present season.

plied to ten than to a thousand, and if it pays to employ remedial measures on a small scale, it will, at the least, prove equally profitable on a larger scale.

London purple would probably be quite as valuable in protecting large orchards as the more costly Paris green. Its much less cost would permit of its more thorough and frequent use, and it seems also to possess the additional recommendation of being absorbed to a greater degree by the leaves. It could be conveniently applied by means of the forcing pump (illustrated on pages 29 and 30), throwing the liquid from a barrel placed on a wagon and drawn through the orchard. The efficacy of this material in preventing the ravages of the Codling moth of the apple has been tested by Professor A. J. Cook, and its use for the purpose was strongly recommended by him, and sustained against adverse criticisms, at the Cincinnati meeting of the American Association for the Advancement of Science. Young apple-trees which had been treated by this method had given fine crops of sound fruit, which had been freely eaten by himself and family without any injurious results. The quantity of London purple used was a table-spoonful to a pail of water, which was found to answer for three trees. In using it against the case-bearer, a large amount of the liquid should be thrown upon the tree, as it would need to be very generally distributed in order to reach all the buds or the foliage.

As a general rule, the best time to attack our injurious insects is when they are just from the egg, and so delicate that they may be easily destroyed. The young caterpillars of the case-bearer emerge from the eggs during the month of September. It would not be prudent to apply the poison at this time, except to trees bearing early apples from which the fruit had been gathered. Even to these, it would require a large amount of liquid to reach all the leaves of the tree upon which the young larvæ might be feeding. Beyond this, the feeding done by them before retiring, less than half-grown, within their cases for hibernation, would not be of any appreciable injury. The proper time, therefore, to use the poison is when the larvæ have awakened from their winter's sleep, and are resorting to the buds to resume their feeding. This can easily be ascertained by observation, and careful inspection of the infested trees should be made during the first warm days in early spring, as soon as the first insects are seen upon the wing. If at this time, all the expanding buds be sprayed with the liquid, and the operation be repeated two or three times at intervals of a week or after rains, during the opening of the buds and the unfolding of the leaves, very few of the case-bearers will be spared to continue their ravages, and to complete their transformation to the perfect moth, laden with eggs for the perpetuation of the pest in another brood.

INJURIOUS DIPTEROUS INSECTS.

ON SOME SPECIES OF ANTHOMYIIDÆ.

The opportunity of observing, during the past summer, the several stages and transformations of some species of *Anthomyiidæ* which had not been known to us in this country before, has led me to an examination of the histories of the allied species; and as some of them merit special consideration from their depredations upon important crops, and one, from the material aid rendered by it in the destruction of the Rocky Mountain locust, it is believed that a notice of the several species, presenting the latest discoveries in relation to their history, their present accepted nomenclature, and the best means of preventing their injuries, may prove convenient for reference, and of service to the student and agriculturist. Some general remarks respecting the family to which they belong and their classification may serve as a fitting introduction to specific details.

Habits of the Anthomyiidæ.

The *Anthomyiidæ* have been so named (from *anthos*, flower, and *muia*, fly) from their habit of frequenting various flowers, particularly those of the *Umbelliferæ* and *Compositæ*; but as there is another group of flies, known as the *Syrphidæ* — prettily variegated in yellow and black, and many of them bearing resemblance to bees, wasps and hornets, which are pre-eminently flower visitors for feeding on their pollen or nectar — the designation of “flower-flies” may properly be reserved for them. The Anthomyians, in addition to their love of flowers, have also their seasons for idle sporting, and large companies are at times to be seen indulging in aerial dances, after the manner of some of the gnats. Their larvæ (naked, footless forms, often spoken of as “maggots”) feed usually on living vegetable matter, as the roots of plants and the inner tissue of leaves, but some of the species find their nourishment in decaying vegetable matter and in manure. In the genus *Homalomyia*, where the species live in wet, decomposing vegetable and animal matter, that their respiration may be the better maintained in such situations, they are provided, in the place of the ordinary spiracles or breathing-pores, with lateral branchiæ or gills, which, as in the fishes, permit the air to be extracted from the surrounding fluids. Some of the species of this genus, as *Homalomyia canicularis*, and the “privy-fly,” *H. scalaris*, which occur in both Europe and North America, are recorded as having been, in a number of instances and sometimes in large numbers, discharged from the human

stomach and intestines, where they may have been introduced in incautiously eating decaying fruit and vegetables. A list of one hundred and eight instances in which insect forms have been discharged from the human body, was published forty years ago;* among these were several of *Homalomyia*. A list of twenty such discharges from the urethra has been collected and published by Dr. Hagen,† but the reliability of the testimony upon which most of them rest is questioned by the author of the paper, and it is thought that not one had been proved by indubitable evidence.

Characteristic Features of the Anthomyiidæ.

Structurally the Anthomyians are closely allied to the typical species of the family of *Muscidæ*, which embraces our common house-fly, the meat-fly, the blow-fly, etc., from which family they were separated by Meigen, in 1838. An obvious difference between the two is to be found in the neuration. Fig. 45 represents the neuration of the *Anthomyiidæ*, as it occurs in the wings of the Onion-fly, *Phorbia ceparum*. The veins and cells are indicated by numerals and letters, and the terminology given below is that of Osten Sacken. The venation of the

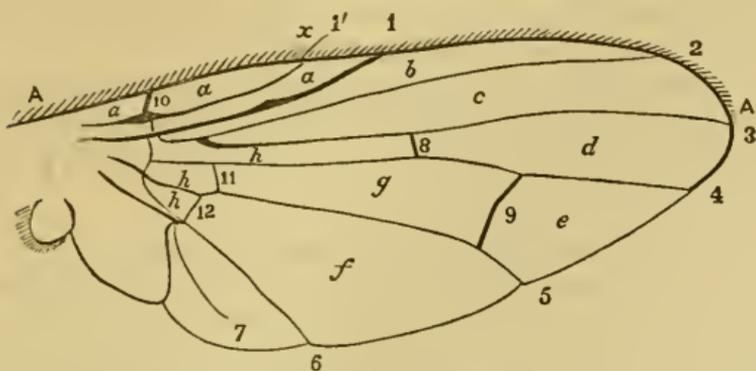


FIG. 45.—Enlarged wing of the onion-fly, *PHORBIA CEPARUM* Meig.—A A, costal vein; 1', auxiliary vein; 1, 2, 3, 4, 5 and 6, first, second, third, fourth, fifth and sixth longitudinal veins; 7, axillary vein; 8, middle transverse vein; 9, hinder transverse vein; 10, transverse shoulder vein; 11, anterior basal transverse vein; 12, posterior basal transverse vein; a, a, a, first, second and third costal cells; b, marginal cell; c, submarginal cell; d, e, f, first, second and third posterior cells; g, discal cell; h, h, h, first (the large upper), second and third basal cells; i, anal or axillary corner of the wing; j, alar appendage (alna); k, axillary incision. (For the last three, see Fig. 46.)

*On the Insects and their Larvæ occasionally found in the Human Body. By Rev. F. W. Hope. *Trans. Entomolog. Soc., London*, ii, 1840, p. 256.

†On Larvæ of Insects Discharged through the Urethra. By Dr. H. A. Hagen. *Proc. Bost. Soc. Nat. Hist.*, xx, 1878, pp. 107-115.

Muscidæ is shown in Fig. 46, drawn from *Calliphora vomitoria*, the common blue meat-fly of butcher's-stalls and occasionally of our houses. The references to veins and cells are the same as in the preceding figure. From a comparison of the two it will be seen that they differ mainly in the shape of the first posterior cell, *d*, which in the *Anthomyiidæ* is quite open, instead of being nearly closed at the

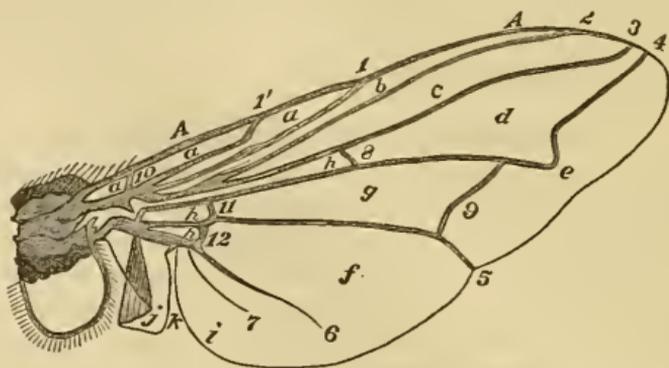


FIG. 46.—Enlarged wing of the Blue meat-fly, *CALLIPHORA VOMITORIA*: the veins and cells are numbered and lettered as in Fig. 45.

wing-margin, as in *Muscidæ*, by the sudden bending up of the fourth longitudinal vein when near the margin, and running obliquely upward to very near the termination of vein 3.

The *Anthomyiidæ* are further distinguished by a transverse suture (impressed line) crossing the thorax, and by their tegulæ (the covering scales of the spiracles of the hinder thorax) being rather well-developed, although frequently not very large in size.

The Anthomyiidæ an Extensive Family.

The family is a numerous one. Baron Osten Sacken, in his Catalogue,* records one hundred and thirty-nine North American species (including above fifty of Walker's unrecognized species), belonging to twenty genera. Later, Mr. R. H. Meade, of England, who has been making special study of the family, has enumerated one hundred and forty-one species, in nineteen genera, from material sent to him from the Museum of Comparative Zoölogy at Cambridge, Mass.,† which, with others in the Museum not seen by him, and those to be noticed in the present report, gives, so far as recognized at the present, one hundred and thirty-six North American *Anthomyiidæ*. Of these, no less than thirty-five species are accepted as identical with European ones.

*Catalogue of the Diptera of North America. By C. R. Osten Sacken, Washington, 1878, 8vo, p. 276.

†List of North American Anthomyiidæ, examined by R. H. Meade, Esq., Bradford, England. By Dr. H. A. Hagen.—*Canad. Entomol.*, xiii, pp. 43-51, 1881.

The New York Species of the Family.

Five species of the interesting genus of *Homalomyia* Bouché, to which reference has been made (four included in the Meade list) occur in the State of New York. The first two mentioned are the more common. The first, from its being so frequently found in houses, has been called the "lesser house-fly," *Musca domestica minor* De Geer; the second has received its common name of the "privy-fly" from its larva occurring in human excrement, particularly in the contents of old vaults. The larvæ of this genus are not rounded forms as in *Anthomyia*, but have flattened bodies, as indicated by the generic name, and also in their popular name of "flat-flies." An excellent paper upon these forms may be found in the *American Entomologist*, vol. ii, pp. 137-141, from the pen of Mr. Walsh, published after his death. The species are the following (the Meade numbers are prefixed to those seen by him) :—

- 44. *Homalomyia canicularis* (LINN.). New York and Mass.
- 45. *H. scalaris* (FABR.). N. Y., Penn., Mass., Me.
- 46. *H. prostrata* (ROSSI). N. Y., Mass.
- 50. *H. sp. indet.* N. Y., Greenland.
- *H. tetracantha* LOEW. Middle States.

Of the genus *Anthomyia* Meig., the larvæ of which are naked, not having the branching lateral appendages of the preceding genus, the following New York species are recorded :—

- 57. *Anthomyia latitarsus* SLÆG. and ZETT. N. Y. and N. Hamp.
- 59. *A. sp. indet.* Similar to *A. pluvialis*, of Europe.
- *A. brassicæ* BOUCHÉ. Perhaps same as *A. ruficeps* MEIG.
- *A. ceparum* BOUCHÉ.* Same as *A. antiqua* MEIG., auct. Schiner.
- *A. raphani* HARRIS. Perhaps same as *A. radicum* LINN.
- *A. similis* (FITCH). Similar to *Hylemyia deceptiva* FITCH.

In *Hylemyia* DESV., of the fourteen species indicated, four are from New York, viz. :—

- 60. *Hylemyia sp.?* N. Y., N. J., and British America: apparently abundant.
- 61. *H. sp.?* N. Y., Conn., and N Hampshire.
- 62. *H. deceptiva* FITCH. N. Y., Hudson's Bay, and Arctic America.
- 63. *H. tarsata* SK. N. Y. and Ill. Perhaps *A. alcatheæ* WALK.
- 64. *H. sp.?*: also 65 and 67, sp. indetermined. Two other species are from Canada and New Hampshire and are probably to be found in New York.

Twenty-two species are referred to the genus *Chortophila*, of which nine are credited to New York, and eight additional ones from localities so near, as Canada, Massachusetts and Connecticut, that they may be presumed to occur also in New York. Many of the species are small and some are known to have an extensive distribution, ranging from the District of Columbia to the Arctic regions.

*Since the publication of this paper, the species has been removed to the genus *Phorbia*, as will be noticed hereafter.

In other genera of the family, fifteen species are enumerated from the State of New York: in all, forty-one species, distributed in eleven genera. Many others are undoubtedly to be discovered, as additional attention shall be paid to them. They are extremely difficult of study, from their close resemblance to one another. The females of several of the species are so much alike that they can scarcely be determined unless their males occur with them.*

Phorbia ceparum (Meigen).†

The Onion-fly.

Ord. DIPTERA: Fam. ANTHOMYIIDÆ.

- BOUCHÉ: *Natursgeschichte der Insecten*, 1834, p. 73.
- WESTWOOD: in *Loudon's Mag. Nat. Hist.*, vii, 1834, p. 425; in *Gardener's Mag.*, xiii, June, 1837, p. 241; *Introduc. Class. Ins.*, ii, 1840, p. 570, f. 132, 3-6.
- KOLLAR: *Ins. Inj. to Gardeners, etc.*, 1840, pp. 157-9 and figures.
- HARRIS: *Rept. Ins. Mass.*, 1841, p. 415; *Treat. Ins. New Eng.*, 1852, p. 495; *Ins. Inj. Veg.*, 1862, p. 617, f. 272 (habits, but another fly described).
- CURTIS: in *Gardener's Chronicle*, 1841, p. 396 and figures: *Farm Insects*, 1860, p. 145 (mention).
- KIRBY-SPENCE: *Introduc. Entomol.*, 1846, p. 141 (brief mention).
- GLOVER: in *Rept. Commis. Agricul. for 1864*, p. 563 (remedies); *Rept. for 1867*, p. 73 (mention); *Rept. for 1872*, p. 133 (history and remedies); *MS. Notes Joura.—Entomolog. Index*, 1877, p. 5 (references).
- WALSH: in *Pract. Entomol.*, i, 1865, p. 20 (remedy); *Id.*, ii, 1867, p. 64 (brief notice).
- SLADE: in *Rept. Commis. Agricul. for 1865*, p. 238 (with notice of onion and culture).
- FITCH: in *Ann. Reg. Rur. Aff.*, v, 1867, p. 91; *Eleventh Rept. Ins. N. Y.*, in *Trans. N. Y. St. Agricul. Soc. for 1866*, xxvi, 1877, pp. 487-494, figs. 1-5 (habits, transformations and remedies).
- BOISDUVAL: *Entomol. Hortic.*, 1867, p. 611.
- PACKARD: *Guide Study Ins.*, 1869, p. 411, f. 332 (larva and imago); *Second Rept. Ins. Mass.*, 1872, p. 8; in *Hayden's Ninth Rept. G.-G. Surv. Terr.*, 1877, pp. 740-743, pl. 67, f. 1 (transformations and remedies).
- DODGE: in *Rept. Commis. Agricul. for 1869*, pp. 224-226 (natural history and remedies).
- RILEY: in *Amer. Entomol.*, ii, 1870, p. 110, f. 72 (an imported insect).
- ORMEROD: *Rept. Inj. Ins. for 1877*, p. 7; *Id. for 1878*, p. 7; *Id. for 1879*, p. 12; *Id. for 1880*, pp. 15-18; *Id. for 1881*, pp. 35-38; *Mannual Inj. Ins.*, [1881], pp. 123-129 and figures (habits, history, preventives and remedies).

*The reverse of this is seen among some of the Hymenoptera. "In the Vespidae, there exist a number of species of which the males resemble one another so far as not to be distinguishable. * * * There is a whole category of species of the genus *Elis*, of which the females offer differences the most extreme, but of which the males are so confounded that they cannot be distinguished from each other (Dr. de Saussure, *Synopsis of American Wasps*, 1875, p. xviii).

†The *Anthomyia ceparum* of all the following citations except the last.

OST. SACKEN: Cat. Dipt. N. Amer., 1878, p. 168 (references), p. 258 (note).

BETHUNE: in Ann. Rept. Ent. Soc. Ontario for 1880, (1881), p. 43.

MEADE: in Entomol. Month. Mag., xix, 1883, pp. 213, 218 (as *Phorbia cepetorum*).

The onion-fly has long been known to interfere seriously with the cultivation of onions. Its ravages had been noticed and recorded both in this country and in Europe, long before Bouché, in the year 1834, described it as infesting onions, and gave to it the scientific name of *Anthomyia ceparum*, which it has since borne up to the present time, and by which it has so often been presented to public notice by entomological writers.* It is not known when it was introduced in this country, but it may easily have been brought over at any time, either as larvæ feeding during the voyage, or as pupæ, since its pupal transformation often takes place within the plant. It is rather a local species, being very destructive in some localities, and almost unknown in others. It also, like many other of our injurious insects, has its periods of unusual abundance over a broad extent of territory. Thus it is recorded as having been quite destructive in the Eastern and Middle States in 1854 and again in 1863.

Its Natural History.

There are successive broods throughout the season. The first attack is made as soon as the young seedlings are an inch or two above the ground. The flies are attracted to the plants, and deposit their eggs upon the lower part of the leaves, either among them at their base, or, as frequently, along the edge of the lower leaf or sheath as shown in Fig. 49. Seldom more than a halfdozen eggs are deposited on a single plant.

The Eggs. — The eggs are white and smooth, elongate-oval in form, and of a size which admits of their being readily seen by the eye, being four-hundredths of an inch long and about one-hundredth broad. In Fig. 47 at *a* and *b* they are shown in their natural size and in enlargement. They usually hatch within a week, the time required varying with the different broods and with the temperature of the season.

The Larvæ. — The young larva, upon leaving the egg, burrows downward within the sheath, leaving behind it a discolored streak to mark its passage. It penetrates the cylindrical root, of which it consumes the interior with the exception of the outer skin. At a later stage of growth of the plant when the bulb has commenced to form, several of the larvæ may be found feeding in company. When

*According to Professor J. O. Westwood, Kirby and Spence were the first to apply the specific name to this insect. Reference is made by him (*Mag. Nat. Hist.*, vii, p. 425), to "*Scatophaga ceparum* K. and S., i, 190." This may have been in the first edition of the *Introduction to Entomology*, to which I have not been able to refer. Probably no description accompanied the name.

the bulb is consumed, they desert the plant for another, and still others in succession, as a dozen or more young onions would be needed to furnish the requisite amount of food for maturing a half-dozen of the larvæ.

The larva when full grown, shown at *c*, in the accompanying figure and at *d*, in enlargement, is nearly one-third of an inch in length. It is glossy, dull white, smooth, naked, of an elongate-conical form, with its anterior end capable of being extended, while feeding, into an acute point. At the extreme end, the two black hooks which form the cutting organs of the mouth show through the skin as a short black stripe. Near the head, the projecting breathing organs are visible. A stripe seen along the middle of its back is the alimentary vessel with its contained substance. The

FIG. 47.—Early stages of the Onion-fly: *a*, eggs, natural size, *b*, enlarged; *c*, *d*, the larva, natural size and enlarged; *e*, *f*, the puparium natural size and enlarged. (After Fitch.)

hinder end of the body is obliquely truncated, and on its flat surface are two small elevated brown points (the spiracles or breathing tubes of this extremity of the body), and on the margin are eight small projections, like teeth, of which the lower two are the larger. Slightly in advance of these latter are two small processes which appear to be of service to the larva in its travels. Some prominent folds — one on the under side of each segment — are also aids in locomotion.

Pupation.

In about two weeks in summer, the larva has attained its growth, and is in readiness for its pupation. In a number of recorded instances it has assumed this stage within the onion, but it usually withdraws itself into the surrounding ground. It has soon contracted in length and become of an oval form, moderately pointed at its anterior end, and somewhat flattened at the other, where projections resembling those of the larva may be seen. The skin has hardened and has changed to a chestnut-brown color, and in this condition resembles some of the pupal forms. It is not the pupa, however, but only its envelope or case protecting the true pupa, which, upon breaking open the outer covering a few days after its formation, would be found as a soft and white body showing the jointed abdomen, with the wings and legs of the future fly appressed to its surface. This case, which shelters the inclosed pupa like the cocoon of a moth, is known as a puparium.* It is shown in Fig. 47, at *e* in its natural size, and at *f* enlarged.

*It is described by Westwood as "of a chestnut color, having its posterior end blackish with the extremity red, and two large black spots observed in the larva; the oral tentacula are also observable at the other end, they being somewhat exerted." (*Mag. Nat. Hist.*, vii, p. 428.)

The pupa state ordinarily continues for about a fortnight in summer



FIG. 48.—The Onion-fly, *PHORBIA CEPARUM* (Meigen), enlarged.

when the front end of the puparium is broken open, and the fly emerges and escapes from the ground. The general appearance of the fly is shown in Fig. 48 (after Fitch), and in Fig. 45, *ante*, page 169, a more accurate view of the wing is given, in enlargement. The last brood of larvæ pass the winter in the pupa state, and the flies emerge in early June, or about the time when the young onions are in readiness to receive their eggs.

Commencement and Progress of an Attack.

The first indications of an attack by the larvæ upon young onions, the method of their procedure, and the progress of the injury, are so well presented by Dr. Fitch (Eleventh Report on the Insects of the State of New York, in *Trans. N. Y. State Agricul. Soc.*, for 1866, p. 489) that we give it here:—

“The first indication which we have that our onion bed is invaded by this enemy, we discover that two or three of the young plants are wilted down and lying on the surface of the ground, perhaps changed to a yellow color, and the plant next in the row to those prostrate ones probably has its lower or outer leaf similarly wilted and prostrate, although it is green and shows no wound or other indication of disease, and the other leaves of this plant are erect, and to the eye appear perfectly healthy; but on feeling them we find that they are soft and flaccid, not firm and substantial, like those of the unaffected plants. Thus by the feeling of the leaves we readily detect those plants which have worms in their roots.

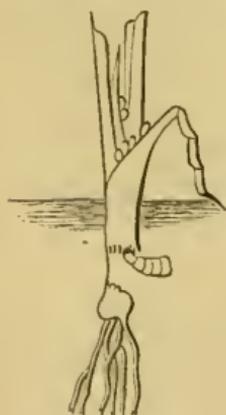


FIG. 49.—Young onion attacked by the onion-worm (after Fitch).

“On carefully digging up and examining the affected plant, if it is young and the roots small and cylindrical, we commonly find it completely cut asunder, as represented in Fig. 49, only the thin outer skin remaining, whereby the slightest pull upon the top draws it up out of the ground. Later in the season, when the round bulb is beginning to be formed, as in Fig. 50, we find a hole perforated in its side, opening into a cavity in the interior, and the earth around this perforation is wet and slimy, forming a mass of filthy mud in which those worms are lying which are not engaged in feeding. And by this interior cavity the central leaves of the plant are severed from their connection

with the fibrous rootlets, as shown in the figure, whereby it is now these central and not the outer leaves which first turn yellow and die; and all the upper portion of the root becomes soft and putrid, while the bottom part, continuing to be nourished by the fibrous rootlets, remains sound, and the worms now crowd into this part to feed, whereby it sometimes presents a wonderful appearance, being

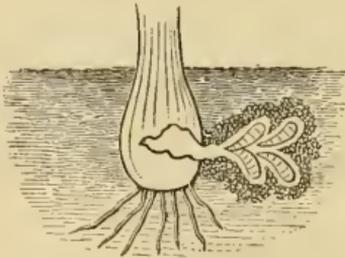


FIG. 50.— Onion bulb with the larvæ in the ground adjacent (after Fitch).

thronged with worms wedged together side by side in a compact mass, all with their heads downward, eagerly consuming the last remains of food there is there, and only the rounded hind ends of their bodies exposed



FIG. 51.— Base of an onion crowded with feeding larvæ (after Fitch).

to view, these forming an even surface similar to the cobble-stones of a street pavement, as represented in Fig. 51."

Although the onion, in all its stages and in its different varieties, is subject to attack, yet the fly occasionally selects a limited locality or even a particular onion for the deposit of its eggs. Dr. Fitch has given a remarkable instance which illustrates this selection: "An escallion, a month after it was set out, having wilted and turned yellow, the whole of its root was found to be a soft putrid mass of a most offensive smell, everywhere thronged with these maggots of all sizes, some of them newly hatched and no larger than the eggs from which they came, others full grown, and others changed to pupæ and lying in the wet dirt in contact with the root. I judged that there was upward of two hundred of these maggots in this one onion, which was little more than half an inch in thickness. And though there was now no sustenance remaining for their nourishment, unless they fed upon the putrid as well as upon the sound substance of the onion, every crevice above ground, around the bases of the leaves, was occupied with eggs to the number of about fifty, and many empty shells from which worms had recently issued. It was a mystery to me why such a multitude of worms should occur in this particular onion, and why flies continued to deposit their eggs upon it, when it was already so overstocked as to furnish no food for their young."

Insect Enemies.

No parasite is known to prey upon the onion-fly. In Europe there is a small four-winged Ichneumon fly, *Alysia manducator* Panzer, which destroys its pupa. It has not been detected in this country, but the genus is represented by at least three determined species* of

* *Proc. Entomol. Soc. Phila.*, i, p. 211, 1862.

which the habits are as yet unknown, and by several undescribed species that are to be found in our collections.

It is believed that the larvæ of the Golden-eyed flies, of the genus *Chrysopa*, are of service in destroying the eggs of the onion-fly, as they are known to devour eagerly the contents of similar eggs, and their own eggs attached to their hair-like pedicel, have been frequently seen upon the lower part of onion plants convenient to the eggs of the fly.

Preventives of Attack.

Many methods have been recommended for use against this pest. Several of them will be given, for often it is only by trial of various methods that one may be selected which will prove efficacious in a particular locality. An application which will be entirely successful under one condition of soil may be of no service whatever where the conditions are quite different; and the convenience for obtaining the materials to be employed may also vary greatly with the locality.

Kollar, in his *Treatise on Insects Injurious to Gardeners, Foresters and Farmers*, recommends as a preventive strewing the onion-bed with powdered charcoal, leaving small portions without the application, where the flies may deposit their eggs, and the infested onions subsequently taken up and destroyed by burning or deep burying.

Dr. Fitch suggests that instead of sowing onion seed in rows, where the young seedlings grown in contact, give every facility for the larvæ to pass from one to another, that they should be grown in hills of only three or four seedlings and among other vegetables, so that when the young larvæ have consumed one hill, they would be unable to travel through the soil the distance required to find another, and would, therefore, die before maturing.

Scattering dry, unleached ashes over the beds as soon as the plants are up, while they are wet with dew or from rain, and at intervals thereafter of a week throughout the month of June, has been found serviceable in preventing the deposit of the eggs upon the plants.

Miss Ormerod, of Dunster Lodge, near Isleworth, England, who, during the past few years, has published several quite valuable Annual Reports of "Notes and Observations on Injurious Insects," has given in each, such methods for the prevention of the attacks of this fly as have been tested and have yielded the best results. Among them are the following:—

Pulverized gas-lime scattered among the onions was found to act well in keeping off the insect.

Watering with the liquid from pig-styes, collected in a tank provided for the purpose, was found to answer still better.

Deep cultivation in autumn, with a good manuring and sowing in drills on a firm, well-trodden surface in spring, insured a good crop, free from the attack of the maggot. In a bed, one-half of which had been prepared in the above manner, and the remaining half only trenched but not manured, the plants in the former were uninjured, but on the latter feeble and attacked by the maggot.

A correspondent of Miss Ormerod presents the following experience: "I find the best preventive in our light soil is to manure well with well-made manure, principally cow manure. We work the ground deeply and trench if need be. After lying exposed to the frost for some time, the ground is pulverized (with a steel fork) on the surface without turning up the manure, then trodden down well previous to sowing, which we do as early as possible in March, providing the ground is in good condition. We sow in lines a foot apart. After covering in the seed, we pass a heavy iron roller a few times over the ground to firm it well. We sow thinly, so that we seldom require to thin the plants. In this way we never fail to have excellent crops of onions, although the garden has been very subject to attacks from onion-fly; and there are many gardens in the neighborhood where the fly has all its own way with the onion crops."

Another correspondent makes use of "hen manure which had been well turned during the winter and covered with soil to retain the ammonia." In place of the roller, the soil is well trodden with the feet and raked over. The trampling of the feet makes it quite hard, and it is considered to do good by preventing progress of the larva. Another person recommends horse manure not over fermented for use on heavy damp soils.

A writer in the *Gardener's Chronicle and Agricultural Gazette* (vol. xiii, 1853, p. 197) states that a simple preventive of attack of the fly, satisfactorily tested by him, is dry soot, dusted over the soil lightly once a fortnight from the time of sowing until all danger is past.

Remedies for Attack.

When an onion-bed has been attacked by the fly, which may readily be known by the leaves wilting and turning yellow at the tip, every onion giving indication of the attack should be taken up at once and destroyed by burning or otherwise. If this be done promptly and thoroughly it will terminate the attack. The onions should not be *pulled up*, but carefully *lifted* by means of a broad-bladed knife, so that the entire bulb with the larvæ within it, may be removed. If simply drawn by hand, the stem, which often is only held in place by its thin skin, will separate from the decayed base, which, with the contained larvæ, will be left behind and no good whatever accomplished.

Water nearly at the boiling temperature poured from a tea-kettle along the rows of onions which have attained considerable size, has been found to kill the larvæ without injury to the plants. It is also stated that watering with strong soap-suds, when the attack is first noticed, has entirely arrested it.

Miss Ormerod believes that the most successful remedy is to be found in a proper use of paraffin oil. Care is required lest it should be used in excess, when it will injure the plants. It may probably be applied with greater safety by saturating sand with the oil to be sown among the onions, and afterward sprinkled from the rose of a watering pot. In one instance reported, a pint (English measure) of the oil was put in two gallons of water, and with it the onions planted in rows were watered through the nozzle of a watering-pot. In another, a good glassful of oil was mixed with about six gallons of water and thrown in a spray over the beds; two or three applications ended the attack. To test the efficacy of paraffin oil in the destruction of the larvæ, a number of them were placed in a flower-pot in soil with young onions. Some days thereafter three drops of the oil were introduced in the pot, and after twenty-four hours, upon examination, all the larvæ, except two, were dead.

The American Fly Compared with the European.

The *Anthomyia ceparum* of Authors (the name by which the onion-fly has long been known) has for some time been regarded as probably identical with the *Anthomyia antiqua* of Meigen, having been given as a synonym of that species by two eminent European Dipterologists, Zetterstedt (*Diptera Scandinaviæ*, viii, p. 3297) and Schiner (*Faun. Austr.*, i, p. 643). In the Catalogue of Diptera of Baron Osten Sacken (1878) the species appears as *Anthomyia ceparum* (Meigen, Bouché), with a reference to a note which simply mentions Schiner's reference of it to *A. antiqua*. The species seems not to be in the collections of the Cambridge Museum, for it was not among the examples of the family submitted to Mr. Meade for his examination (see page 70) and it does not appear that a critical comparison of our species with the *A. ceparum* and *A. antiqua* of Europe had ever been made. Mr. Meade, after a special study of the *Anthomyiidae* for several years,* being at present engaged upon a Revision of the British Species.† it seemed a favorable opportunity for making the desired comparison, and, accordingly, several examples of "*A. ceparum*," bred by me from onions, were recently sent to him for the purpose. The

*See a paper on the "Arrangement of the British Anthomyiidae," in *Entomol. Month. Mag.*, xi, 1874-'75, pp. 199, 220.

† "Annotated List of British Anthomyiidae," *Entomol. Month. Mag.*, xviii, 1881-'82, pp. 1, 27, 62, 101, 123, 172, 201, 221, 265; xix, 1882-'83, pp. 29, 145, 213.

result of the comparison is given in the following interesting communication received from him :—

“ The specimens of onion-fly which you sent to me are [very nearly] identical with *Hylemyia antiqua* Mgn. The only difference between your specimens and those that I have, named by the late Professor Rondani, is that in yours, the arista is rather less pubescent. Curiously enough, I have bred several specimens myself this summer (since the part of my paper on the genus *Hylemyia* was published) from onions, some of which were sent to me by Miss Ormerod, Entomologist to the Royal Agricultural Society in England, which are all exactly like yours. They must be placed with *Hylemyia antiqua*, unless, on account of the shorter pubescence of the arista, they may be considered as a new species. They must, however, be removed from the genus *Hylemyia* (the arista not being plumose) and placed in that of *Phorbia* (part of *Chortophila* according to Rondani).”

As the result of further study, the species has been found to be distinctly separable from *H. antiqua*. Its chief points of difference are stated to be in its simply pubescent antennæ, its interrupted dorsal stripe upon the abdomen, and its clear wings, as opposed to the sub-plumose antennæ, a continuous abdominal stripe, and the brown wings of *antiqua*. It is represented as *par excellence* an onion-fly, as all the specimens seen, had been bred from the bulbs of that vegetable. In some instances, it had been discovered feeding upon bulbs in association with *Phorbia cilicrura*, both species passing through their transformations at the same time.

In the *Entomologist's Monthly Magazine* for March, 1883, Mr. Meade has carefully described the species, and, in consideration of its having for some time been confounded with *H. antiqua*, has given it the name of *Phorbia cepetorum*, n. sp. Inasmuch as the *A. ceparum* of Meigen is, at the same time, given by Mr. Meade as a synonym, with doubt, of the new species,—as he also admits that it may be identical with the *A. ceparum* of Bouché and Meigen, which he has not identified,—and as there are other reasons which render it quite probable that it will prove to be the same, it seems proper that the specific name, so familiar to us from its long use, should still be employed for this species, and so continue, unless it can be clearly shown to pertain to another.

Its New Generic Position.

The genus *Phorbia*, to which the onion-fly has been referred as above, was proposed by Desvoidy, to include a portion of the old genus *Anthomyia*, which had been found to be so large as to be inconvenient and to contain greatly varying forms. The subdivisions that had been made by Desvoidy, Macquart and Rondani seem to Mr. Meade to be either too many or too artificial. In the new arrangement, which, in consideration of the critical study which has been given to it, will doubtless be generally received, he proposes to retain

the name of *Anthomyia* for a small group of the black-legged species, more highly developed than the others, having the alulets rather larger with the scales unequal in size. The remainder of the black-legged species are separated in two divisions, for the first of which *Chortophila* Macquart is adopted, to include those which have the abdomen more or less thickened and cylindrical; and to the second division, to include all those with black legs not belonging to either of the other two groups, Desvoidy's name of *Phorbia* is given. The species of this genus have the abdomen narrow and elongated, or oblong and flattened. The pale-legged species (without the limitation of Desvoidy and Macquart to those that have the body also more or less yellow) are placed in the genus *Pegomyia* Desv.

In the above genera, all the species to be noticed at the present time are arranged. The student who may desire to study this group may find them tabulated in the *Entomologists' Monthly Magazine* for July, 1882, p. 31.

***Phorbia cilicrura* (Rondani).**

The locust-egg Anthomyian.

Ord. DIPTERA : Fam. ANTHOMYIIDÆ.

Chortophila cilicrura ROND. Att. Soc. Ital. Sci. Nat., ix, 1866, p. 165.

Anthomyia radicum var *calopteni* RILEY : Ninth Rept. Ins. Mo., 1877, pp. 92-95, f. 23 (discovery and description); Supp. Mo. Repts., 1881, p. 89 (description).

Anthomyia angustifrons MEIGEN : in First Rept. U. S. Entomolog. Commis., 1878, pp. 285-289 (from 9th Mo. Rept.); in Second Rept. U. S. Ent. Commis., 1880, p. 263 (mention).

Chortophila angustifrons Meig. OSTEN SACKEN : Cat. Dipt. N. Amer., 1878, p. 107 (citation).

Chortophila angustifrons (Meig.). MEADE : in Entomol. Month. Mag., xiv, 1878, p. 252 (in Cambr. Museum); in Canad. Entomol., 1881, p. 49 (identical with *A. rad.* var. *calopteni*).

Phorbia cilicrura (Rond.) MEADE : in Entomol. Month. Mag. xix, 1883, pp. 213, 216.

A species belonging to the same genus with the preceding, but owing its economic importance to very different habits, may next be briefly noticed.*

Discovery of its Attack upon Locust Eggs.

During the summer of 1870, when the Rocky Mountain Locust was proving so exceedingly destructive in several of our Western States, and public attention had been drawn to the study of its habits and natural history, in the hope of discovering some means of controlling its excessive ravages, the interesting discovery was made, that the eggs, which had been laid in immense numbers, had been attacked by a small "white worm or grub," which was destroying a large propor-

*Later observations have disclosed a larval food-plant in common, which intimately connects the two species. Mr. Meade has discovered *P. cilicrura* feeding on onions, and during the past summer, he has bred a number of the flies from onion-feeding larvæ.

tion of them. The following are some of the statements relating to their earliest discovery, made to Professor Riley in the summer and autumn of 1876, from correspondents in Minnesota and Kansas:

Yesterday we discovered that our locust eggs were hatching out maggots. We break open the cocoons, and the eggs on exposure to the sun for a few moments crawl away a worm. In warm places along the hedges, the earth is alive with them.—S. M. P., Hiawatha, Kansas, Oct. 30, 1876.

I find the parasites more plentiful to-day than before. The ground seems to be full of them, from five to twenty of the small white worms in a single cell. In every cell in which I have found any, the eggs were nearly or quite destroyed.—C. E. L., Rockport, Minn., Oct. 16, 1876.

A large proportion of the eggs have been destroyed by a small white larva. Many of the egg-cases, which ordinarily contain from twenty to thirty eggs, had no eggs in them, but were full of these worms or larvæ, each one of which took the place of the egg which it had destroyed.—F. H. S., Lawrence, Kansas, Nov. 1, 1876.

During the autumn of 1876, these larvæ, it was estimated, destroyed about ten per cent of the locust eggs in Missouri, Kansas, and Nebraska. They also rendered excellent service in Minnesota, Iowa, Colorado and Texas. That they had not been previously discovered may be owing to the fact that but little attention had been, before this time, given to the locust eggs.*

Description of the Insect.

The larva and the perfect insect have been popularly described by Professor Riley as follows: "This good little friend, which simultaneously prevailed over so large an extent of country, is a small white maggot, of the same general form of the common meat maggots or

"gentles," but measuring, when full-grown and extended, not quite one-fourth of an inch in length. The head with some of the anterior joints of the body, tapers and is retractile, and the jaws consist of two small hooks joined to a V-shaped, black, horny piece, which, as it is

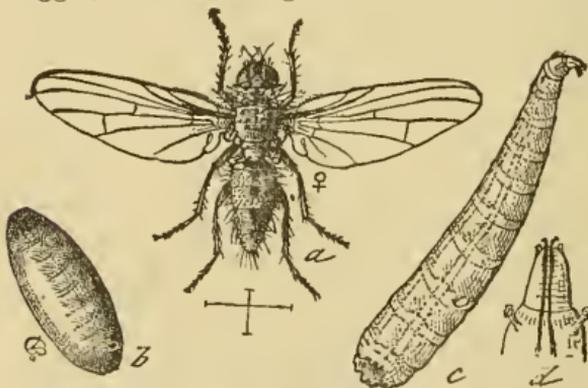


FIG. 52.—Locust-egg Anthomyiæ parasite, *PHORBIA CILICRURA*: *a*, the fly; *b*, puparium; *c*, larva; *d*, head of same—all enlarged. (Riley).

*A similar attack upon locust eggs in Asia Minor, made by a parasitic Bombyliid fly—*Callostoma fascipennis*, Macq., which had entirely destroyed the locusts throughout an area of eighty square miles, was last year brought to the notice of the Entomological Society of London. For some of the observations made upon the parasite, see the *American Naturalist* for 1882, p. 916.

retracted or extended, plays beneath the transparent skin. The hind or tail end is squarely docked off, and contains two small yellowish-brown, eye-like spots, which are the principal breathing pores.

The perfect insect issues from its puparium as a small grayish two-winged fly (Fig. 52, *a*), about one-fourth of an inch long, the wings expanding about one-half of an inch, and in general appearance resembling a diminutive house-fly, except that the body is more slender and more tapering behind, and the wings relatively more ample. More carefully examined, the body is seen to be of an ash-gray color, tinged with rust-yellow, and beset with stiff, bristle-like hairs, those on the thorax stoutest, and those on the abdomen smaller, but more uniformly distributed. The wings are faintly smoky and iridescent. There are three dusky longitudinal stripes on the thorax, most distinct anteriorly, and another along the middle of the abdomen, most distinct in the male, which also differs from the female in the larger eyes, which meet more closely on the top of the head, and in the face being whiter.

The above general description will serve for the identification of the insect when it occurs in association with locust eggs.

A detailed description of the fly, by Professor Riley, for scientific use, may be found in the 9th Missouri Report and in the *General Index and Supplement to the Missouri Reports* (*loc. cit.*); also in the *First Annual Report of the U. S. Entomological Commission*, pp. 288-89, under the name of *A. angustifrons* Meigen. We refrain from quoting it here, for while it would be of service to the entomological student to collate, as opportunity offers, the descriptions of allied species which are scattered through many volumes not conveniently accessible, and although this species is known to occur in the State of New York, yet it has not shown itself in the eastern portion of the United States, in such numbers, or with such habits, as to render it of economic importance.

The Larva feeds also upon Vegetables.

It is not at all improbable, that, in conformity with the known economy of many other insects in different localities, it may adapt its habits to the changed conditions surrounding it, and that in our State it may exist as a depredator upon the roots of some of our cruciferous plants, where it may not, as yet, have been distinguished from the similar species with which it is acting in concert. As we have recently found no less than three species, differing but slightly in specific characters, infesting the leaves of beets, in company (and two other species are known in Europe), it is probable that several of the Anthomyians may be jointly operating upon the roots of the cabbage and the radish. Indeed, Professor Riley states (9th Missouri Report, p. 95), that speci-

mens in his cabinet, bred from cabbage and radish roots, *do not differ specifically* from those reared from the locust-egg feeding larvæ.

Synonymy of the Species.

From its general resemblance to the *Anthomyia radicum* of Europe, it was at first regarded by Professor Riley as simply a variety of that form, and it was accordingly characterized by him as *A. radicum* var. *calopteni*. Examples having been submitted to Mr. Meade, they were by him referred to *Anthomyia angustifrons* of Meigen, which had been placed by Rondani in the genus *Chortophila*. Recently Mr. Meade informed me that *C. angustifrons* Meig. has been found by Rondani to embrace three or four distinct species, differing in slight points of structure, and that our locust-egg feeding species seems to correspond to the one named by Rondani, as *Chortophila cilicrura*.* In the recent re-arrangement of the *Anthomyiidae*, it falls into the genus *Phorbia*. *Aricia fusciceps* Zetterstedt, is believed to be a synonym of this species.

Anthomyia brassicæ Bonché.

The Cabbage-Fly.

Ord. DIPTERA: Fam. ANTHOMYIIDÆ.

- BOUCHÉ: *Naturgeschichte der Insecten*, 1834, p. 74, pl. 5, f. 34.
 KIRBY-SP.: *Introduct. Entomol.*, 1846, p. 140 (infesting cauliflowers).
 CURTIS: *Farm Insects*, 1860, p. 141, figs. 1, 2 and 3 of no. 26, p. 143.
 FITCH: *Eleventh Rept. Ins. N. Y.*, in *Trans. N. Y. State Agricul. Soc. for 1866*, xxvi, 1867, pp. 496-499.
 RILEY: *First Ann. Rept. Ins. Mo.*, 1869, p. 156 (mention); *Fourth Rept. do.*, p. 22 (parasite); *Ninth Rept. do.*, p. 95 (mention).
 SPRAGUE: in *Amer. Entomol.*, ii, 1870, pp. 302, 370 (Aleochara parasite).
 GLOVER: *MS. Notes Journ.—Entomolog. Index*, 1877, p. 5 (references).
 OSTEN SACKEN: *Cat. Dipt. N. Amer.*, 1878, pp. 167, 258.
 BARNARD: in *Amer. Entomol.*, iii, 1880, p. 199 (abundance of parasites).
 COOK: in *Amer. Entomol.*, iii, 1880, p. 264; in *Canad. Entomol.*, xiii, 1881, p. 190 (remedy).
 GARFIELD: in *16th Rept. Mich. St. Board Agricul.*, 1878, p. 61 (experiments with remedies).
 ORMEROD: *Mannual Inj. Ins.*, [1881], p. 31, figs. 1, 2, 3 (habits, transformation and remedies).

Its Operations Upon Cabbages.

This is probably the most injurious species of the *Anthomyiidae*, as its distribution is very extensive both in Europe and America, and it has shown at times such capacity for multiplication as to cause entire

*This species should not be confounded with the *Homalomyia cilicrura* of Rondani (which is a synonym of *H. floricola* Meig.), for, according to Mr. Meade, Rondani very strangely gave the same specific name to two quite distinct Anthomyians.

destruction of cabbage crops. It commences its attack upon the young plants while yet in the seed-bed, and continues to infest them, in several successive broods, until they are taken up in the autumn. The larvæ operate by consuming the rootlets of young plants, and by ex-coriating the surface and eating into the rind of older ones, or even penetrating into the interior of the root. When they abound to the extent of seriously burrowing the stalk, the decay of the root frequently follows, in wet seasons, and entire fields are thus destroyed. They are usually to be found in the swellings upon the roots, and the species is one of those which Curtis notices as infesting "anbury."

Its Injuries not Confined to Cabbages.

It also attacks the turnip, mining into its interior in an irregular burrow, or occupying eroded spots upon its outer surface. "Sometimes a small roughened spot is seen, appearing like a crack in the skin of the turnip, with its edges rough and ragged and turned outward, and on paring off the roughened spot a plump white maggot is come upon, lying in a cavity it has there made for itself. At other times a larger eroded spot occurs, which is filled with wet and slimy dirt. On removing this dirt, the surface is found to be rough and warty, with little grooves here and there, in each of which is a maggot." (Fitch).

Kirby and Spence (*Introduc. Entomol.*, 1846, p. 140) evidently refer to this species, when they mention that "one of the most delicate and admired of all table vegetables, concerning which gardeners are most apt to pride themselves, and bestow much pains to produce to perfection — the cauliflower — is often attacked by a fly, which, ovipositing in that part of the stalk covered by the earth, the maggots, when hatched, occasion the plants to wither and die, or to produce a worthless head."

When and Where First Described.

A. brassicæ was described by Bouché, in 1834, as above cited. It is thought by Schiner,* that it may have been previously described by Meigen, in 1826, as *A. ruficeps*. If the two are hereafter shown to be identical, then the northern range of the cabbage-fly will be extended into Greenland, whence examples of *A. ruficeps* have been received. There is an older *A. brassicæ*, viz. that of Weidemann (*Zoölog. Mag.*, i, p. 87), which is a different species, and has recently been referred by Mr. Meade to *A. radicum* Linn.†

* Schiner, *Fauna Austriaca, Dipt.*, i, p. 644.

†With *A. ruficeps* Meigen, Mr. Meade is not acquainted.

Its Resemblance to *A. radicum*.

Dr. Fitch (*loc. cit.* p. 497) declares his inability to separate *A. brassicæ* from *A. radicum*, the root-eating species, either by a comparison of the larvæ occurring in the roots of the cabbage, turnip and radish, or by descriptions given by authors of the two species. The difference in the color of the larvæ indicated by Curtis — that of the former being yellowish-white and of the latter yellowish-olive — he regards as unreliable, as he has found them pure white when first taken from their burrows in the roots, and from exposure to the light they acquired a yellow tinge, which became deeper as they were longer exposed.

Description of the Larva, Puparium and the Fly.

The best description of the insect given is that of Dr. Fitch, from which we quote: "The larvæ occur of different sizes at the same date, the largest measuring 0.30 in length. They are footless and white, composed of ten or eleven visible segments. On the throat or underside of the pointed end the jaws appear as a bifid black internal streak. The hind end is bluntly cut off and flattened, with two elevated tawny yellowish dots or spiracles on the disk, and around the margin is a row of twelve conical fleshy points, the lower two larger and forked at their tips, the next one on each side equally long but narrower and acute pointed, and forward of these last is another transverse row of similar points. [Kollar states that the truncated anal joint is surrounded by ten fleshy points, of which the four lower are in pairs. According to Curtis, it has two brown tubercles in the center, and several short teeth on the lower margin.]

The puparium is described in such general features as not to be serviceable for separating it from the allied species. The pupation continues for about a fortnight when the perfect insect is given out, "which is a two-winged fly, resembling the common house-fly, but, somewhat smaller in size, measuring 0.20 in length to the end of its body, and 0.26 to the tip of the closed wings. It is of an ash-gray color, and with three black stripes on the thorax or fore body, and on the hind body a black stripe along the middle of the back, and a black band upon each of the sutures. In the male the head is silvery-white, the eyes coppery-red in the living specimen, and very large, nearly in contact above — having between them a black stripe, which is much broader at its commencement at the base of the antennæ. The antennæ, feelers and legs are black. On the crown of the head, the legs, and the hind body are black bristles, and on the fore body are coarser ones, arranged in rows. The hind body is of a cylindrical-conic form, its under side with a black stripe in the middle and black bands on the sutures, similar to the upper side. The wings are hyaline, ciliated

with fine bristles along the outer or costal edge, nearly to the tip. At the apex of the first vein is a slight notch, where is a coarser bristle.

“The female differs in having the eyes smaller and farther apart, and the black stripe between them is much broader, and is tinged with tawny-red in its middle, and forked at its upper end, with a small black spot between the forks. The black stripes on the fore body are obsolete, as are also the black bands on the sutures of the hind body.”

Natural Enemies.

According to Curtis, the cabbage-fly is not known to have any parasite destroying it in Europe. A small four-winged Ichneumon, belonging to the Hymenoptera, known as *Alysia manducator*, lives in the pupæ of several flies allied to *Anthomyiidae*. It undergoes its transformation in a thin, yellow case, within the pupæ, and emerges in the spring and summer, when it may frequently be seen about decaying turnip and other roots. It may, therefore, be inferred that it is a general parasite of these flies, and that the cabbage and turnip larvæ do not escape its vigilance.

In our own country, a parasite upon *A. brassicæ* has been discovered, from which much service is expected in checking the depredations of this injurious species. It is a small beetle, belonging to the family of *Staphylinidae*, which are sometimes known as rove-beetles.

The Staphylinidae.—These beetles are characterized by their narrow, elongated and somewhat flattened bodies, which vary in size from about an inch in length to a microscopic form. Their wing-covers are very short, often extending only over a small portion of the abdomen, leaving the greater part uncovered and left free to be raised upward in running, or employed for folding and packing up the true wings under their abbreviated covers after flight. The end of the body often bears two bristly processes. The jaws (mandibles) are long and curved, and are used in a menacing and formidable manner when the insect is taken in the hand; when at rest, or in cabinet specimens, they are usually crossed at the tips. The antennæ are short, composed of short rounded or lenticular joints, which frequently increase in size toward the tips. Their food consists largely of decaying animal and vegetable matter, rendering them very useful as scavengers. Some of the species attack and destroy other living insects, and are so cannibalistic as to prey upon their own species. Others are true parasites, and find their food in the larvæ of ants' nests, in the nests of wasps, in beetles, and doubtless, from recent observations, and an increased knowledge of their habits—in many more insects than are now suspected. The family is a very large one, more than five hundred North American species having been described. *Leistotrophus cingulatus*

(Grav.), and *Staphylinus cinnamopterus* Grav., are among the species frequently met with in the State of New York.

ALEOCHARA ANTHOMYLÆ *Sprague*.—The particular species which is parasitic on the larvæ of the cabbage-fly was discovered a few years since, in a garden near Boston. According to the account given (*loc. cit.*) by their discoverer, Mr. P. S. Sprague, some cabbage-plants which had just been set out gave indication, by their wilting and discoloration, of insect attack. On taking them up, from ten to thirty of the cabbage-fly larvæ were found upon each plant. They had destroyed all of the tender rootlets, and were following the center of the main stock to the surface of the ground. Subsequently (June 20th), twenty-six puparia were collected from the soil of the hills and put in boxes of earth, one moist and the other dry. From these, there were obtained, about the middle of July, seven examples of the parasitic beetle, which had eaten their way through rough holes in the sides of the puparia. No wound or marks could be found upon their exterior, to indicate that the attack had been made while in that stage, and the inference there-



FIG. 53.—
ALEOCHARA
ANTHOMYLÆ,
parasitic
upon the cab-
bage-fly.

fore was drawn, that the larvæ had been parasitized, either by the eggs of the beetle having been fastened to their bodies, or by the direct entrance of the young parasitic larvæ. An examination of the beetle showed it to be an unknown species, and it was accordingly described by Mr. Sprague as *Aleochara anthomyiæ*. Fig. 53 represents the insect—the hair-line beside it indicating its natural size.

The only knowledge that we have of the habits of this insect is given us by Professor W. S. Barnard, as follows: "It is now very abundant at Ithaca. * * * * * The beetles are often seen running from one young cabbage to another, or entering holes, but more commonly close about the stalk. Half of our young cabbages here, last year and this, have been killed by the maggots, and now, on pulling up an infested stalk, these beetles often come out, sometimes several from about one plant. To test their habits, I put a maggot in a bottle with them. When hungry, a single one alone will attack a full-sized maggot, tearing open its sides and feasting upon it. I have seen five of them like a pack of wolves cling to, and tear, a writhing maggot, killing it quickly. They are wonderfully active, and promise to be the best enemy against the fly which has ruined so many crops here." (*Amer. Entomol.*, iii, 1880, p. 199.)

Of the other species of *Aleochara* which occur with us, doubtless some will hereafter be shown to be of similar service. Nine species are recognized in this country, of which two are identical with European forms, viz., *A. brachypterus* (Fourc.), and *A. nitida* Grav.

Parasitism of the Staphylinidæ.—The above parasitic attack is of much interest in connection with our efforts to check the ravages of these root-eating larvæ. It would not be confined to the cabbage-fly larva, but would doubtless embrace all the allied species existing under similar conditions. The *Staphylinidæ* or rove-beetles have long been known to abound in the diseased and distorted roots of the cabbage and turnip. Curtis states (*op. cit.*, p. 138) that different species of *Aleochara* and *Oxytelus** are frequently found in England, in decayed turnips, and that in one instance, forty or fifty of the larvæ of a *Staphylinus* had been taken from below the leaves of a single bulb. Some specimens of the same genera were discovered gnawing the roots in July, and “two of the beetles lived three months upon maggots occurring in some turnips.”

As it is highly probable from the above statements of Curtis and from other knowledge that we have of the habits of the *Staphylinidæ*, that a large proportion of their food consists of living larvæ—the injury that they may at times inflict by gnawing the roots of vegetables is many times compensated by their predilection for living animal food, and particularly for tender larvæ.† It is, therefore, very desirable, that these serviceable predatory and scavenger beetles should not be harmed when discovered in their favorite retreats, in association with injuries which would naturally, in the absence of a knowledge of their habits, subject them to unjust suspicion and seem to authorize their destruction.

Possible Introduction of Parasites from Europe.

In the large importation of cabbages from Europe, following the widespread destruction of our crop of the past year (1881),‡ among the new species of insects that will in all probability be brought over, it is to be hoped that some useful parasites upon the cabbage-fly may at the same time have been introduced, toward compensation for the losses sustained in the sending hither, about twenty-five years ago, the destructive cabbage-butterfly, *Pieris rapæ*, and at another time, *Plusia brassicæ*, if its recently asserted identity with *Plusia ni* Hüb. n.

*On page 139 (*l. c.*), *Oxytelus sculpturatus* and *O. rugosus*, which infest turnips and the clubbed roots of broccoli in England, are figured.

†See statement in the 8th Annual Report on the Insects of Missouri, of these beetles pursuing and devouring the “snake-worm”—a name given to an assemblage of the larvæ of *Sciara* (a genus of small gnats), which have the strange habit of traveling in large companies, in which all the individuals are attached to one another, heads to tails, and the entire body moving together as if guided by a common impulse.

‡The high price of cabbages—from \$15 to \$30 per hundred, wholesale—has led to large importations from Germany. They are brought in crates, and some sour-kraut is imported ready pickled in tierces. Turnips, celery and carrots are also to be seen among the freight of all incoming vessels.—*New York Post*, December, 1881.

shall be established. To the increasing ravages of these two species this novel importation is mainly attributable.

Preventives and Remedies.

Various means have been suggested for controlling the depredations of the cabbage-fly. Bouché, the original describer of it, tells us that the plants may be preserved by dipping the roots when they are transplanted from the seed-beds, into oil or lye of ashes.

Powdered tobacco, or the fine dust from tobacco factories, scattered over the plants, is said to preserve them from attack.

The use of superphosphate of lime has been advised, as a preventive against the deposit of the eggs.

If cabbages are not grown upon the same ground for successive years, and the ground meantime thoroughly cultivated with some other crop, the insect will be materially reduced in numbers.

In the experiments at the Michigan State Agricultural College, referred to on p. 193, a strong decoction of tobacco was freely applied to the plants, but without appreciable benefit.

When the attack of larvæ has reached that stage of progress that the plants unmistakably show it by wilting and the leaves turning to a faint lead-color, all such should be promptly taken up, and the hole left should be filled with strong brine or lye to destroy any of the larvæ which might remain in the soil. This last precaution would be unnecessary if the plants were removed by the method recommended for onions (p. 178), but in that case, the accompanying ground should be thrown with the plants in a deep hole made for the purpose, and covered with solidly packed earth, through which the flies, if any of the buried larvæ should attain this stage, could not penetrate to the surface.

Watering the plants with lime water has been found to be of service in killing the larvæ.

Professor A. J. Cook has recently recommended the following method for the destruction of the larvæ. Bisulphide of carbon is used. "To apply it, a small hole is made in the earth near the main root of the plant, by use of a walking-stick or other rod, and about one-half a teaspoonful of the liquid poured in, when the hole is quickly filled with earth, which is pressed down by the foot. In every case the insects were killed, without injury to the plants." *Amer. Entomol.*, iii, 1880, p. 264.

While Professor Cook, as the result of the experiments of the present year, believes carbolic acid to be preferable to bisulphide of carbon for the protection of radishes (see p. 194), he is still of opinion that the latter material is the most reliable in contending with the cabbage-fly,

and that its use, as above recommended, promises to be the cheapest and most desirable means that can be made practicable on all occasions. (*Canad. Entomol.*, xiii, 1881, p. 190.)

Anthomyia radicum Linn.

The Root-fly.

Ord. DIPTERA: Fam. ANTHOMYIIDÆ.

- LINNÆUS: "Faun. Suec., Ed. ii, 1761, p. 75, no. 1840. Syst. Nat., xii ed., ii, 1767, p. 992, no. 79."
- WEIDEMANN: in *Zoölogical Magazine*, i, p. 87 (*A. brassicæ*, but according to Meade is *A. radicum*).
- CURTIS: *Farm Insects*, 1860, p. 143, f. 26, nos. 4, 5 (brief description).
- FITCH: *Eleventh Rept. Ins. N. Y.*, in *Trans. N. Y. St. Agricul. Soc. for 1866*, xxvi, 1867, p. 497 (compared with *A. brassicæ*).
- GLOVER: in *Ann. Rept. Commis. Agricul. for 1872*, (1874), p. 134 (food-plants); *MS. Notes Journ.—Dipt.*, 1874, p. 3, pl. 10, f. 9 (references, etc.).
- PACKARD: in *Hayden's Ninth Rept. G.-G. Surv. Terr.*, 1877, pl. 63, f. 2 (imago only).
- RILEY: in *First Ann. Rept. U. S. Ent. Commis. for 1877*, (1878), p. 288, f. 22 (imago only).
- HAGEN: in *Canad. Entomol.*, xiii, 1881, p. 48 (identified by Meade).
- ORMEROD: *Manual Inj. Ins.* [1881], p. 33, fig. 4 on p. 31 (brief notice).
- MEADE: in *Entomol. Month. Mag.*, xix, 1882, p. 32 (general features).

As this European species has been referred to in the notice of the preceding species, as a closely allied and possibly an identical form, a brief notice of it will be proper here, particularly as it is known to occur in the United States,* although no injuries have as yet been traceable to it.

Described and Noticed in Europe.

The species was originally described by Linnæus in the year 1761, in his *Fauna Suecica*, ed. ii, p. 75, no. 1840, as *Musca radicum*,—nearly all of the flies known to this distinguished Naturalist, having been arranged by him in the four genera of *Tipula*, *Musca*, *Tabanus* and *Culex*.

It does not appear to have been numbered among the more destructive species of Europe. Mr. Kollar, in his well-known volume, prepared under the authorization of the Emperor Francis I, of Austria, and command for its speedy execution, in the examination of, and report upon, "the most important enemies of the agriculturist," does not include this insect while noticing the onion-fly, the cabbage-fly and the lettuce-fly (*Anthomyia lactucarum* Bouché).

*Meade: *Ent. Month. Mag.*, xiv, 1878, p. 252.

Curtis, in his *Farm Insects*, gives but a brief account of it. It is placed under the "Insects affecting the turnip crops," and more particularly under those infesting "anbury." Anbury is defined as a malformation or large excrescence produced below the bulb of certain vegetables, which, when they arrive at maturity, exhibit a putrid fermentation and emit a most offensive smell. When the anburies are divided they are hard; but with the assistance of a lens, veins or string-like vessels may be seen dispersed through the tumor. It is believed by Curtis that they are not occasioned by insects, but are subsequently entered and occupied by multitudes of maggots, which feed upon the putrid substance and contribute in no small degree to the more speedy dissolution of the bulbs. The cause of the disease is probably to be found in certain conditions of the soil, induced, perhaps, by the long-continued repetition of certain crops.

The eggs of the root-fly are deposited in the crown of the turnip or close to the young bulb. Hatching, the larvæ proceed downward to the bulb, into which they enter and where they are to be found, and not in the surrounding soil, as frequently in the onion-fly. They are described by Curtis, from examples taken from turnips on July 21st, as follows: "Similar in form to those of *A. brassicæ*, but of a yellowish-ochre color. The head was armed with two black hooks, and at the extremity was a green stripe from the intestines, showing through; the rump was truncated, and furnished with two brown projecting spiracles, and the margin surrounded with small teeth, largest below. I put them, with a turnip root, into a flower pot, and the following April I found four of them in the pupa state, and buried deep in the earth; these pupæ were also like those of *A. brassicæ*, but of a paler color, being lurid ochreous. On the 26th of April I bred a male fly, and soon after two females.

"The fly is similar in size and form to *A. brassicæ*; but the male

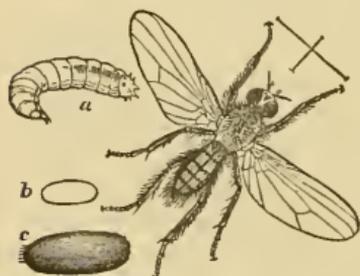


FIG. 54.—The root-fly, *ANTHOMYIA RADICUM* Linn. The fly only, not the figures. (After Curtis.)

(Fig. 54) has an ochreous face, reflecting satiny-white; the stripe on the forehead is rusty; the thorax is black, with three darker stripes; the sides are gray; scutel blackish; abdomen slender, linear shining gray, with a broad black dorsal stripe; the incisures are black also; wings, balancers and legs as in *A. brassicæ*. Female still more like that species; but there are three fuscous stripes on the thorax, and in certain lights a slender dark line down the back of the abdomen; length, 2 1-2 lines."

Miss Ormerod, writing the present year of this insect, says: "These

flies are not noted as causing any serious damage in this country, but may be mentioned from their great resemblance to the common cabbage-fly." From the similarity in appearance and habits of the two species, it would not be strange if the injuries of *A. radicum* were much more common than is generally supposed, and that much of the damage ascribed to *A. brassicæ* in reality pertains to the former species.

Mr. Meade (*loc. cit.*) remarks of this species as follows: "This excessively common little fly, which, as its name imports, feeds in the larva state upon the roots of plants, especially those of the cabbage tribe, is often confounded with other species. It may be recognized by its projecting epistome [the lower face]; by the unequal sized scales; by the thorax being black and marked in the male by two short, gray, narrow stripes (rather than by three wide black ones, as is usually stated); by the rather short, wide, somewhat pointed abdomen, with a longitudinal dorsal black mark, crossed by three transverse straight black lines, extending of an even width to the margin; and by the third and fourth longitudinal veins [see figure of venation, *ante*, for position of these veins] being slightly convergent at their extremities."

Briefly Noticed in this Country.

The above meager account of this insect, which, from its specific name, together with its habits, so far as known, should be of considerable economic importance, is all that can be compiled from the sources at my command. While quite unsatisfactory, it may at least serve to show our ignorance of the species, and incite to efforts for the attainment of a fuller knowledge of it.

Dr. Packard's notice of "*A. radicum*," contained in his Report on the Rocky Mountain Locust (9th Ann. Rept. of the U. S. Geolog. and Geograph. Survey of the Territories, for 1875), is that of the radish-fly, *A. raphani*, in acceptance of Dr. Fitch's belief in their being the same. Of the figures given in illustration, on plate lxiii, fig. 2, the same as Fig. 54 above, the fly alone represents *A. radicum*, while *a*, *b* and *c*, showing larva in double size, and pupa-case in natural size and enlarged, are from Curtis' figures of *A. brassicæ* (*b*, to show the natural size of the puparium, is very badly copied). The same figures are introduced in the *First Annual Report of the U. S. Entomological Commission* (p. 288, fig. 22, *a*, *b*, *c*) to illustrate *A. radicum*.

Mr. Glover (*loc. cit.*) refers to *A. radicum* as injuring radishes in Europe. Dr. Fitch's notice of the species is limited to a comparison of it with *A. brassicæ*, which has been quoted on a preceding page (p. 186).

Remedies and Preventives.

Salt and lime combined, and mixed with the soil previously to sowing the seed, or applying it to the surface after sowing, was attended with excellent results. A correspondent of the *Gardener's Magazine*, recommends "for the protection of turnips against the attacks of the fly and other insects, that the plants be made offensive to the parent fly, which may be done by incorporating with the soil soap-boilers' waste, or any other substance of similar alkaline quality." It is recommended that the plants be watered with "a mixture of one gallon of soap-suds to one gallon of gas-water, or, in lieu of the latter, two quarts of gas-tar; either will do, as the only use of the mixture is to create an offensive smell."

It will be seen that the above recommendations are similar to the means adopted by Professor Cook for averting the attack of the radish-fly by the odor of carbolic acid.

In experiments made by the Zoölog.-Botan. Society of Vienna, plants were preserved from attack by manuring the ground with superphosphate.

Anthomyia raphani Harris.

The Radish-fly.

Ord. DIPTERA : Fam. ANTHOMYIIDÆ.

HARRIS : Rept. Ins. Mass., 1841, p. 415 ; Treat. Ins. New. Eng., 1852, p. 494 ; Ins. Inj. Veg., 1862, p. 617 (brief description of the fly).

FITCH : Eleventh Rept. Ins. N. Y., in Trans. N. Y. St. Agricul. Soc. for 1866, xxvi, 1867, pp. 515-517.

PACKARD : Guide Study Ins., 1869, p. 411 (mention).

TRIMBLE : in Amer. Entomol., ii, 1870, p. 273 (habits in N. J.).

GLOVER : MS. Notes Journ.—Dipt. 1874, p. 3 (reference and habits).

COOK : in Thirteenth Ann. Rept. Mich. St. Board Agricul. for 1874, (1875), p. 121 (natural history and remedies); in Canad. Ent., xiii, 1881, p. 190 (carbolic acid remedy).

PACKARD : in Hayden's Ninth Rept. G.-G. Surv. Terr., 1877, p. 762, pl. 63, f. 2 of *radicum* from Curtis (description from Fitch).

GARFIELD : in Sixteenth Ann. Rept. Mich. St. Board Agricul. for 1877, (1878), p. 61 (experiments with remedies).

OST. SACK. : Cat. Dipt. N. Amer., 1878, p. 168 (references and localities).

The most Injurious of Radish Insects.

For some reasons not evident to us, the radish is not subject to the attack of as many species of insects, as are most of our vegetables and garden plants. We can recall at the present comparatively few which prey upon it. The caterpillar of the white cabbage-butterfly *Pieris rapæ*, is sometimes found feeding upon its leaves. Two of the flea-

beetles, *Epitrix cucumeris* (Harris), and *Orchestris vittata* (Fabr.), are serious depredators upon the foliage, which they eat so full of small holes as materially to interfere with the vigor of the plant. A small weevil has been observed by Dr. Packard, in Maine, eating holes through the sides of the seed-pods and devouring the seeds,* which he believes to be identical with the radish-seed weevil, *Ceutorhynchus assimilis* Payk., of Europe. The Harlequin cabbage-bug, *Murgantia histrionica* Hahn., injures it severely in the Southern States; while in the western portion of the United States, another member of the order of bugs, *Nysius destructor* Riley, which resembles the chinch-bug so closely in appearance that it has been taken for it, and has received the popular name of the false chinch-bug, —sucks the juices from the leaves and causes them to wilt,† while the Rocky Mountain locust, *Caloptenus spretus*, eats its leaves with great avidity.‡

Of greater magnitude than all the above combined, are the injuries inflicted upon radishes by the larvæ of the radish-fly. Throughout at least the northern part of the United States, wherever they are cultivated, these larvæ may be found burrowing into the roots, and rendering them unsightly, hard, guarly, stringy, and unfit for the table. They traverse the root in all directions, extending often an inch or two in its interior. In many localities they abound to such an extent that no radishes can be grown without great injury from them, and often they compel the entire abandonment of its cultivation.

Description of the Insect.

This species was first described by Dr. Harris in his Second Report to the Legislature, on the *Insects of Massachusetts*, published in the year 1841. It had been named by him in his List of Insects, contained in the *Catalogue of Animals and Plants of Massachusetts* (page 80), published in 1835, together with several other species of *Anthomyia*,§ of which this only seems to have been subsequently described. The description is as follows:—

“Radishes, while growing, are very apt to be attacked by maggots, and rendered unfit to be eaten. These maggots are finally transformed to small, ash-colored flies, with a silvery-gray face, copper-colored eyes, and a brown spot on the forehead of the females; they have some faint brownish lines on the thorax, and a longitudinal black line on the hind-body, crossed by narrower black lines on the edges of the rings. They vary in size, but usually measure rather more than one-fifth of

*Ninth Ann. Rept. Geolog.-Geograph. Surv. Terr., 1877, p. 763.

†Fifth Ann. Rept. Ins. Mo., 1873, p. 111.

‡Seventh Ann. Rept. Ins. Mo., 1875, p. 159.

§The other MS. names are the following: *lunatifrons*, *timida*, *notatifrons*, *calceola*, *ischiaca*, *goniphora*, and *lenis*.

an inch in length. They finish their transformations, and appear above the ground, toward the end of June. * * * * It closely resembles the root-fly (*Anthomyia radicum*), of Europe."

Dr. Fitch has given a more detailed description of, presumably, the same insect: "The larva is 0.20 long, elongating itself to 0.25 when crawling. It is about three times as long as thick, appearing to be more short and broad than the larva of the onion-fly. It is white, shining, cylindrical and tapering to a point anteriorly, where the jaws appear under the skin as a short, black, movable line, its anterior end when protruded forward becoming split, and then seen to be two sharp hooks, which are curved downward, and when the animal is crawling these hooks are pressed downward against the surface to aid locomotion. The body is divided by transverse lines into eleven or twelve segments, and when the head is exerted, thirteen segments can be counted. At the hind end of the back a pale, tawny, yellowish dorsal stripe is faintly visible. The hind end is abruptly cut off, obliquely downward and slightly backward, forming a flat surface, having above its center two conspicuous spiracles or elevated dots, their surface opaque and rugose, and their color sometimes tawny-yellow, sometimes black. The flattened hind end has a number of small acute teeth around its outer margin, of which the two lower ones are thicker, of a brownish color, and slightly notched or two-toothed at their tip in the large but not in the smaller young larvæ. Above these on each side are three teeth, distant from each other, the middle one nearer to the upper than to the lower one."

Although Dr. Fitch adopted the specific name given by Dr. Harris, yet he states that "it appears to be identical in every particular with the European *A. radicum*." Farther on, he indicates these differences: "The worm and also the pupa differs in no respect from those of the Onion-fly, that I perceive, except that at the hind end the two larger teeth on the middle of the under side are slightly notched or two-toothed at their tips, instead of being tapered to a single point. The flies, too, are very similar, but here three faint brownish stripes are perceptible on the thorax or fore-body, and upon the hind-body in the male is a black stripe along the middle of the back, which is crossed by narrower black lines on each of the sutures."

The following is a detailed description of the flies:—

"The *male* is ash-gray and very bristly; the large compound eyes occupy most of the surface of the head and are almost in contact upon the crown. There are also three minute eyes at the base of the crown. The face is silvery-gray, almost white in some reflections of the light, with a long black streak on the forehead, which is pointed at its hind end. Below this streak are the black three-jointed antennæ, the basal

joint being small, the second large, the third largest and oval, with a two-jointed pubescent bristle on the back, the first of the joints being very minute. The fore-body is oblong, whitish on the sides, with three faint interrupted dusky stripes upon the back. The hind-body is shining gray, rather small and elliptical, tapering to the apex, with a black stripe down the back, the edges of the segments and the region of the scutellum being also black. The two wings are large, transparent, iridescent, laid the one upon the other in repose, the longitudinal veins extending to the margin, with two transverse veinlets in the disk. The poisers are pale yellowish. The six legs are black and bristly, the feet five-jointed, ending in two little claws, and two large pale leathery lobes.

“The *female* is of a uniform ash-gray color, excepting the silvery-white face and pale sides of the fore-body. The eyes are widely apart, with a broad black stripe between them, which is shaded into chestnut color in front. The hind-body is larger than in the male and conical toward its apex. The wings have a tinge of yellowish at their bases. The species measures 0.23 in length, and 0.45 in width across the extended wings.”

Natural History.

The history of this insect does not appear to have been carefully observed. Dr. Harris' only statement is that the fly emerges from the ground toward the end of June. Dr. Fitch states that the pupa state lasts for two or three weeks. Professor Cook, of Lansing, Michigan, writes: “The flies are around early in the spring, for our earliest radishes are the ones most liable to suffer from attacks. The eggs are laid on the stem close to the ground. These soon hatch. * * *

In June they transform to pupæ and to imagos, and are ready to make a new deposit of eggs. Whether there are more than two broods a year, and whether they attack other plants than radishes, are, so far as I know, still open questions.” The observations of Dr. Fitch, in relation to the early appearance of the fly, are somewhat at variance with the above. It was only from his earliest-sown radishes that he obtained any that were fit for use, but he adds, “for several years past, the first sowing has also been a total failure.” It is not improbable that with a more thorough establishment of the fly among us, its first appearance in the spring may be earlier than it was wont to be.

Its Literature.

Very little, beyond that above referred to and quoted, has been written of this species. We find nothing in the Reports of Mr. Glover, during his long connection with the United States Agricultural Depart-

ment, either of its occurrence, distribution, or habits, beyond a simple mention of it as injurious to radishes (Report for 1872, p. 134). In his "MS. Notes from my Journal," a few copies of which were lithographed for private distribution, some references to writers are given (p. 3). Professor Riley's Reports contain no notice of it. Dr. Packard refers the species to *Anthomyia radicum*, of Europe, and records its frequent occurrence in early-sown radishes in Maine, where the plants were sometimes killed by it.

A Doubtful Species.

While we still retain *A. raphani* among our list of depredators on the radish, it is uncertain whether it is distinct from the European species described by Linnæus, in 1761, as *Musca radicum*. The type is probably not in existence, as it is not contained in the Harris collection in the Museum of the Boston Society of Natural History. There are no specimens of it among the *Anthomyiidae* of the Museum of Comparative Zoölogy at Cambridge. Mr. Meade, of England, in reply to inquiries made of him, informs me that he has not seen and does not know the species. A single specimen of it, labeled by Dr. Fitch, is in the collection of the N. Y. State Agricultural Society, but in too poor condition for satisfactory comparison.*

There is, in favor of the identity of the two species, in addition to their qualified identity stated by Dr. Fitch, the fact that an example of *A. radicum* Linn., was found by Mr. Meade in the collections of North American *Anthomyiidae* sent to him for examination from the Cambridge Museum: the particular locality is not indicated (*Canad. Entomol.*, xiii, p. 48, no. 52).

Remedies and Preventives.

At the State Agricultural College of Michigan, experiments were made with tobacco-water, superphosphate, and gas-lime, upon alternate rows of radishes, hoping that the effect might be, by means of a vile odor, to prevent the flies from laying their eggs. These applications were all failures.† The earth was partially removed from the roots and salt thrown in and covered up, but to no purpose. Boiling water was poured upon the roots, and when the larvæ were not too deep in the ground, this was effectual, but was not accounted a successful

*A difference is shown in the venuration, which, could it be sustained by other examples, would be of no little importance in the separation of these closely allied forms. The two longitudinal veins 3 and 4 do not converge at the margin, as in most of the allied species, and the hinder transverse vein (9) is more conspicuously angulated at the middle than in any other of the *Anthomyiæ* before me (resembling in these features *Pegomyia vicina*, hereinafter described).

†It does not appear from the statement, that the applications were made before the first flies had come abroad for the deposit of their eggs.

remedy. Not one-tenth of the radishes were saved (*Rept. St. Board Agricul.* for 1877, p. 61).

It is thought that benefit has been derived from late sowing in clayey soil, as the insect has been observed to be very injurious to earlier crops and upon sandy soil.

Professor Cook last year recommended the use of bisulphide of carbon for the destruction of the larvæ, but he has subsequently concluded, in consideration of the amount of the liquid necessary for thorough execution, that the expense would be too great to warrant its use. The trial was made to lessen the expense by applying the liquid in fewer places in the beds, at some distance apart, but it did not give as good results as when similarly used for the destruction of the cabbage *Anthomyia*. During the present year, he has experimented with carbolic acid, as a cheaper agent, known to be very repellant to insects, and remarkable for retaining its disagreeable odor for a long time. It was prepared by adding two quarts of soft soap to two gallons of water, to which, when heated to the boiling point, a pint of crude carbolic acid was turned in. For use, one part of this mixture was taken with fifty parts of water, and applied by sprinkling directly upon the plants. It was used in three localities in the college grounds, and it was found that a single application kept the insects at bay for about two weeks. When applied weekly, the radishes were almost entirely free from attack, although the flies were observed and captured in the vicinity, and some beds near by, but not protected by the carbolic liquid, were badly injured. It is recommended to sprinkle the plants as soon as they are up, and to repeat the operation every week or ten days thereafter; and the caution is appended, "if sprinkled directly upon the plants, the mixture must not be so concentrated as to injure them."

The above method gives promise of enabling us to prevent the ravages of the radish-fly (and of many other insects), by simple but effectual means. It will be very encouraging if subsequent experiments with the carbolic acid liquid in other localities and under different conditions of soil are attended with results quite as satisfactory as those above recorded.

Anthomyia zea Riley.

The Seed-corn Fly.

(Ord. DIPTERA: Fam. ANTHOMYIDÆ.)

- Anthomyia zeas* RILEY: 1st Rept. Ins. Mo., 1869, pp. 154-156, figs. 86, 97, pl. 2, f. 24.
A. zeas WALSH: in Amer. Entomol., i, 1869, p. 224, figs. 158, 159.
A. zeas PACKARD: Guide Study Ins., 1869, p. 411, f. 344 (mention).
A. zeas GLOVER: MS. Notes Jour.-Dipt., 1874, p. 3, pl. 8, f. 26; pl. 9, f. 33.
A. zeas RILEY: Gen. Ind. and Supp. Repts. Ins. Mo., 1881, p. 89.
A. zeas OST. SACKEN: Cat. Dipt. N. Amer., 1878, p. 168.

The operations of this insect were first detected in New Jersey, in

the year 1868, in the month of June, by Mr. A. S. Fuller, where it was found as a small white worm eating into and excoriating the surface of seed-corn after its sprouting. In several localities in New Jersey it destroyed the seed-corn, but since that time, its injuries have not been reported, nor has it as yet been discovered in the State of New York. From the rapid increase in numbers and the great multiplication in certain seasons, which the species of this family show, it is liable at any time to become, over a wide area, a serious check upon corn growing, and it is therefore important that our agriculturists should have such a knowledge of its appearance and habits as to enable them to detect its presence.

No description has yet been given of the larval form which will permit of comparison with allied species. Fig. 55 after Riley, represents its appearance, as enlarged, with a line showing its natural size. It is described as "a footless maggot, measuring 0.25 to 0.30 of an inch, of a yellowish-white color, blunt at the posterior and tapering at the anterior end." Its manner of feeding upon the corn is similar to that of the



FIG. 55.—Larva and puparium of the seed-corn fly, *ANTHOMYIA ZEÆ*.

larvæ of the Onion-fly, and is represented in Fig. 56. When the corn is injured to this extent, the young shoots die, and the kernels decay. The larvæ eat rapidly and soon attain their growth, when they contract into a light-brown puparium, shown at *b*, similar to the other species of the genus. In from one week to two weeks thereafter, the fly makes its appearance. Whether there are subsequent broods of the species during the summer, and whether in the absence of seed-corn which it may feed on, it attacks some other plant, has not been ascertained.



FIG. 56.—Corn as eaten by the larva of *ANTHOMYIA ZEÆ*.

The following is a description of the fly as given by Professor Riley:—

Length 0.20 inch (5 mm); alar expanse 0.38 inch (9.5 mm). Antennæ black; style microscopically pubescent; front, fulvous, with a distinct, rather narrow, brownish, cinereous margin; face and orbits brownish-white; palpi and proboscis black; ocellar area somewhat heart-shaped; thorax and abdomen pale yellow-brownish cinereous, with minute black points at the insertion of the bristles; thorax with an indistinct middle stripe of brown; legs black, tinted with cinereous; poisers pale ochre-yellow; scales small, the upper valve larger than the lower.

This species was referred to the genus *Anthomyia* upon characters observed in two examples of the female sex, which would scarcely afford the material for positive generic reference. Baron Osten Sacken has, in his catalogue, placed it in the genus *Anthomyia* provisionally. The specific name of *zeas* originally given to it, has recently been modified by the author into *zeæ* (see references above).

Preventives.

As the harm done by this insect would usually precede its detection, it is evident that the means to be employed against it should be of a nature to prevent the attack. For this purpose, soaking the corn before planting in gas-tar or copperas water has been recommended. Any strong-smelling material that may be convenient for use would probably prevent the deposit of the eggs. Where there is reason to apprehend an attack, a small quantity of sand saturated with kerosene oil and sprinkled over the corn before covering, would, in all probability, not only preserve it from this insect, but might also protect it from destruction by grubs.

Hylemyia deceptiva Fitch.*The Deceptive Wheat-Fly.*

(Ord. DIPTERA: Fam. ANTHOMYIIDÆ.)

FITCH: in Trans. N. Y. St. Agricul. Soc., for 1855, xv, 1856, p. 533: First and Second Rept. Ins. N. Y., 1856, p. 301, pl. 1, f. 3 (description).

GLOVER: MS. Notes Journ.-Dipt., 1874, p. 27, pl. 10, f. 11 (mention).

OSTEN SACKEN. Cat. Dipt. N. Amer., 1878, p. 167 (citation).

HAGEN: in Canad. Entomol., xiii, 1881, p. 49, no. 62 (in Mus. Comp. Zool. coll).

Our only knowledge of this Anthomyian thus far, is that obtained from the notice above cited of Dr. Fitch. It was found by him in abundance upon the heads of wheat, in the latter part of June, and received from him its specific name, from the fact that it had been commonly but erroneously believed to be the fly that deposited the eggs within the heads of wheat which produced the little yellow larvæ of the wheat-midge, *Diplosis tritici*. Nothing is known of its larva or of the habits of the fly, except that it was so numerous as to attract common attention to it, as it hovered over and alighted upon the heads of wheat at the time of their flowering.

It is described by Dr. Fitch as being "a quarter of an inch in length to the tip of the wings. It is ash-gray, with black legs, antennæ and feelers. Abdomen with a row of longitudinal brown-black spots forming an interrupted stripe along its middle. Thorax in a particular reflection of the light, showing a brown stripe anteriorly, and on each side of it a brown spot. A tawny-yellow spot upon the front, more conspicuous in the females, and passing into a black stripe upon

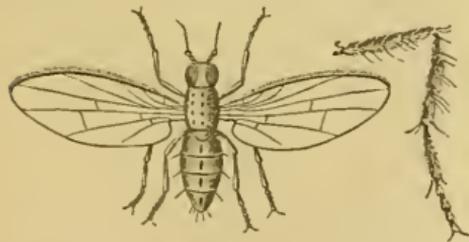


FIG. 57.—The Deceptive wheat-fly, *HYLEMYIA DECEPTIVA*, enlarged about four times, with a hind leg still more enlarged.

the top of the head." It is shown enlarged in Fig. 57, after Fitch.

Two type specimens of the species, from the Loew collection, are contained in the Museum of Comparative Zoölogy at Cambridge, Mass. Dr. Hagen finds these identical with examples of *Hylemyia* from Hudson's Bay Territory, examined by Mr. Meade, and stated by him to resemble *H. antiqua* Meig. As this latter species has since been placed in the genus *Phorbia* R. Desv., it is probable, from the above comparison, that the *deceptiva* of Fitch should also be referred to that genus.

Anthomyia similis Fitch.

The Similar Wheat-Fly.

(Ord. DIPTERA : Fam. ANTHOMYIIDÆ).

Hymelyia [*Hylemyia*] *similis* FITCH: in Trans. N. Y. St. Agricul. Soc. for 1855, xv, 1856, p. 533 ; First and Second Rept. Ins. N. Y., 1856, p. 301 (description).
Hylemyia similis GLOVER : MS. Notes Journ.-Dipt., 1874, p. 27 (mention).
 ?*Anthomyia similis* OSTEN SACKEN : Cat. Dipt. N. Amer., 1878, p. 168 (referred with doubt to *Anthomyia*).

This species is represented by Dr. Fitch as about equally numerous with the preceding, and as of the same habits. It is also quite similar in appearance, whence its specific name. It is described as being somewhat smaller in size, measuring 0.22 inch in length, and of a paler shade of ash-gray. The tawny-yellow spot upon the front of the head of *Hylemyia deceptiva* is replaced in this species by black. The thorax is also without the brown stripe and spots seen in *deceptiva*.

No figure is given of the species ; and as it does not appear that it has been seen by Baron Osten Sacken, the reason of his transferring it from the genus in which it was placed by Dr. Fitch, doubtfully to that of *Anthomyia*, is not apparent. I do not know of specimens contained in any of our collections.

NOTICE OF SOME ANTHOMYIANS MINING BEET LEAVES.

During the month of August of the past year (1881), my attention was called to an unusual condition of the beet leaves growing in a vegetable garden, in Middleburgh, N. Y. The leaves were said to be infested by some insect attack to such an extent that they could no longer be served upon the table for "greens." On examination, a large number of the leaves were found to be extensively mined in blotches of various sizes and in irregular forms. Most of them had been ruptured by the escape of the miner, leaving the blotch discolored, shriveled, and in many cases torn, apparently by the subsequent growth of the leaf. Others, smooth and unbroken, showed, in elevation, the general form of an active larva feeding within.

The Larva.

On removing portions of the thin covering cuticle, the larvæ, evidently belonging to the order of Diptera, or flies, were disclosed. The date of my first observation of them was July 19th. They were then of various sizes and in different stages of growth. When taken from their mines the largest were found to be about one-fourth of an inch in



length, of a watery color, showing in their transparency the intestinal canal crowded with its contents. The rings of the body were illy defined; the anterior end was produced in a point, beneath which the forked black jaws were visible; the posterior end was truncate, bearing a few small warts marginally, of which the two subdorsal (spiracular) ones were the largest. The accompanying figure of the larva is from an alcoholic specimen, which fails to show several of its characteristic features.

Method of feeding.—It was interesting to observe, by holding an infested leaf to the light, the method of mining and the rapidity with which it was executed. The anterior end of the larva, when feeding, was extended in an acute point, from which the two black cutting organs were protruded like a pair of nippers, the motions of which were so rapid as to suggest the idea of greediness or long abstinence from food, and extreme hunger. In excavating the parenchyma, the extensile anterior portion of the larva permitted the jaws to sweep a curve of an entire semicircle.

Larvæ first observed.—The larvæ had first attracted attention within the leaves, as was learned upon inquiry, at about the middle of June. As soon as they were brought to my notice (on the 17th of July), and their interesting character ascertained, several of the largest, still

within the leaves, were collected and placed in glass jars, where their operations could be carried on under observation. Two days later, four of the number had undergone their transformation to the pupal state.

The Puparium.

The puparia (plural of puparium) average in size, from ten examples measured, 0.21 of an inch long, by 0.08 inch broad. They are of a chestnut-brown color, oval as seen from above, but



FIG. 59.—*a*, Puparium of beetle leaf-mining *Anthomyia*; *b*, empty puparium.

but somewhat elevated dorsally when viewed laterally, a little narrowed at the anterior end, the extreme front of which, under a lens, is flattened, corrugated and with a short process (the spiracle) on each side. The division into segments is barely traceable. The last segment shows from above two minute black warts (spiracles) separated by about one-third the greatest diameter of that portion. Fig. 59 *a* represents a puparium, with a line beside it indicating its natural size.

The Fly.

The escape of the fly (imago) from the puparium is through its anterior end, by rupturing, usually, the three anterior segments (not counting the head) horizontally along their middle, to the junction of the third and fourth segments, and perpendicularly along this line of junction, as shown in Fig. 59 *b*. Of the two subequal pieces thus loosened, the upper one is sometimes wholly removed, but more frequently they each remain attached to the main body, at a portion of their transverse (sutural) line of fracture.

The flies observed.—While examining the leaves for larvæ, a number of flies were noticed, resting upon or walking over the plants, which so much resembled the common onion-fly that they were at once suspected to be the final form of the leaf-miners. Several of them were captured, and nearly all were found to be females (the proportion, seven females to one male), which had doubtless been drawn to the plants for the deposit of their eggs, while the males were probably feeding from the flowers of the *Compositæ* which the *Anthomyids* are known to frequent. Upon gently pressing the females upon the abdomen, some long white eggs were extruded, which, under a lens, showed the peculiar reticulation characteristic of *P. ceparum* and *A. betæ*, of Europe, as represented in the enlarged figures given of them in various publications. Many eggs identical with these were afterward found upon the larval infested leaves, and it was evident that the four stages of the insect had been obtained.

The Eggs.

The eggs are white, delicately reticulated, elongate-elliptical in form, 0.03 of an inch in length, and about one-third as broad (.075 mm. by .024 mm). Their general appearance is shown in Fig. 60.*



They are placed by the fly on the under surface of the leaf, with few exceptions, — sometimes singly, most frequently in twos attached by their sides, often in threes, occasionally in fours, and in a very few instances, five were seen together. Upon one leaf, during the latter part of July, when the eggs seemed most abundant, thirty-seven were counted, of which about one-third had given out their larvæ or had been killed. They were distributed over the entire surface of the leaf, but rather more numerous toward the margin. A leaf free from eggs could rarely be found.

The Mines.

When the egg hatches, the young larva enters at once into the leaf. Its burrow is at first quite narrow, scarcely exceeding the diameter of the egg-shell, but it soon enlarges, and after proceeding a short distance, expands into an irregular blotch. When two or more eggs are placed side by side, the larvæ occupy the same burrow and the same mined cavity. Their channels usually lead toward the outer edge of the leaf and extend to the margin, where the mined portions, after their abandonment by the mature larva, become dried and present the appearance before described. Occasionally, the larvæ find themselves so crowded in one portion of a leaf as to interfere with their food-supply, when some of the number emerge from their circumscribed quarters and travel to other parts of the leaf, or to another leaf, where they quickly gnaw through the epidermis and burrow beneath it. In one instance in which the operation was watched by me, the larva (a large one) had entirely hidden itself in fifteen minutes.

The Flies from Pupæ.

On August 7th, four of the flies emerged from pupæ, which had been obtained from the larvæ about two weeks before. On the 8th, several of the infested leaves were gathered, and portions cut from them containing about twenty-five of the larvæ nearly full-grown. These were placed in a glass jar of loose earth, and as the material was eaten, or became unfit for food, as it speedily did, fresh pieces were supplied. As

*The eggs of these species are longer than those shown in the figure; the reticulations also are longer and less regular, so that while their general shape is hexagonal, others are but four-sided and of the form of a parallelogram, and others still of irregular form with four, five or six unequal sides.

the larvæ matured, they left their mines and entered the earth for pupation, except in a few instances in which the puparia were formed between the leaves. On the 26th of August, ten flies were found in the jar, some of which were dead. It had not been possible to note the earliest date of their emergence, and the period of their pupation was therefore not ascertained. It will probably be found not to vary much from two weeks.

Successive Broods.

There are two or more broods of these flies annually, for at the date of leaving the locality where the above observations were made — September 6th,— the eggs were still numerous upon the leaves, although less so than in July. Their examination showed, however, that the larger number had been destroyed, perhaps by some insect puncturing them and feeding upon their contents. Of some, the entire flattened shell remained, while of others, portions had disappeared. It is possible that toward the close of the season, many of the eggs may be deposited without fertilization.

Three Species of Flies.

While rearing and collecting the above flies, I believed them to be but a single species. From the food-plant on which they occurred, and from reference to the very limited Dipterological literature accessible at the time, I thought them identical with the European species, *Anthomyia betæ*, of Curtis.* It seemed an interesting coincidence that while the past year had developed extensive injuries to the beet-crop in England, from the attack of this species which had remained almost unknown since its publication in 1860,† it should at the same time first present itself to us in this country.

Later, upon closer observation and critical comparison, I discovered material differences among my examples, which appeared to indicate three species. Knowing the worthlessness of determinations between the closely allied species of this family not based on special study, I

**ANTHOMYIA (PEGOMYIA) BETÆ.* The *males* are only known at present; they are much smaller than the Onion-fly, being only 2-3 lines long, and expanding about five lines; they are of an ashy-gray color, clothed with black bristly hairs; head semi-orbicular; eyes large, brown, nearly contiguous above, with three minute ocelli on the crown; face satiny-white, with a bright chestnut-colored line down the middle, in the center of which are placed the little black drooping horns, the third joint being the largest, elliptical, and producing a naked bristle on the back; the protruding lips and palpi are also black; on the trunk are three or five indistinct longitudinal stripes; the six-jointed abdomen is linear, with a dorsal, black triangular spot at the base of four of the segments; the two wings are ample and transparent, a little tinted with tawny at the base; the nervures are pitchy; poisers ochreous; six legs, longish, bristly and pitchy, the shanks with a tawny tinge. (*Farm Insects*, 1860, p. 297.)

† *Canadian Entomologist*, xiv, 1882, p. 96.

sent the specimens to Mr. R. H. Meade, of England, for his decision. He kindly returned me answer that the examples submitted to him belong to three different species, as supposed, but that "neither corresponds with the *Anthomyia* (*Chortophila*) *betæ* of Curtis (*sulcans* Rondani), the distinctive characters of which* are to have the femora all black in the male (posterior often testaceous in the female), as well as the tarsi, tibiæ all testaceous or piceous in both sexes; antennæ entirely black; palpi yellow with black ends."

One of the species was found to be identical with an European one, and it may therefore have been introduced in this country from Europe as among the many species which are common to the two continents, a number, doubtless, are of European origin. The species is given below.

Phorbia floccosa (Macq.) Meade.

Musca floralis? of FALLÉN, MEIGEN, ZETTERSTEDT, SCHINER, *et al.*

Chortophila floccosa MACQUART: Hist. Nat. des Insectes — Diptères, 1835, ii, pp. 326-7.

Chortophila floccosa. MEADE: in Entomol. Month. Mag., xiv, 1878, p. 252.

Chortophila floccosa. LINTNER: in Canadian Entomologist, xiv, 1882, p. 96.

Phorbia floccosa MEADE: in Entomol. Month. Mag., xix, 1883, p. 214.

In identifying this species, Mr. Meade states that it has been found in England by Mr. Inchbald, feeding in the larva state upon the roots of cauliflowers. It was the first time that it had been brought to his notice as a leaf-miner. He also writes of it: "I see that I noticed one male specimen of this species in the collection of *Anthomyiidae* sent to me from the Cambridge (Mass.) Museum." In the paper here referred to (*Canad. Entomol.*, xiii, p. 49), the determination of the species is doubtfully given, thus: "74. Very similar to *C. floccosa* Meig., 1 male, Mass." We infer from the above, that the examination of these additional examples has satisfied Mr. Meade of their identity with the one first seen.

The specific name of this species refers to a little tuft of hairs like a flock of wool under the base of the hind femora in the male. This sex may be readily recognized by this feature, and by the additional one of "the inner sides of the hind tibiæ being ciliated along the middle part of their inner surfaces with a series of short bristles of unequal length." The original description by Macquart, above cited, kindly transcribed for me by Professor Riley, is as follows:—

Length, 3 lines. Palpi and antennæ black. Face and sides of occiput whitish; frontal band black. Thorax dingy-gray with blackish lines. Abdomen cinereous

*These are mainly in addition to those given by Curtis above (differing in the color of the palpi), who only describes the male.

with a black dorsal line and black sutures. Legs black; posterior thighs with rather short hairs, tufted near the base. Alutæ yellowish. Wings slightly brownish; second transverse vein somewhat oblique and arched.—From the North of France.

As these pages are passing into the hands of the printer, a paper by Mr. Meade has been received in which the above species is noticed, and some additional facts in relation to it given. It was reared in England last summer from cabbage-plants which were represented as infested with the “grubs of the cabbage-fly.” If the very probable identity of the species with *Musca floralis* is established, then, according to Zetterstedt and Schiner, it also embraces in its food-plants the radish (*Raphanus sativus*).

Chortophila betarum n. sp.

Four examples of this species — one male and three females — were among the material submitted to Mr. Meade. They were unknown to him, and believed to be undescribed. I therefore give them a name, and present the following description:

Smaller than *P. floccosa*, and of about the size of *C. betæ*; the average expanse of wings of five examples is 0.4 inch. The thorax and abdomen are gray, intermediate in shade to *P. floccosa* and *C. betæ*.

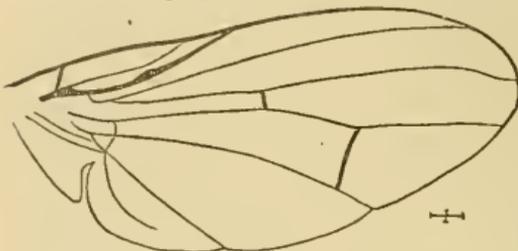


FIG. 61.—Wing of a beet-leaf miner, *CHORTOPHILA BETARUM*; enlarged 15 diameters.

The thorax has a broad dusky mesial stripe with a narrower one on each side, while the abdomen is without line or spots. In the male, the narrow front of the head is silvery-white. In the female, the space between the eyes is broad, exceeding one-third the width of the head; the frontal band is black, except a crescentiform portion just above the antennæ, which is red; the lateral borders and front beneath is whitish; the bristles of the borders are quite stout; the arista is hairy to the tip, the hairs rather long; the antennæ and palpi are black. The wings are more rounded apically and less prolonged than in the associated species (form and venation shown in Fig. 61); slightly brown in color; the costal margin distinctly spined from the base to the axillary vein, with the two spines anterior to the latter point but slightly exceeding the others in length.* The legs are black; the hind femora and tibiæ with strong bristles.

Described from eight examples — 2 ♂'s and 6 ♀'s.

**P. floccosa* has these spines strong and long — the outer one the longer.

This species has also been reared by Professor Comstock, at Ithaca, in a single example, which emerged from pupa after twenty days' pupation.

Pegomyia vicina n. sp.

Of the examples of this form, Mr. Meade writes: "They are males of a species very similar to Fallen's *Musca (Chortophila) conformis*. Fallen, however, as well as Zetterstedt, only knew the female, which has the femora all yellow as well as the basal joints of antennæ, etc., as in your specimens. I have, however, this last summer, obtained both males and females of *conformis*, bred from the leaves of *Arctium lappa* [burdock] which they mine, and the males have the antennæ quite black, and also the anterior femora, so that they differ in these respects from your species."

From its close resemblance to *conformis*, this species may be designated as *vicina*. Three examples of it—all males—were among the specimens obtained by me from the mined beet-leaves. The following is briefly its description:—

Head with a few black bristles, front whitish, with the frontal stripe pale reddish-brown; antennæ black, first joint yellow; arista with very short hairs under a strong magnifier; palpi yellow, black at tip. Thorax cinereous, inclining to yellow, bristly, faintly lined, with a broad mesial and narrower lateral brownish stripes, and spotted laterally with brown. Abdomen subcylindrical, color of the thorax, with a mesial blackish spot on the anterior half of each segment; hairs black, arranged in five transverse rows, of which those of the hinder row are long; five segments seen from above, the appendages recurved beneath. Poisers yellow. Legs moderately hairy, the femora and tibiæ yellowish, the tarsi black, middle femora more hairy beneath, with four long bristles near their base; the posterior femora and tibiæ with numerous stout black bristles. Wings slightly tinged with brown, quite iridescent, the two longitudinal veins 3 and 4 parallel toward the margin, and diverging at it, and the hinder transverse vein (9) quite angulated. Fig. 62, represents the venation of the species

Expanse of wings, 0.48 inch.

Described from two males disclosed from pupæ, August 7th.

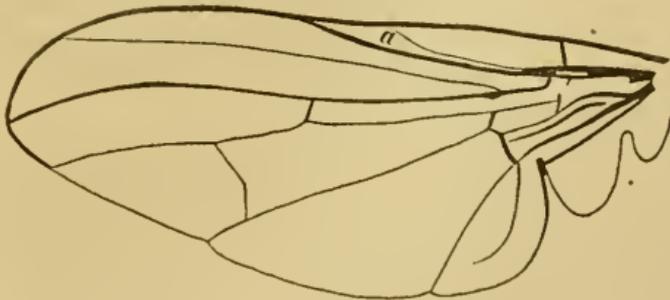


FIG. 62.—Wing of a beet-leaf miner, PEGOMYIA VICINA, enlarged 15 diameters.

During an absence of several days (Aug. 15-25) from Middleburgh, where these collections were made, a number of the flies emerged within the covered boxes in which the larvæ had pupated, and on my return they were found dead and badly injured by the mold that had attacked them and partially encased them in earth. From the material taken from the box at this time, the best portion of which was laid aside for subsequent examination, I am able to distinguish five males and three females of the above species, but from their poor condition, they can only serve the purpose of verification of the above description. This species was therefore obtained in larger number from the mined beet-leaves than either of the two others.

This species also occurs, in similar depredations in Central New York. Beet-leaves, in Morrisville, were observed during the summer to be extensively mined, and it was thought that the insect infesting them had caused sickness in several instances in persons who had eaten them for "greens." Through the kindness of Professor J. H. Comstock, in submitting to me three examples of *Anthomyiidae* which he reared from the puparia of some of the leaf-miners sent to him, I am able to recognize this species, and as it happens to be a female, to give herewith its distinctive features :—

Female P. VICINA. In color paler than the male, approaching an ash shade. The frontal band of the head is whitish, equal in width to one-third the diameter of the head, with six black bristles in each lateral margin, of which the three upper ones are directed outwardly, and the three lower inwardly. The body is narrowly oval, and its hairs are shorter than of the male; the terminal segment bears at its tip a transverse row of six long black bristles.

The puparium (as per notes of Professor Comstock placed in my hands) was received, with three others, July 25, 1881, and was believed to have transformed the previous day. It gave out the fly on August 16th, making a pupal period of twenty-two days.

A feature in the venation of this species which distinguishes it from other of its associated species examined by me, is the great constriction of cell *a* (shown in Fig. 62) at the point of thickening of the vein below it (the 1st longitudinal). In the other example of the male in my possession, the cell beyond this point toward the base, is quite obliterated — the two veins being contiguous.

The work of these leaf-miners was also observed by me during the present year, at Bennington, Vt., in a single garden, while it was not found in other gardens where search was made for them. Infested leaves were gathered and a few puparia obtained, but, as they did not produce the fly, the species could not be determined — these *Anthomyiæ* puparia showing but few features of specific value.

It is not improbable that many of our *Anthomyiide* will hereafter be found operating as leaf-miners. I can recall, in former years, meeting with miners within the leaves of various succulent plants, of which the mines were so much like those of the above described species, that there can be but little doubt that their rearing would show them to belong to the same group — perhaps to the genus *Pegomyia*, embracing so many of the leaf-mining Diptera of Europe. Mr. D. W. Coquillett, of Anaheim, California, has informed me that during the past season, he had bred from mines in the leaves of a wild sunflower (*Helianthus* sp.?), several dipterous insects belonging apparently to the *Muscide*. They were probably Anthomyians.

***Mallota posticata* (Fabr.) Wlsth. MS.**

(Ord. DIPTERA : Fam. SYRPHIDÆ.)

Eristalis posticatus FABR : Systema Antliatorum, 1805, p. 237, no. 21. Non *M. posticata* (Fabr.) of Osten Sacken : Cat. Dipt. N. Amer., 1878, p. 135 (= *M. cimbiciformis* (Falleu) Wlsth. MS.); non id., Bull. Buff. Soc. Nat. Sci., iii, 1875, p. 58 (= *M. cimbiciformis* var. *dentipes* Wlsth. MS.); non id., Western Diptera, in Bull. G.-G. Surv. Terr., iii, 1877, p. 338 (= *M. Sackeni* Wlsth.).

Milesia barda SAY : in Journ. Acad. Nat. Sci. Phila., vi, 1829, p. 163 (not the ♀).

Eristalis coactus WIEDEMANN : Aussereurop. Zweifflüg. Ins., ii, 1830, 165; Ib., p. 194, no. 62 (*E. posticatus*, translation from Fabr.).

Imatisma posticata MACQUART : Diptères Exotiques, 1840, ii, p. 2, no. 68 (♂ only).

Merodon balanus WALKER : List Dipt. Ius. Br. Mus., iii, 1852, p. 599.

Merodon bardus PACKARD : Guide Study Ins., 1869, p. 399, fig. 319; in Amer. Nat., ii, Jan. 1869, p. 593, pl. 12, figs. 10, 10 a (imago and puparium).

Merodon bardus GLOVER : MS. Notes Journ.—Dipt., 1874, p. 32, pl. viii, f. 30.

Mallota barda OSTEN SACKEN : in Bull. Buff. Soc. Nat. Sci., iii, 1875, pp. 58, 64; Cat. Dipt. N. Amer., 1878, pp. 135, 249.

Mallota posticata (FABR.). WILLISTON : MS. Monograph of the Syrphidæ, 1883.

The Family of Syrphidæ.

The *Syrphidæ*, the name of the family to which this species belongs, are commonly known by the name of *flower-flies* from the habit of the perfect insects of frequenting flowers for the purpose of feeding upon the pollen* and the nectar. They fly with great rapidity, and may often be seen hovering in the bright sunshine, for a long time almost immovably, upon their rapidly vibrating invisible wings. The family

*Although entomologists have expressed a doubt as to whether it was possible for insects possessing only a suctorial proboscis to devour such solid bodies as pollen-grains, a microscopic examination of the stomach of Diptera belonging to the order of *Syrphidæ*, showed them to contain large quantities of pollen-grains, especially of plants belonging to the order of *Compositæ*. (*Science Gossip*, for 1873, p. 41.)

is a very large one, containing no less than fifty-seven North American genera and three hundred and thirty-six species, as given in Osten Sacken's catalogue.* Many of them are conspicuously marked with brown and yellow bands or spots upon their flattened bodies. While many are smooth, others, as in the genera *Volucella*, *Eristalis*, *Helophilus* and *Mallota* are hairy, and often from their colors and hirsuteness so strongly resemble bees that they are not infrequently mistaken for them. The larvæ of many species are of eminent service in destroying plant-lice (*Aphides*), among which the parent Syrphus deposits her egg, where the young larvæ, which are destitute of eyes, have only to reach out with their extensile bodies in order to find their prey. Several species of *Eristalis* and others are aquatic, living during their larval stage in the water, where they burrow in the mud, and breathe through a long respiratory tube with which they are provided, which they protrude from the water for the reception of air. Other species (*Volucella*) occur in the nests of bees and wasps where they feed upon the larvæ and pupæ. Still others are found in decaying wood, in vegetable mold, in the soil about decaying bulbs, and in the filth of cess-pools.

A Strange Location for the Larvæ.

Dr. Packard, in his brief notice of this species, under the name of *Mallota barda*, states that "the puparium or pupa-case closely resembles that of *Eristalis*, in possessing a long respiratory tube, showing that the maggot undoubtedly lives in the water, and when desirous of breathing, protrudes the tube out of the water, thus drawing in air enough to fill its internal respiratory tubes (tracheæ)." The long breathing-tube would seem to be a fitting provision for such a mode of life, moreover, it is almost identical in appearance with the figure given by Glover (*MS. Notes of Diptera*, pl. 7, f. 28), of *Helophilus tenax*, now included in the genus *Eristalis*, which is generally regarded as aquatic. The conditions, however, under which the larvæ occurred from which I bred the perfect insect, render it probable that the present species is not aquatic. They were taken from a birch tree which stood on a knoll, twenty-five to thirty rods from the nearest water. At about thirty feet from the ground a limb had been broken off, and water had been admitted, causing a decay in the heart-wood for about three feet in extent. From this decayed material the two larvæ (together with others of different character which were not preserved) were taken and sent to me, in the fine black mold in which they were buried. The tree-trunk elsewhere was perfectly sound.

*Six genera and a number of new species have since been added. See "Contribution to a Monograph of the North American Syrphidæ," by Dr. S. W. Williston, in *Proc. Amer. Philosoph. Soc.*, 1882, xx, pp. 299-332.

The natural inference from the above statement, as communicated to me, is that the larvæ were found in the tree at the time when it was cut. Such a location for one of these peculiar larvæ would seem so different from their usually assigned aquatic habitat, that the possibility is suggested that the tree may have lain upon the ground sufficiently long before its examination to have allowed the larvæ to have entered the prostrate trunk while searching for a place for pupation. But as tending to confirm a larvation of some of these species in the mold of decaying portions of standing trees, we have the following observations made at Berlin, Conn., by Mr. N. Coleman, of another species of these curious forms:—

A singular place for Rat-tailed Larvæ.—I found several of these curious larvæ in a branch of an old apple-tree that had just been cut down. They were below a large nest of black ants, who had honey-combed the branch for quite a distance. They were twenty-five millimeters long when crawling, not so much when at rest, wrinkled and ridged rather remarkably, the tail a little longer than the body and tipped with a row of bristles curved backward. (*Psyche*, ii, 1878, p. 154.)

Habits of Rat-tail Larvæ.

These species belong to a class which Réaumur called “*vers à queue de rat*,” and which are now commonly known as *rat-tail larvæ*, from the long tail-like appendage to their body, consisting of two tubes, one of which can be drawn into the other like a telescope, through which air may be inhaled from the surface of the water when the body is buried in the mud beneath. Réaumur found, in some examples experimented with, that the tail terminated in a little knob, perforated by two holes for the reception of air, and having five little tufts of hair which floated on the water. Having placed some specimens of them in a basin of water, he saw that “they kept in a perpendicular position at the bottom, and parallel to one another, the extremities of their tails being on the surface. He then increased the depth of the water by degrees, and as it got deeper, observed that the tail of each worm became longer. These tails, which at first were only two inches long, at last attained to five.”

Description of the *Mallota* Larva.

The examples received by me about the middle of January were sordid white or flesh-color, with a body of an oval form, about three-eighths of an inch in length by about one-fourth of an inch when at rest, and about twice as long and of a diminished diameter when in motion. From the narrower end a tail-like projection is given out, an inch in length, which is slightly tapering and transversely wrinkled for two-thirds of its length; the remainder being a black, cylindrical, bristle-like process, which is unsusceptible of projection from, or contrac-

tion within, the anterior portion. When the grubs were taken from the mold, they extended their front segments like the pushing out of an introverted glove-finger, and made a moderate degree of progress over the paper on which they were placed, by the aid of several pairs of small, low, flattened ventral tubercles, bearing on their circumference a number of closely-set, radiating spinules—these organs serving the purpose of legs.

From the fact that the larvæ did not go into pupation until about a month after their reception, it may be presumed that during this time they fed upon the mold in which they were buried. If this be so, then it does not seem necessary to doubt that the place in which they were discovered was that in which their earlier larval stage had been passed.

Pupation.

Several times between February 9th and 13th, the larvæ emerged from the mold, and traveled restlessly about the jar in which they were confined, as if seeking a more agreeable or suitable retreat. Finally they remained upon the surface, being no longer able to bury in the mold. On the 16th of February it was evident that their pupal change was in progress. They had contracted materially in size, and become more pointed behind. The front segments assumed a darker shade,

and of these the first two segments were of a blackish color. The two respiratory horns on the dorsum over the second pair of leg-tubercles had become more prominent, and were now about one-twentieth of an inch long. The tube containing the respiratory seta was dark brown. An irregular-shaped packet of excremental matter was attached to the anal orifice.

The pupation was brief—twelve days in one example (a male), and fourteen in the other (a female). The flies emerged from their pupal cases, which were left as thin shreds within the puparia, by rupturing the latter in a line above the mouth-parts and again just back of the respiratory horns, and forcing off an oval piece: in one example the horns continued attached to the puparium.

The Puparium.

Fig. 63 represents the puparium as seen from above, in double its natural size. The respiratory tube is clearly seen to consist of three portions, of which the main part is more corrugated and granulose than shown in the figure. Laterally, seven slightly projecting black spiracles may be seen with a lens—one over each leg-tubercle. Ventrally



FIG. 63.—Puparium of MALLOCHA POSTICATA.

between the tubercles are transverse rows of bristles, and outside of the tubercles are longitudinal rows, which evidently are of service in locomotion. The body-portion of the puparium is flattened beneath and rounded above. The respiratory horns as figured, are somewhat foreshortened, and are not, therefore, shown in their full length.

The Fly.

The flies emerged, in a warm room, on February 27th and March 1st. Fig. 64 represents the male, in twice its natural size. The wings are transparent, without spots. The body is black; the thorax is covered with yellow hairs, which are sparsely distributed centrally; the first (basal) segment has similar hairs on its sides and base. The female differs in having the thorax, entire basal segment, and base of second entirely covered with yellow hairs, and a small brown spot* on the anterior central portion of the wing. We give herewith Say's description of it, as *M. barda*:

Body black; *hypostoma* with silvery hairs and longitudinal, polished, naked line; *antennæ* piceous; *front* covered by yellow hair; *thorax* densely covered by yellow hair, black in the middle; *scutell* piceous covered by yellow hair; wings with a large fuscous spot on the middle, obsol-



lete in the male; *poisers* piceous; *tergum* black, covered by black hairs; basal segment and second segment at base covered by yellow hairs; *feet* hairy; *tarsi* piceous; posterior thighs of the male much thickened and with their tibiae arquated. Length 3-5 of an inch. Inhab. Indiana.

Dr. Packard, represents the fly as a common species and "frequently met with." I have never taken it abroad. Dr. S. W. Williston, of New Haven, has found it rather common in Connecticut, in the month of June, about the blossoms of blackberry and dogwood, in company with *M. cimbiciformis* (= *M. posticata* of Osten Sacken's Catalogue), He had also received it from Canada and Kansas. Localities given for it (*M. barda*) by Baron Osten Sacken, are Catskill, N. Y., Massachusetts, and the White Mountains, N. H.

My specimens were determined by Mr. E. Burgess, as *M. barda*, by comparison with the original types of Say, preserved in the Harris collection, in the Museum of the Boston Society of Natural History.

*Osten Sacken's note, No. 226, on page 249 of the Catalogue of Diptera, in which he states that "the brown spot on the wings of the females mentioned in Say's description does not exist in the real female of *M. barda*," might convey the impression of the entire absence of a spot. Say's mention is that of a large fuscous spot. The spot is small and obscure, and is not a conspicuous feature.

In its reference to *M. posticata*, I have accepted the conclusions reached by Dr. Williston, as a result of his recent studies of the *Mallocha* species — kindly given me in advance of publication in his nearly completed *Monograph of the Syrphidæ*.

Drosophila ampelophila Loew.

The Pickled-fruit Fly.

(Ord. DIPTERA : Fam. DROSOPHILIDÆ.)

LOEW : Dipt. Amer. Sept. indig. : in Berl. Ent. Zeit., Cent. ii, 1862, no. 99, p. 101 (original description).

OSTEN SACKEN : Cat. Dipt. N. Amer., 1878, p. 205 (cited, with localities).

LINTNER : in Count. Gent., lxv, 1880, p. 7 (general notice).

BOWLES : in Canad. Entomol., xiv, 1882, pp. 101-104, figs. 10, 11 (description, habit, etc.).

WILLISTON : in Canad. Entomol., xiv, 1882, p. 138 (habits).

COMSTOCK : in Ann. Rept. Commis. Agricul. for 1881-1892, (1882), pp. 198-201, pl. 15, figs. 1-8 (detailed account).

Some examples of a small fly were sent to me during the month of December, with the statement that "they had been taken from a pan of decaying peaches, and on opening some of the softest, they were found filled with small white maggots. What was believed to be the same kind of maggot had been found at different times in a jar of sweet jam and in one of sour pickles, while the same flies were abundant around them."

The Fly Described.

The flies were about one-eighth of an inch long, with a large rounded thorax, the head and legs of a yellowish color, and the broad wings (form and venation, shown in Fig. 65) iridescent, with shades of green, purple, etc. They proved to be identical with numerous specimens of *Drosophila ampelophila* in my collection, having the memorandum of "bred from a jar of pickled plums, September, 1875."

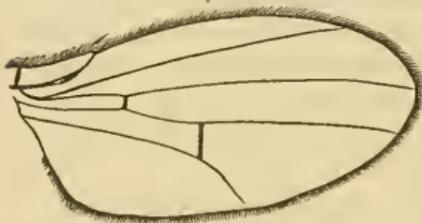


FIG. 65.—Wing of the Pickled-fruit Fly, *DROSOPHILA AMPELOPHILA*; enlarged 25 diameters.

They had been determined for me by Baron Osten Sacken, to whom I had communicated some of the examples, and he has also, as I learn from Dr. Hagen, placed specimens of the same, labeled as above and with the above memorandum, in the collection of the Museum of Comparative Zoölogy, at Cambridge.

As the original description of this species by Dr. Loew is published in Latin, in a work to be found in very few of our libraries,* I give herewith its translation:—

Drosophila ampelophila n. sp., ♂ and ♀. From pale yellow to rufescent, antennæ pallid, abdomen marked with black bands, the last two segments in the male, the last one in the female, jet-black, a jet-black apical point on the anterior metatarsus of the male, wings wholly without spots. Length of body 3-4 to 5-6 line. Length of wing 5-6 to 11-12 line.

“Front pale yellow, opaque. Antennæ pallid, the third article sometimes slightly fuscous. The prominent face pale yellow, with several rather stout beard-bristles on each side. The back of the thorax from pale yellow to rufescent, uniform in color, moderately shining. Scutellum of the thorax the same color. Pleura more pallid. Abdomen from pale yellow to rufescent, each segment girl with a posterior black band which is sometimes dilated on the middle segments; the last two segments in the male jet black, the last one in the female black or dark fuscous. The feet yellowish; the anterior metatarsus of the male has a minute jet-black tubercle on the upper side at the apex. Wings short, rather broad, from cinereous to somewhat yellow, wholly unspotted, the transverse veins not distant from each other. (Cuba; Poey.)

“NOTE.—*Drosophila ampelophila* is very frequent in the southern regions of Europe, nor is it entirely wanting to Middle Europe; it also inhabits the southern parts of Africa.”

The species will undoubtedly be found to have quite a general distribution over the Western, as in the Eastern Continent. Mr. Bowles has found it in Montreal, Canada. Dr. Williston records it in the New England States in Massachusetts and Connecticut, in great abundance in August, September and October. It occurs in Pennsylvania (Bowles), and District of Columbia and Cuba† (Osten-Sacken). It may be expected to be found in South America.

Attracted by Fermentation.

The specific name of this species signifies *a lover of the vine*. It may have originally been discovered on grapes,‡ or a more liberal translation of its name might indicate a lover of substances undergoing a vinous fermentation. As it has already been observed within decaying peaches and pears, injured grapes, and pickled plums and raspberries, it is probable that it will hereafter be found associated with a large number of fruits, berries, and perhaps garden vegetables also, undergoing fermentation, either through pickling, injury or decay. Dr. Williston (*loc. cit.*) writes of them: “Perfectly sound fruit I have

*I am indebted to Professor Riley for its transcription from the volume in the Congressional Library at Washington.

†Dr. Loew's types, from these two localities, are in the Museum of Comparative Zoölogy at Cambridge, Mass.

‡Examples of the fly have been sent to me from Rev. Samuel Lockwood, of Freehold, N. J., with the statement that the insect had infested his ripe grapes during the autumn of 1881. An account of its attack and of its life-history is promised.

never known to be attacked by them, but the slightest indication of fermentation attracts them in great numbers, and about heaps of cider refuse I have seen them in clouds."*

The Larvæ.

I have not observed the larva of this species. Mr. Bowles (*loc. cit.*) gives this account of it: "The larvæ, when full grown, are nearly one-fourth of an inch long, somewhat tapering toward the head, which is small, and are sparsely covered with minute hairs, particularly on the divisions of the segments. They have no feet, but can travel quite rapidly on glass, seeming to retain their hold by a glutinous condition of the skin, and moving by extending and contracting their bodies. They seem to exist with ease either in the vinegar or the air, moving through the former in search of food, and sometimes coming out of it, and either resting or moving about on the sides of the vessel. Their bodies were quite transparent, and under the microscope, their internal organs could easily be seen. At both ends of their bodies are curious projections or tubercles, which are also seen in the pupa. The puparium is about three-sixteenths inch long, oval in shape, and yellowish-brown in color, with the tubercles at head and tail before referred to."

A jar of pickled raspberries prepared for raspberry vinegar, opened about ten days after it had been put up, was found to be swarming with hundreds of the larvæ, crawling on the sides of the jar and underside of the cover, while numbers of pupæ, singly and in clusters, were found near the cover of the jar. The pupal state lasted ten or twelve days.

Other Species of *Drosophila*.

Twenty-five North American species of *Drosophila* are catalogued, which have all, with the exception of three species† common to Europe and America, been described by Dr. Loew, the distinguished Prussian Dipterist (lately deceased), and Mr. Walker of the British Museum. They have not been studied by our American entomologists, and consequently nothing is known of their habits. I find no reference to a single determined species by any of our writers.‡

Apple-infesting *Drosophilas*.

In the *American Naturalist*, vol. ii, p. 641, an unknown species of

*At Bennington, Vt., in August of the present year (1882), I saw beneath pieces of boards lying upon a large patch of decomposed cider refuse of last year, numbers of what was thought to be this species, but the examples taken were lost before comparison could be made.

†*Drosophila funebris* Meigen, *D. graminum* Fallen, and *D. transversa* Fallen.

‡See Note upon page 221.

Drosophila is noticed as infesting apples, preferring the earlier varieties. The larvæ enter the apple usually where it has been bored by the apple-worm (*Carpocapsa pomonella*), and sometimes through the calyx. They penetrate its interior in every direction, and if several are working together, as is sometimes the case, they render it quite unfit for use. Apples that appeared perfectly sound when taken from the tree were often found to be "all alive" with them after having been kept a few weeks. The writer of the communication referred to, had frequently observed the pupæ in the bottom of barrels in a cellar in the winter, from which the flies appeared in the spring. Dr. Packard, in his *Guide to the Study of Insects*, p. 415, figures an unknown species of *Drosophila* as the "apple-fly," which is believed to be the above species. The larvæ, of which a brief notice is given by Walsh, in vol. ii of the *Practical Entomologist*, page 20, were probably those of a species of *Drosophila*. They are described as nearly one-fourth of an inch long, of the diameter of a common pin, without legs, the color of the pulp of an apple, and with a black mark on the top of the head. They had injured an apple crop in the State of Vermont to the extent of about one-half its value by boring the fruit in every direction. They had also proved similarly injurious to apples on Long Island. On page 55 of the same volume, other "apple-worms" are noticed, which had been received from Massachusetts, which may have been of the same species, although there are discrepancies between the descriptions given of the two.

The above "apple-worms" should not be confounded with the larvæ of the apple-midge, *Molobrus mali*, of Dr. Fitch (*First and Second Reports*, page 252), which also destroy the interior of the apple, while the exterior is without blemish with the exception, usually, of the perforation of the *Carpocapsa* apple-worm, through which, it has been thought, the midge larvæ effect their entrance. This little species, now known as *Sciari mali*, belongs to a family quite far removed from the *Drosophilidæ*, viz., the *Mycetophilidæ*.

Strawberry *Drosophila*.

Larvæ, stated to be a species of *Drosophila*, have been found within strawberries.* They were gathered quite late in the season, after they were no longer offered in market; and as all were infested with the larvæ, it is not improbable that the flies may have been attracted to them through an incipient fermentation of the juices of the later berries.

The different species of *Drosophila* vary considerably in their habits, as we learn from European writers; and indeed the same species seems

**Field and Forest*, ii, 1876, p. 102.

often to occur under apparently quite different conditions. The larvæ of the European *D. cellaris* occur in fermented liquids in cellars, as wine, cider, vinegar and beer, and also in decayed potatoes. *Drosophila aceti* Kol., infests decayed fruits. Its larvæ occupy about eight weeks in attaining their growth, and their pupal state lasts for ten or twelve days; the flies appear in May and June. *Drosophila funebris* has been reared from pupæ taken from mushrooms; it is sometimes known as the vinegar fly. Another European species, the *D. flava*, is stated by Curtis, to mine the leaves of turnips, raising blister-like elevations on their upper surface.

Flour-paste *Drosophila*.

A species of *Drosophila* seems to occur occasionally in flour-paste. A gentleman wrote me as follows: "I send a package containing larvæ of a fly very troublesome around my cellar and pantry. These I found in a little paste that I had set aside for a short time. I could not obtain the flies, but presume that they will be produced from the larvæ. They are very partial to any thing in a state of fermentation, and if my pickled fruit or jam begins to sour, they find it before I do, and frequently the entire top of the fruit seems alive with the larvæ, although they never go deep in the jar."

The paste larvæ formed puparia one-tenth of an inch long, which in a short time gave out flies having a spread of wings of one-eighth of an inch. The large thorax and small abdomen are dull yellowish in color, and under a lens show a number of long, stout hairs; the wings are brilliantly iridescent. These flies are probably an undescribed species of *Drosophila*, and may be presumed to be different from those above mentioned as infesting the pickled fruit and jam: it is not improbable that the latter were *D. ampelophila*.

Mode of Attack upon Pickled Fruits.

As our pickled fruits are usually preserved in large earthen or glass vessels which are opened from time to time for the removal of a portion of the contents, the escaping acetic odor which they give forth, readily attracts the *Drosophila* flies which are to be found in our houses during the early autumn. The minute fly effects an entrance into the jar beneath a loosely-fitting lid, and deposits its eggs upon the fruit, if accessible, or upon the side of the jar, whence the young larvæ instinctively, when hatched, make their way to the fruit, or find their needed sustenance in the liquid in which they are sometimes seen to swarm. Or, with a more closely-fitting lid, the eggs may be deposited upon the outer edge, beneath which the newly-hatched diminutive larvæ insinuate themselves without material difficulty.

In a species of *Drosophila* which has recently been under my observation, occurring in a jar of mustard pickles, the larvæ, when nearly full grown, left the liquid and passed to the side and top of the glass jar in which I had placed them, where they could be observed in feeding upon the condensed moisture, and in comparatively rapid movement over the surface. Here they transformed to puparia, from which the first fly emerged in four days.

Preventives.

If a cloth or paper charged with some substance, the odor of which would overcome the acetic odor, be placed underneath the lid, if practicable, or if not, tied over it, and the exterior of the jar kept entirely free from acid, the contents of the jar will not be attacked. The flies would not be drawn to the jar for the deposit of their eggs. For the above purpose, tarred paper, such as is sometimes used for preserving merchandise from wet, would probably prove effectual. Paper steeped in strong carbolic-acid water or in soluble phenyle might be serviceable, or any strong and permanent odor might be thus used.

NOTE.—Since the writing of the preceding notice, an advance copy of the Report of the Entomologist of the U. S. Department of Agriculture, Prof. C. V. Riley, for the year ending June, 1882 [issued Oct. 13, 1882], has been received through the kindness of the author. In it is contained an account, by Professor Comstock, of the early stages of *Drosophila ampelophila*—the egg, larva and pupa—with references to a plate of several figures, illustrating structure, etc., not yet issued. A second species of the genus, *Drosophila amœna* Loew, the larvæ of which, like those of *D. ampelophila*, were reared from decaying apples, is also described and has been figured in its larval, pupal and perfect states.

Meromyza Americana Fitch.*

The Wheat-stem Maggot.

(Ord. DIPTERA: Fam. OSCINIDÆ.)

- FITCH: in Trans. N. Y. St. Agricul. Soc. for 1855, xv, 1856, p. 531; First and Second Rept. Ins. N. Y., 1856, p. 299.
 RILEY: in Rural New Yorker for Jan. 28, 1869, p. —; First Rept. Ins. Mo., 1869, pp. 159-161, fig. 90, pl. 2, f. 28 (depredations, transformations, description, remedies); in Amer. Entomol., iii, 1880, p. 181, f. 85 (mention).
 GLOVER: MS. Notes Journ.—Dipt., 1874, p. 32, pl. 9, f. 32 (not "33").
 HIND: Insects Inj. to Wheat Crops, 1857, p. 104 (description from Fitch).
 ØSTEN SACKEN: Cat. Dipt. N. Amer., 1878, p. 207 (citation).
 LINTNER: in Count. Gent., xlv, 1879, p. 535; in 39th Ann. Rept. N. Y. St. Agricul. Soc. for 1879, (1880), pp. 42-46.

Some stalks of spring wheat, from a field in Scipioville, Cayuga county, N. Y., were submitted to my examination about the 1st of

*Reprinted, with a few changes, from the 39th Report of the State Agricultural Society, of which but 300 copies were issued.

August, which were seriously affected by some insect depredator, thought by the sender to be the "Southern joint-worm."

An examination of the specimens sent revealed the ravages of a quite formidable depredator on the wheat, and one which is broadly distributed throughout the country, although thus far it has attracted very little attention. It does not appear to be known to our agriculturists, and has only, we believe, engaged the study of two of our entomological authors.

Nature of the Attack.

The heads were entirely destitute of kernels. Within some of the husks, the remains of the blossoms were discoverable, showing that their development had been arrested before the formation of the grain. Upon removing the investing sheath, the stem was found to be discolored and shrunken, and quite dry for three or four inches above the joint, and near the joint it was so eaten and shriveled as to be utterly useless for the purpose of conveying the sap:

The Larval and Pupal Forms.

Immediately above the joint, and surrounded by the remains of the stem, larvæ were discovered, a single one in each stem (shown at *a* in Fig. 66), of a watery-green color, elongate, quite tapering toward the terminal end, and sub-cylindrical at the other, and of a length of about one-fourth of an inch (shown in enlargement at *b*). In some of the stems, larvæ had assumed the pupal stage, not very unlike the larvæ in general appearance, but showing the wing-cases, a more acute form at its head, and more rounded at its anal extremity (represented at *c*).

The pupæ were also imbedded within the remains of the stem, at about the distance of half an inch from the joint.

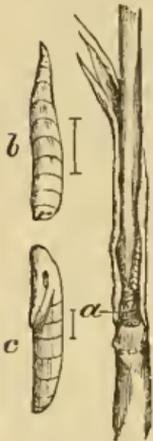


FIG. 66.—The wheat-stem maggot; *a*, the larva, natural size; *b*, larva enlarged; *c*, the pupa enlarged.

Time of Appearance of the Fly.

While examining the stems the day following their reception by me, on August 5th, two of the mature flies were discovered quietly moving over my table. They had probably emerged *en route*, and had escaped unnoticed by me from the box in which the plants had been sent. Although Dr. Fitch mentions the occurrence of this fly in wheat fields during the latter part of June, it appears that the first week in August is within its period of apparition in the State of New York, and, as indicated by the larvæ still unchanged at that time, the flies will continue to emerge throughout the month of August, and perhaps into September.

The Fly Described and Illustrated.

The insect, in its perfect state, is a fly, not unlike our common house-fly (*Musca domestica*) in general shape, but of a more slender form, smaller, and more delicately colored, and more conspicuously marked. It belongs to the family of *Oscinidæ*, which embraces several genera, and quite a large number of American species, of which, by far the larger proportion have been described by Dr. Loew.

This species was first described by Dr. Fitch, in the year 1856, in his *Second Report on the Insects of New York*, as above cited, under the name of *Meromyza Americana*. The description given is as follows:

“It is 0.17 inch in length to the tips of its abdomen, and 0.20 inch to the end of the wings. It is yellowish-white, with a black spot on the top of its head, which is continued backward to the pedicel of the neck. Thorax with three broad black stripes, approaching each other anteriorly but not coming in contact, the middle stripe prolonged anteriorly to the pedicel of the neck and posteriorly to the apex of the scutel. Abdomen, with three broad, blackish stripes, which are confluent posteriorly, and interrupted at each of the sutures. Tips of the feet and veins of the hyaline wings blackish. Eyes bright green. Antennæ dusky on their upper side.” The fly is shown in Fig. 67.



FIG. 67.—The wheat-stem fly, *MEROMYZA AMERICANA*; enlarged to six diameters.

Literature of the Species.

No account of the habits or transformations of the insect is given by Dr. Fitch, as they were unknown to him, the flies having merely been taken by him in sweeping with a net over growing wheat. Its transformations were first observed by Prof. Riley, and published by him in the *Rural New Yorker* as above cited.

In his *First Report on the Insects of Missouri*, 1869, its transformations are also described, the larval depredations narrated, and the larval, pupal, and perfect stages figured.

Mr. Townsend Glover in his *Manuscript Notes from my Journal—Diptera*, mentions the species and states: “The larvæ live in the stem of wheat, and injure it by gnawing the stalk from within, and by devouring the substance immediately above the upper joint.”

It does not appear, from the above brief mention, that it had come under the personal notice of the writer. Baron Osten Sacken has recorded the species in the two editions of his *Catalogue of the Diptera of North America*, as the only known member of the genus, placing it between the well-known genera *Oscinis* and *Chlorops*. The species is

also noticed in Hind's *Insects and Diseases Injurious to the Wheat Crops* [of Canada], Toronto, 1857, but the description is evidently borrowed from Dr. Fitch, and there is no evidence of its having been identified among the Canadian insects. The literature of the species, so far as we can discover, is limited to the above.

Its Occurrence in Missouri in 1867.

Professor Riley noticed its operations about the middle of June, 1867, in all the wheat fields examined by him between St. Louis and seventy miles westward to Bluffton, on the Missouri river. From one to four per cent of the heads of wheat in these fields had turned yellow and apparently prematurely ripened, and on close inspection were found to be stunted and shorter than the rest, and with their kernels withered and shrunken. The last or ear-bearing joint could be easily drawn out of its sheath in a yellow and dried condition, with its lower end irregularly gnawed. The larvæ causing the injury were discovered very near the joint (within one-fourth of an inch). Specimens of the infested stalks were collected, within which the pupal state was soon assumed, and perfect insects emerged during the first week in July, after a pupation of from twelve to fourteen days.

Its Operations not Noticed for Several Years.

From the above notice to the present, we have no positive information of its depredations, but there is every reason to believe that they have been meanwhile continued, while inexcusably attributed to other of the well-known wheat insects, as the joint-worm, Hessian fly and the wheat-midge, by those who should have made themselves acquainted with the very different modes of operation from which their injuries result. It is somewhat singular that investigations were not continued upon an insect of so great economic importance, and that there has not yet been given to us its complete history, commencing with the deposit of the egg.

The occurrence of this insect, in Medina county, Ohio, seems to be indicated by an inquiry made by a correspondent of the *Country Gentleman* (issue of July 27, 1876), from Hineckley, O., for information of the insect which is injuring his spring wheat—a small white worm above the joint nearest the head, causing the head to die before it fills.

Similar Grain-flies in Europe.

In Europe several of the species of *Oscinis* and *Chlorops*, which are closely allied to the *Meromyza*, are known to be injurious to wheat, rye, and barley, and one of them, the *Oscinis vastator* Curtis, is reported as having the same habit with our *M. Americana*, the larva

living near the base of the stem and eating out the plume of wheat, barley, etc., "thus destroying the future ear." *Oscinis frit* Linn., occupies the husks of the barley, injuring the crop in Sweden annually, as calculated by Linnaeus a century ago, to the amount of half a million of dollars. *Oscinis granarius* Curtis, lives in the stems of wheat, but its excessive ravages are restrained by numerous *Pteromalus* parasites. *Oscinis pumilionis* and *Oscinis glabra* Westw., occur "in the lower part of stems of wheat, rye and barley, causing the plants to become stunted in growth." Other allied species (*O. tæniopus* Meig. and others) are said to cause a swelling in the stems of wheat and barley, known in England as the "Gout."

Lack of Knowledge of our Grain-flies.

The great need of the study of our injurious insects is shown in our almost entire ignorance of the habits and transformations of the destructive flies which comprise the family of *Oscinidæ*. Mr. Glover, in his report for the year 1872 (page 134), writes: "It is singular that we hear no particular or decided complaints from our own farmers of any insects in the stalks of wheat, excepting the well-known joint-worm, which is a hymenopterous insect, and has four wings instead of two. We have several species of *Chlorops* in this country, the flies of which are extremely abundant among the plants in grain-fields, and no doubt, do attack our grain in the same manner as the European species, but as yet they have not done sufficient damage to attract the attention of the agriculturist."

Dr. Fitch, in his notice of the wheat and barley flies of the genera *Chlorops* and *Oscinis* and others (*First and Second Report No.v. Ins. N. Y.*, pp. 297, 298, 300), records and comments upon their abundance: "I have the present season discovered these small flies in abundance, in every wheat field in my neighborhood. On sweeping with a net anywhere among growing wheat, a multitude of them will be gathered. They are of several different kinds. * * * *
One of these species [*Sapromyza (Chlorops) vulgaris*] was so abundant the latter part of June, that at almost every step in any of our wheat fields a dozen or more of them could be seen. * * * *

"I doubt not it is from the number of these and other insect depredators which abound upon our wheat, that we are no longer able to produce such crops of this grain as were uniformly harvested formerly, when our lands were newly cleared. How is it possible for wheat to grow with any thriftiness when it is incessantly assailed by such hosts of these enemies, bleeding it at every pore?"

Of the above flies, Dr. Fitch names and describes *Siphonella obesa*, *Chlorops vulgaris*, *C. antennalis*, *Oscinis tibialis*, *O. coxendix*, *O. cras-*

sifemoris, *Hylemyia deceptiva*, *Hylemyia similis* and *Agromyza tritici* (*loc. cit.*, pp. 299-303),— all found upon wheat in wheat-fields, except the latter, which was reared from larvæ crawling in immense numbers from unthrashed wheat in a barn. Of the other eight species, nothing has been published of their depredations, habits or transformations, but we shall probably not err in accepting them as serious pests which are annually levying no inconsiderable tax upon our wheat crops.

One of the undetermined *Chlorops* observed by Dr. Fitch may be presumed to be the *Chlorops proxima*, of Say, the larvæ of which were recently discovered infesting wheat in the month of April, in Fairview, Kentucky, where they were found "working between the blades, and seemingly trying to reach the first joint." The identification was made, and the larva and pupa described, by Professor Comstock (in *Rept. Commis. Dept. Agricul. for the Year 1879*, p. 257), who also gives, in connection therewith (p. 258), the habits of the European species *Chlorops lineata* (so closely related to *C. proxima* as to suggest the specific name of the latter) as given by the Commission of French entomologists which was appointed by the Society of Agriculture to investigate its history and habits, in consideration of the ravages committed by it in the wheat districts.

The Common Name of this and Other Insects.

Now that the *Meromyza Americana* has been discovered in a formidable attack upon the wheat crop in our State, and the method of the injury disclosed, we shall doubtless soon have occasion to make frequent reference to it. For the convenience of ready reference a common name is desirable, which may easily be recalled by those not versed in entomological science; and as the larva is among the largest of the wheat-infesting *Oscinidæ*, it may with propriety be called *the wheat stem maggot*.* The distinctive name may not be agreeable to ears polite, yet it will have the merit of defining the order of insects to which it pertains, and names in popular use should at least convey no erroneous teaching.†

The "army-worm," the "cotton-worm," the "canker-worm," the "joint-worm," the "currant-worm," and the "meal-worm," all belong to a different animal kingdom from the worms; the "grain-weevil" is not a weevil, the latter being a beetle and the former a fly;

*An allied European species, *Chlorops pumilionis*, is known as the wheat-stem fly.

†When these names have been long applied and have come into general use, it might not be advisable, even if practicable, to correct them, but we may be able (and the effort should certainly be made) to prevent a further extension of so objectionable a nomenclature. Some of our entomologists hold to a law of priority in common names as in scientific ones, by authority of which, when once bestowed in a proper publication, they have a valid claim for subsequent use against any others that may be proposed thereafter.

and the "carpet-bug" is a beetle, and not a member of the order of bugs (*Hemiptera*). The name of "maggot" indicates the larval state of a fly, and should be allowed no farther latitude; a grub is understood to be the larva of a beetle, and a caterpillar the larva of a butterfly or moth.

Preventives.

In the event of an increase of the wheat-stem maggot to a serious extent, we regret to have to state, that in all probability, very little can be done to control its ravages, and our main dependence will have to be on parasitic aid. Measures which can advantageously be employed in controlling other of our wheat pests, as turning over the soil or burning the stubble, would be of no avail with this insect. Its pupation and transformation to the perfect stage take place, as previously related, *within the plant*, and it emerges before the grain is harvested. In some of the countries of Europe, where the ravages of the *Oscinidæ* are excessive, whenever they become extremely abundant, relief is found in a resort to the culture of other crops for a few years.

INJURIOUS COLEOPTEROUS INSECTS.

Macroductylus subspinosus (Fabr.)

The Rose-Beetle.

Ord. COLEOPTERA; Fam. SCARABÆIDÆ.)

FABR: "Syst. Ent., 1775, p. 39" (*Melolontha subspinosus*).

LOWELL: in Massachusetts Agricul. Repos.-Journ., ix, 1826, pp. 143-147.

HARRIS: in Repts. Commis. Zoölog. Surv. [Mass.], 1833, p. 71; in Mass. Agricul. Repos.-Journ., x, 1827, pp. 1-12; Treat. Ins. N. Eng., 1852, p. 30; in Bost. Cult., xvii, 1855, p. 283; Ins. Inj. Veg., 1862, p. 35, f. 16; Entomolog. Corr., 1869, p. 71.

EMMONS: Nat. Hist. N. Y.—Agricul., v, 1854, p. 78, pl. 5, f. 13.

FITCH: in Count. Gent., 1856, p. 75; same, in The Cultivator, 3d ser., iv, pp. 270, 271 (general notice); First-Second Rept. Ins. N. Y., 1856, pp. 245-252, pl. 2, f. 3; in Trans. N. Y. St. Agricul. Soc., for 1856, p. 682 (comparison with *M. barbatus*).

RATHVON: in Rept. Commis. Patents for 1861, (1862), p. 602.

GLOVER: in Rept. Commis. Agricul. for 1863, pp. 567-8 (habits, food-plants, remedies); Id. for 1867, p. 71 (figure and mention); Id. for 1868, p. 87, f. 65 (brief history), pp. 104, 107-115 (food-plants); Id. for 1872, p. 122 (remedy); Id. for 1874, p. 125 (on grapes)

WALSH: First Ann. Rept. Ins. Ill., 1868, p. 24 (preference for Clinton grape-vine).

HENTZ: in Harr. Entomolog. Corr., 1869, p. 69 (rose-bug)

PACKARD: Guide Study Ins., 1869, p. 454 (transformations).

WLSH.-RIL: in Amer. Entomol., i, 1869, p. 251 (on apples).

BETHUNE: in First Ann. Rept. Ins. Ontario, 1871, p. 78 (history).

SAUNDERS: in Rept. Entomolog. Soc. Ontario, for 1872, (1873), pp. 10, 11, f. 1 (injury to grapes); in Canad. Entomol., xii, 1880, p. 196 (on cherries).

RILEY: in Trans. Kans. St. Bd. Agricul. for 1872, (1873), p. 318, f. 18; Fifth Ann. Rept. Ins. Mo., 1873, pp. 108-110, f. 39 (natural history, etc.).

COOK: in Second Ann. Rept. Mich. St. Pomolog. Soc. for 1872, (1873), p. 667 (injury to grapes and history); in Thirteenth Ann. Rept. St. Bd. Agr. Mich. for 1874, (1875), p. 145, f. 41 (remedies).

CROTCH: Check List Coleop. Amer., 1873, p. 59, no. 3445.

LEBARON: Fourth Ann. Rept. Ins. Ill., 1874, p. 87 (mention).

HORN: in Trans. Amer. Entomolog. Soc., v, 1876, p. 184 (sexual differences).

THOMAS: Sixth Rept. Ins. Ill. [1877], p. 103 (habits, remedies, description); Seventh Rept. Ins. Ill., 1878, p. 34 (description).

LINTNER: in Count. Gent., lxxv, 1880, p. 407 (description, habits, transformations, etc.).

The appearance of this beetle, in any considerable number, is a sufficient cause of serious alarm to the gardener and fruit-grower. It often makes its advent suddenly, in immense numbers: it is exceedingly voracious, has an extensive range of food-plants, is very difficult to destroy, and is distributed over a large portion of the United States, occurring, according to Dr. Horn, especially in the Northern States, northward of a line from Virginia to Colorado. It has been known for more than a hundred years, during which time it has often forced itself upon public attention by its depredations upon fruits, field-crops, flowers, etc.

Classificatory and Descriptive.

The species, according to our present classification, belongs to the extensive group of Lamellicornes, or lamellicorn beetles, as they are commonly called, from their antennæ terminating in a club consisting of from three to seven thin, flat, movable plates or leaves, as shown in Fig. 68, which can be unfolded and closed like a fan, at the pleasure of the insect. It is a member of the family of *Scarabæide*, and of the sub-family of *Melolonthide*. The genus *Macrodactylus* signifies long-footed, referring to the long joints of the tarsus as shown below. It comprises only American species, of which but three are known. The common May-beetle, *Lachnosterna fusca*, is an allied species, belonging to the same family. Unlike that beetle, however, the rose-



FIG. 68.—The Rose-bug, *MACRODACTYLUS SUBSPINOSUS*, slightly enlarged; enlarged antenna on the right; enlarged front leg on the left.

beetle, represented in Figure 68, is comparatively slender and small. Its body is about one-third of an inch long. "It tapers before and behind, and is entirely covered with very short and close ashen-yellow down; the thorax is long and narrow, angularly widened in the middle of each side, which suggested the name *subspinosus*, or somewhat spined; the legs are slender and of a pale red color, and the joints of the feet are tipped with black and are very long."* Dr.

*For several interesting features in which the sexes differ, see Dr. Horn's Note in *Trans. Amer. Ent. Soc.*, v, 1876, pp. 182-185.

Harris also describes the larva, as follows: "They attain their full size in the autumn, being then nearly three-quarters of an inch long, and about an eighth of an inch in diameter. They are of a yellowish-white color, with a tinge of blue toward their hind extremity, which is thick, and obtuse or rounded; a few short hairs are scattered on the surface of the body; there are six short legs, namely, a pair to each of the first three rings behind the head, and the latter is covered with a horny shell of a pale rust color." In general appearance this larva closely resembles the "white-grub" of the May-beetle, which is a much larger form, being almost as thick at maturity as the little finger.

Its Food-plants,

The name of "rose-beetle" (perhaps quite as commonly known as the "rose-bug") has been given it, from its appearing at about the time of the flowering of roses, in June, and from the fondness which it displays for roses of all varieties,* with one exception, it is said,—the cinnamon-rose (*Rosa cinnamomea*). When Professor Hentz wrote to Dr. Harris (*loc. cit.*), "our 'rose-bug' is not a rose-bug, for it is never found on that flower as far as I know, which is common here [in Alabama], both in a wild and cultivated state," it would seem that his was a distinct species, or that it had developed different tastes in the Southern States. The rose-beetle is also very fond of other members of the family of *Rosaceæ*, as the apple, plum, and cherry. When abundant, however, it becomes almost omnivorous, feeding upon oak and elm and other forest trees; upon wheat and grasses, and on various garden vegetables, as pease, beans, potato, squash, etc. On a single leaf of young corn, only six inches high, twenty-five of the beetles have been counted, and one hundred and five on one hill. Grape-vines suffer severely from their ravages, as they attack at first the blossoms and later the leaves, which they completely destroy, leaving only the net-work; they eat also the young grapes. The Concord vine has been said to be preferred by them to the other varieties, and the suggestion has been made that it might be advantageously cultivated as a lure for them and their more ready destruction.† Entire peach crops have been cut off by them. Young apples, however, seem to attract them in preference to other fruits. They have been observed in apple orchards displaying so great eagerness to eat the fruit, that at

*As showing its fondness for roses, the statement made by Mr. Lowell (*loc. cit.*, p. 145) may be quoted: "Eighty-six of these spoilers were known to infest a single rose-bud, and were crushed with one grasp of the hand."

†Their preference for the Concord vine is not sustained by other observations. Professor Cook, in noticing some deplorable ravages by the insect in some vineyards in Michigan, in the years 1871 and 1872 (*2d Ann. Rept. Mich. St. Pomolog. Soc. for 1872*), states that the Clinton and the Delaware vines were entirely despoiled of their foliage and the crop ruined, while the Concord and the Catawba escaped.

times, where two or three young apples were growing from a single bud, they have mounted upon the back of one another, until a cluster of excited, struggling beetles had accumulated to the size of a man's fist. When they occur in such force, not a single apple escapes, and even the clothing of a person entering the orchard is nearly covered by them. In fields being cut for grass, it is stated that they have arisen in such numbers as to get in the faces and cover the clothing of the mowers. They eat the ox-eye daisy (*Leucanthemum vulgare*) with such a relish that it would be most fortunate if their forces could be concentrated on this noxious weed. They also often occur on the blossoms of the common elder (*Sambucus Canadensis*), and on the sumach (*Rhus typhina* and *R. glabra*).

Its Ravages.

The earliest notice of its ravages in this country appears to have been in Massachusetts, in 1810, where it was reported as entirely destroying a crop of grapes. In 1825, it was so abundant in the same State, that the State Board of Agriculture offered a premium for the best essay on the insect, which should give its natural history and point out efficient means for its destruction. The award was made to Dr. Harris, for his essay, published in the Massachusetts Agricultural Repository, as above cited. So numerous were the beetles at this time, that a large white ox-heart cherry-tree, fifty feet in height, and usually bearing from four to five bushels of cherries, was stripped of every leaf within five days after its first attack, and upon the second day not a cherry could be found on the tree which did not have upon it from two to ten of the beetles.

Mr. Bethune (*loc. cit.*) records an attack made by the beetles upon his garden, at Oakville, Ont.: "They came in vast numbers and devoured every thing — nothing appeared to come amiss to them; they were especially destructive to the grape-vines." In Kansas, in certain years, they are stated to have eaten up the fruit of whole orchards of peaches.

In 1880 the beetle was unusually prevalent in various parts of the State of New York, and particularly in the vicinity of Albany. In Schodack, it attacked the leaves of the fruit trees first, changing to the young fruit as soon as it appeared. Cherries, apples, and pears, were speedily devoured by it. At Londonville, it was very destructive to the leaves and blossoms of grape-vines, cherry leaves, young apples, rose bushes, various garden vegetables, and the white daisy. "Millions of the beetles hung in clusters from the apple-trees." A correspondent, writing from this place, represents the demonstration as a singularly local one, being almost confined to his own farm, while his neighbor's

grounds on either side were nearly exempt from it. At Adamsville, wherever the attack was concentrated, all the young apples were eaten up, and by beating down the clusters of ravenous beetles surrounding the fruit, into sheets, "bushels were collected and destroyed."

Characteristics of its Appearance.

Many of the invasions of this insect, throughout the United States, have been quite local, and limited to two or three counties of a State. In these instances, the distribution has not been general, but certain towns have alone suffered severely, and in some cases, a single farm, as above stated, has served as a nucleus for the attack.

The sudden appearance of the beetle is an interesting fact in its history. In this latitude it usually appears about the second week in June. Mr. Lowell, in his account above cited, states that on the 1st of June, at eight o'clock in the morning, he gathered a mess of pease, and not a beetle was seen on the vines. Two hours later the vines were literally overrun with beetles of both sexes, most of which were paired. Three hours thereafter, thousands were observed on some rows of beans. These were all killed, and returning to the pease, they were as full as before. Young cherry-trees were attacked and stripped of their leaves in twelve hours. After feeding for about a month, the beetles disappeared almost as suddenly as they came.

Its Natural History.

The sexual instinct is very strongly developed in this species, for whenever several of the beetles are found in company, they occur paired. They mate almost as soon as they emerge from the ground, and the males die a few days thereafter. The female, according to Fitch, when ready to deposit her eggs, enters the ground for the purpose, to a depth of from one to four inches, where she places about thirty eggs. The eggs hatch in about twenty days, and the young larvæ produced from them feed on such tender roots as are accessible to them. They attain maturity in the autumn. Late in autumn, they descend beyond the reach of frosts, where they remain through the winter in a torpid state, and in the spring burrow upward to near the surface, and mould an oval cell by the pressure of their body, within which, in the month of May, they transform to the pupal state. During the early part of June, the thin pupa skin is rent, and the perfect insect digs its way out of the ground.

Remedies and Preventives.

Hand-picking and jarring.—As with most of the beetles whose egg and larva and pupa are concealed beneath the ground, very little, if any thing, can be done to destroy this species in these stages, and it is scarcely vulnerable except in its last and perfect stage. So far as we

know, the insect enjoys an immunity from parasitic attack, and its destruction, therefore, when in excessive numbers, is left to human agency. The most efficient means to control its depredations thus far found, is collecting by hand and killing. When they infest rose-bushes, or other low-growing plants and grape-vines, they can easily be collected in a large tin pan containing some kerosene oil. From fruit-trees, they may be brought down by sudden jars of the trunk or separate branches, upon sheets spread underneath. This may best be done in the cooler parts of the day—in the morning and evening—when they are less active. They can be killed by crushing, burning or scalding with hot water. Under this latter method, they may be utilized to a certain extent by feeding to poultry. The injuries which have been reported to poultry fed upon them is doubtless owing to their having been eaten in their living state, and the irritation consequent on the active movements of their strongly spined legs.

The beetles should be gathered daily during the continuance of their abundance. Dr. Lowell, previously cited, collected them every morning for about a week, and from a quarter of an acre destroyed, on a moderate estimate, a hundred thousand.

Plaster and Tansy applications.—Plaster thrown upon grape-vines when wet with dew is said to make the leaves unpalatable to them and drive them away. A correspondent of the *Country Gentleman* states that he has had good results from syringing his vines with water in which tansy has been boiled. The application of soap-suds and tobacco-water has not proved of service.

Protection by netting.—Where it is desirable to preserve a few vines or plants from attack, it has been accomplished, in some instances, by inclosing them in millinet or some close netting. The above, however, are simply palliatives, and there is scarcely a doubt but that the proper method to combat this, at times one of the greatest scourges of our gardens and nurseries, is to collect and destroy them.

Euphoria Inda (Linn.).

The Indian Cetonia.

(Ord. COLEOPTERA : Fam. SCARABÆIDÆ.)

Scarabæus Indus LINN : Syst. Nat., Ed. x, i, 1758, p. 352; Mus. Ulricæ, 1764, p. 27; Syst. Nat., Ed. xii, ii, 1767, p. 556, no. 71.

Trichius Inda FABR : Syst. Ent., 1775, p. 40, no. 2; Sp. Ins., 1781, i, p. 48, no. 2; Mant. Ins., 1787, i, p. 25, no. 3; Syst. Eleuth., 1801, ii, p. 132, no. 6.

Cetonia Inda OLIVIER : in Encyc. Method.—Hist. Nat.—Ins., v, 1789, p. 421, pl. 160, f. 13.

Cetonia barbata SAY : in Journ. Acad. Nat. Sci. Phila., iii, 1824, p. 239.

Cetonia Marylandica FRÖHLICH. *Cetonia brunnea* DEJEAN.

Cetonia Inda HARRIS : Rept. Ins. Mass., 1841, p. 36; Treat. Ins. N. Eng., 1852, p. 35; Ins. Inj. Veg., 1862, p. 40, f. 17 (description and habits).

- Eriirhipis Inda* BURMEISTER : Handb. Entomol., iii, 1842, p. 389.
- Cetonia Inda*. EMMONS : Nat. Hist. N. Y.—Agricul., v, 1854, p. 79, pl. 12, f. 6.
- Euryomia (Eriirhipis) Inda*, GLOVER : in Rept. Commis. Agricul. for 1868, p. 90, f. 84 (habits, etc.).
- Euryomia Inda*. PACKARD : Guide Study Ins., 1869, p. 457 (mention).
- Euphoria Inda* GEMMINGER et HAROLD : Catalog. Coleop., 1869.
- Euryomia Inda*. CROTCH : Ch. List Coleop. Amer., 1873, p. 62, no. 3646.
- Euryomia Inda*. LEBARON : Fourth Ann. Rept. Ins. Ill., 1874, p. 91 (mention).
- Euryomia Inda*. THOMAS : Sixth Ann. Rept. Ins. Ill. [1877], p. 108 (description, habits, etc.).
- Euryomia Inda*. LINTNER : in Count. Gent., xlii, 1877, p. 585(*Cetonia*); in 38th Ann Rept. N. Y. St. Agricul. Soc. for 1878, pp. 67-69; Separate, as Rept. Inj. Ins. for 1878, (1880), pp. 10-12 (habits, description, etc.).
- Euryomia Inda*. RILEY : in Ann. Rept. Commis. Agricul. for 1878, (1879), p. 208, (attacking corn); Separate, as Rept. of Entomologist for 1878, p. 4.
- Euphoria Inda*. AUSTIN : Supp. Ch. List Coleop. Amer., 1880, p. 26 (generic change).
- Euryomia Inda*. SAUNDERS : in Canad. Entomol., xiii, 1881, p. 1, f. 1; in Ann. Rept. Ent. Soc. Ontario for 1881, p. 19, f. 3 (brief notice).

For many of the years of the early growth of entomological science in our country, this species was known under the name by which it was first brought to popular notice in the successive editions of Dr. Harris' valuable Report on the Insects of Massachusetts, viz., *Cetonia Inda*, and the common name applied to it at the time—the "Indian *Cetonia*." Although no longer retained in the genus *Cetonia*,—having since held place in several genera,—and as it may still be subjected to farther change—there seems to be no good reason why the first popular name applied to it should not be continued.

Alarm Excited by "a New Corn-bug."

From various sections of the State of New York and from New England, complaints were made, during the autumn of 1878, of an insect which was proving very injurious to standing corn, by burrowing beneath the husks and feeding upon the kernels. All the accounts concurred in the statement that it had never before been known to prey upon corn. The following notice of it is extracted from a New Haven, Conn., paper of September 7th, 1878 :—

"*The Corn-bug*.—The corn-fields of the interior of the State are suffering from a brown-colored, six-legged bug, having a broad body and a small head, which starts at the tips of the ears and works through to the butt, devouring the kernels. Meriden and Burlington report the ravages of the pest. A correspondent from the latter place says: 'Fields of corn are ruined almost in a single day.' A gentleman, of Woodbridge, picked twenty of the bugs off two ears of corn, August 30th. The general impression among farmers is, that this pest will prove more disastrous than the potato-bug."

From examples received by me, it proved to be no new insect, but

one that had long been known to science, and familiar to all entomologists under the old name of *Cetonia Inda*.

Habits of Associated Species.

The Cetonians, as the associated species have been called, belong to the Lamellicornes, in company with the Rose-bug and May-beetle. They are pre-eminently flower-beetles, their mouth-organs being provided with a brush of hairs with which to collect the pollen of the flowers that they frequent, as those of the golden-rod (*Solidago*), *et cet.* They are diurnal in their habits, flying actively about, with a loud humming noise like that of bees, in the warm and bright sunshine.

They appear abroad very early in the year, and I have captured examples sporting in sunny places in the woods while large bodies of snow were to be found elsewhere. Professor Forbes, of Normal, Ill., has found the species in the stomach of blue-birds (*Sialia sialis* L.), shot at Normal, in the month of March.

The Cetonians were formerly arranged in the family of *Cetoniadæ*, but later they have been placed by Dr. LeConte in the family of *Scarabæidæ*, and in the subfamily *Pleurosticti* (from the position of the abdominal spiracles), in which they constitute the tribe *Cetoniini*.

Description of the Indian Cetonia.

Thirty-one species of this tribe are known to North America, of which the *C. Inda*, or as it has been designated since the latest authoritative subdivision of the old genus of *Cetonia* — *Euphoria Inda*, is our most common species. It is a thick-bodied insect, measuring about six-tenths of an inch in length, by nearly four-tenths broad. Its appear-

ance is shown in Fig. 69. Harris describes it as having "a broad body, very obtuse behind, with a triangular thorax, and a little wedge-shaped piece on each side between the hinder angles of the thorax and shoulders of the wing-covers; the latter, taken together, form an oblong square, but are somewhat notched or widely scalloped on the middle of the outer edges. The head and thorax are dark copper-brown or almost black, and thickly covered with short, greenish-yellow hairs; the wing-cases are light yellowish-brown, but changeable with pearly and metallic tints, and spattered with numerous, irregular, black spots; the underside of the body, which is very hairy, is of a black color, with the edges of the wings and the legs dull red."



FIG. 69.—The Indian Cetonia, *EUPHORIA INDA*, natural size; a, b, c, enlargements of antenna, anterior leg, and posterior leg.

is of a black color, with the edges of the wings and the legs dull red."

Surprise at its Appearance as a Corn Depredator.

That one of our flower-beetles should present itself to our notice as a corn-pest has excited no little surprise among entomologists. Its habit of frequenting sap-trees in the spring to partake of the sap has long been known, and it is charged with the crime of occasionally burrowing into ripe peaches to feed upon the sweet and luscious pulp.* An entomological correspondent of the New Haven paper from which we have quoted above, Mr. H. F. Bassett, questions the statements made that this insect is the author of the injuries credited to it, and says: "It would be just like it to prow around and in ears of corn that some bird or beast had meddled with, but to strip the husks off and gnaw the cobs would be quite beyond the power of any flower-eating beetle known to me, their mouth not being fitted for hard or difficult work."

Earlier Notices of its Injuries to Corn.

The above-mentioned writer also states that he had looked over a large portion of our economic entomological literature, consisting of the New York reports of Dr. Fitch and the Missouri reports of Riley, the reports of the Canadian Entomological Society, and the volumes of the American Entomologist, without finding any reference to this species as particularly destructive to any thing but sweet, juicy fruits. Upon further search of our writers, I find that he had overlooked a statement made by Dr. LeBaron, formerly State Entomologist of Illinois, in his Fourth Annual Report (1874), where in a brief reference to *E. Inda*, he has written of it: "It is sometimes troublesome by burrowing into ripe fruit, and also by feeding upon sweet corn in the milk." Dr. Harris states that about the middle of September, it may be found in great numbers on corn-stalks, feeding upon the sweet sap; and Mr. Glover has seen it in the South, feeding on the exuding sap of cotton-bolls.

Its Attack Probably Follows Previous Injury.

The idea advanced by Mr. Bassett, above quoted, that this insect is not alone answerable for the injury to the corn, finds support in a communication to the *Country Gentleman* of January 16, 1879, from a correspondent at Flushing, New York, which at the same time adds another count to the formidable bill of indictment against that notorious avian pest—the English sparrow! The correspondent writes: "I had fifty or sixty hills of corn planted in my garden, which came up and thrived wonderfully, and we found it deliciously sweet; so did the English sparrows. For a considerable time we found, after it was

*Dr. Harris states that he has taken a dozen of them from a single peach, into which they had burrowed so that nothing but the naked tip of their hind-body could be seen; and not a ripe peach remained unbiten by them on the tree.

fully ripe, many ears were eaten for five or six inches from the top, and upon examining the places closely, I found one or two bugs in each one about the size of the Colorado-bug, with a mottled back something like in color to a tortoise shell, with considerable hair on the underside and legs, which I picked off and destroyed. This I followed up for three or four days, but one morning, going to the corn earlier than usual, I saw on one ear seven of the sparrows making a new opening where there was none before. Of course, here was the solution. After I had put a coat, pantaloons and hat on some sticks nailed together and stood it up in the middle of the corn, I had no more trouble with them. I supposed that the bugs did the mischief, but they had only entered where the birds had made an opening."

It is quite probable that the season (summer of 1878) was one in which the species occurred in unusual abundance, and its ordinary food not being met with in sufficient quantity to supply the wants of such a host, it was led to resort to the juices of the tender corn, as an exceptional article of food.* The excitement created by the advent of the new corn insect in several localities from which examples were received, was allayed by the assurance which we were able to give, that its large numbers at this time would not probably be followed by an increased or even an equal number the next year,* it being well known to entomologists, that a year noted for the abundance of some particular species of insect may be followed by many when the same insect will be rarely met with.

Time of its Appearance.

Dr. Harris' statement that this insect has its second brood about the middle of September, in Massachusetts, may need some modification. Examples of this brood were found as early as the middle of August, near Bridgeport, Conn. Mr. Bassett records its having been seen by him feeding on the sap which flows from certain woody galls on oak trees. The intense bitterness or acidity of most galls would seem to be very unlike the sweets for which it manifests so great partiality.

Mr. Bland, in a communication to the Entomological Society of Philadelphia (*Proc. E. S. Ph.*, i, 1864, p. 42), reports finding the species on the 25th of August, in Camden county, N. J., abundant on *Vernonia noveboracensis*.

Another species of this genus, the *Euphoria melancholica* Gory, of which a figure is given in the *American Entomologist*, vol. ii, p. 61,

*Its abundance at this time is recorded by the Entomologist of the Department of Agriculture, in his résumé of the correspondence of the Department for the year 1878, as follows: "One of the commonest flower-beetles (*Euryomia inda*) has been received from several correspondents as attacking green corn — a habit which the species was not before known to possess, and which has, beyond much doubt, been recently acquired."

fig. 39, is frequently found in Illinois, boring into apples, and is represented as fond of eating into the flowers and fruits of a variety of plants.

Other Injuries by the Insect.

Professor H. Osborn, of the State Agricultural College of Iowa, in his Entomological Report for 1879, made to the State Horticultural Society (pp. 85-107), records a habit reported to him as recently observed in this beetle, which has not been previously recorded, and which will require verification before it can be accepted. The beetle had been sent to him, with the statement that it had done much damage to apple-trees by gnawing off the bark, and that one tree had been entirely ruined. The portion of the branch which accompanied the beetle was so badly damaged as to resemble the girdling done by rabbits and mice.

As we cannot accept the tearing open of the husks of the corn to reach the tender kernels, by this flower-beetle, for like reasons it seems far more probable, that the above injuries to the apple-trees had been committed by some other depredator, and that the beetle found upon the wounds had merely been drawn thither to feed upon the oozing sap.

From the known habits of allied Cetonians, this species is, in all probability, injurious in its grub or larval state to the roots of many of our cultivated plants, but as its history has not as yet been worked out, we remain ignorant of the nature and extent of its injuries. A species nearly related to it, *Allorhina nitida* Linn., has been noticed at times as quite injurious to strawberries,* after the habit of the green rose-chaffer, *Cetonia aurata*, of Europe,† and there is little doubt but that *E. Inda* will be hereafter found attacking the same plant. Although Curtis distinctly states that *C. aurata*, in its grub state, lives two or three years under ground, feeding on the roots of grass and various plants and breeding amongst strawberry beds, yet it is questioned by some of our writers whether injuries of serious amount are committed by these insects in their larval stage. The belief seems to be gaining ground that their food consists mainly of decaying vegetable matter. Dr. Thomas is of the opinion that *E. Inda* breeds in decayed wood, as the beetles may often be seen flying over chip-yards as if in search of a place to deposit their eggs.‡

A Grass-feeding Larva of an Allied Species.

In corroboration of their grass-feeding habits, we have the interesting account given us by Mr. L. O. Howard,§ of the remarkable occur-

**American Entomologist*, i, 1869, p. 246.

†Curtis' *Farm Insects*, 1861, p. 107.

‡*Fourth Ann. Rept. Ins. Ill.*, 1874, p. 91.

§*Canadian Entomologist*, xi, 1879, p. 200.

rence of thousands of the larvæ of the May-beetle, *Lachnosterna fusca* Fröhl., observed by him, on one occasion, on the stone pavements adjacent to the Capitol Building at Washington; and of the statement made to him by the Superintendent of the grounds, that the sweepers of the walks would frequently collect as many as a bushel basket full of the larvæ. Professor Riley has informed me that it has been subsequently ascertained that the above species was not the May-bug, but the *Allorhina nitida**; and, he suggests, that while their larvæ must have been feeding upon the roots of the grass within the grounds where they were found in such excessive numbers, still, as there are always many decaying rootlets among all grasses, it is possible that their food may, in part, have consisted of these.

The *E. Inda* is of serious harm at times in its resort to flowers to feed upon the pollen, by its destroying the anthers and thus rendering the blossom abortive.

Preventives and Remedies

Guarding corn from attack by birds.—It is but seldom that this species occurs so abundantly as to become a serious corn-pest. In seasons of unusual abundance, its depredations upon corn could undoubtedly be prevented by guarding against the opening of the corn-husks to admit of their entrance. As the first attack upon the corn appears, in most cases, to be made by small birds, if these can be kept away, the resultant attack of the beetles will be prevented. When they have discovered the exposed kernels of corn, and commenced to feed upon them, it will then be necessary to collect the beetles by hand and destroy them.

Catching the beetles in nets.—When they are attracted to ripe fruits, they may easily be discovered in their circling flight around the trees, by the loud humming which they produce, when they may be captured in nets attached to long handles.

Hand-picking from flowers.—When they frequent flowers and blossoms to feed upon the pollen, they should always be picked off and killed.

Collecting the larvæ after heavy rains.—If there is reason to believe that the larvæ are depredating upon the roots of grasses, search should be made for them on the surface of the ground after heavy rains, when, in the proper season, large numbers may perhaps be collected. This method of prevention is deduced from Mr. Howard's observations (*loc. cit.*), from which it appears to be the habit of *A. nitida* (and by inference, of *E. Inda*, also) to appear above ground at such times, when

*Mr. Howard also makes the correction in the *Canadian Entomologist*, xiv, 1882, p. 240, and states that the error was shown by rearing the larvæ to the perfect state.

near maturity. The date of the remarkable appearance of *A. nitida* at Washington, was September 14th. About the middle of September, or somewhat later for more northerly latitudes, would therefore be a proper time for searching for these larvæ. The experiment might also be made, when their presence is suspected in grass-plots, of sprinkling the ground copiously with water, in the hope that they will present themselves above ground in response to the invitation.

***Crioceris asparagi* (Linn.**

The Asparagus Beetle.

● (Ord. COLEOPTERA : Fam. CHRYSOMELIDÆ.)

- LINNEUS: Faun. Suec., 1796, Ed. i, p. 151; Ed. ii, p. 172; Syst. Ent., p. 601, no. 112
 WESTWOOD: Introduc. Mod. Class. Ins., i, 1839, p. 374, f. 45, nos. 15-18 (figs. of eggs, larva and imago).
 KOLLAR: Ins. Inj. Garden, etc., 1840, p. 140 (general description of larva and imago).
 CURTIS: Farm Insects, 1860, p. 307 (mention).
 FITCH: in Count. Gent., xx, 1862, pp. 81, 82 (discovery, transformations, etc.); in Trans. N. Y. St. Agricul. Soc., xxii, 1863, pp. 659-668 (introduction, distribution, life history, etc.); Sixth-Ninth Repts. Ins. N. Y., 1865, pp. 177-185 (same, and figures from Westwood).
 GLOVER: in Rept. Commis. Agricul. for 1865, p. 91 (importation).
 WLSH.-RIL.: in Amer. Entomol., i, 1868, pp. 114, 115, f. 94 (history, and figures from Westwood).
 PACKARD: Guide Study Ins., 1869, p. 502 (notice of introduction); in Ninth Rept. G.-G. Surv. Terr., 1877, p. 764 (brief notice).
 DODGE: in Rept. Commis. Agricul. for 1870, p. 513 (damages).
 ———: in Count. Gent., xxxvii, 1872, p. 520, c. 3; Id., xlvi, 1881, p. 291, c. 1 (remedies).
 CROTCH: Check List Coleop. Amer., 1873, p. 94, no. 5558.
 THOMAS: Fourth Rept. Ins. Ill., 1874, p. 165 (mention); Sixth Rept. do., [1877], p. 158 (description and remedy).
 FULLER: in Count. Gent., xli, 1876, p. 683; Id., xliv, 1879, pp. 743, 791; in Amer. Entomol., iii, 1880, pp. 3-5 (lime remedy).
 ORMEROD: Rept. Inj. Ins. for 1877, (1878), p. 17 (remedy); Manual of Inj. Ins., [1881], pp. 1-3 (description, remedies and figures).
 COMSTOCK: in Rept. Commis. Agricul. for 1879, (1880), p. 216-218, pl. 3, f. 4 (notes and original figures).
 LINTNER: in Count. Gent., xlvi, 1881, p. 243 (history, description, habits and remedies).

This beetle seems steadily to be extending its depredations to new localities, as complaints are being made from time to time, of its first appearance in different places, and information is solicited of its habits and the means of destroying it. It is fortunate, in view of its destructiveness, that its progress, unlike that of another member of its family — the Colorado potato-beetle — is quite slow, and that it as yet gives no manifestation of its distribution throughout the United States.

During the early years of its operations in this country, it was estimated that its rate of distribution would be about twenty miles a year. This rate of progress, however, has not been sustained. About twenty-five years have passed since its introduction, and during that time, it has not extended to any great distance from the sea-coast, where most of our larger asparagus plantations occur. As yet, we only hear of its serious injuries from Long Island, the vicinity of New York city, New Jersey, Eastern Pennsylvania and Southern Connecticut. It doubtless exists beyond these limits, but I find no published statements of its presence elsewhere. We have not yet observed it in the vicinity of Albany.

Its Introduction into the United States.

The asparagus beetle is one of the many injurious insects which have been brought to this country from Europe, and it is among the latest imported. It is not known how long it had existed in Europe, or where it originated, but there is reason to believe that for several centuries it had no general distribution. Asparagus had been cultivated in Europe from a very early date — at least 60 years before the Christian Era. It was held in much favor by the Greeks, and the Romans must have acquired great skill in its production, for according to Pliny, three shoots of that grown at Ravenna weighed a pound. Linnæus states (*loc. cit.*), that the gardeners believe that the beetle was imported from Russia, but that it was never known as obnoxious there. Fr. Th. Keppen, in his *Obnoxious Insects of Russia*, p. 273, 1880, states that *Crioceris asparagi* is sometimes common in Russia and the Caucasus, but never proves obnoxious.

In this country it was first noticed at Astoria, near the western end of Long Island, in the year 1859, the same year in which the first specimen of the imported cabbage-butterfly (*Pieris rapæ*) was captured by Mr. Couper, within the city limits of Quebec. The actual importation of the two species was probably three or four years earlier, in 1856 or 1857. Mr. Ulke is reported to have taken some specimens of the beetle in or near the city of New York as early as the year 1858 or 1859.

Its Spread Throughout Long Island.

In 1860 it proved moderately destructive at Astoria, increasing its injuries the following year, and the third year, destroying the grown plants to the extent of killing the roots and necessitating the plowing up of the beds.

In 1862, it had spread as a serious pest over all the asparagus plantations of Queens county, Long Island. The attention of Dr. Fitch was called to the invasion. He visited the locality for the purpose of

investigating the habits of the insect, and from the careful observations made, gave a very interesting paper upon it, embracing also the history and culture of the asparagus plant, in his *Eighth Annual Report on the Insects of New York*, published in the *Transactions of the State Agricultural Society*, vol. xxii, 1863. A previous publication, describing the insect in its different stages, had been made by Dr. Fitch, at a somewhat earlier date, in the *Country Gentleman*, as above cited. In this year it had already spread along the north shore of Long Island for a distance of forty miles. It threatened to ruin every plantation in Queens county, at a prospective loss estimated at \$50,000 annually.

A Parasitic Attack.

In the year 1863, when to all appearance the cultivation of asparagus was arrested, relief came through the attack of "a small, shining-black parasitic fly," belonging to the family of *Chalcididae* or *Proctotrupidae*, which is supposed to have laid its eggs in the eggs of the asparagus beetle or in the larva, and by the destruction of large numbers of them, materially to have checked the depredations of the insect (*American Entomologist*, i, 115). I do not find any particular account of this valuable parasite, which seems, very strangely, not to have received scientific attention.

Its Extension into New Jersey.

For some following years, less was heard of these injuries on Long Island, which may in great part have resulted from an experience gained in methods for their prevention.* In the year 1868 it was noticed in New Jersey, where it has since

proved very destructive. In the second year of its operations at Burlington, N. J., one-fourth of the asparagus crop was destroyed; in several instances, entire beds were ruined in the third year of the attack. It has also been very destructive in Essex county, in the same State. The present year complaints have reached me, from Camden, N. J., of the great difficulty encountered in efforts to check the increase (*Country Gentleman*, for April 14, 1881).

Its Description.

The egg.—The eggs of the beetle are of the size and form shown at the middle of Fig. 70. At the right, they are given in enlargement.



FIG. 70.—The Asparagus beetle, *CRIOCERIS ASPARAGI*, its eggs and larva in natural size; also, the eggs and larva enlarged to about three diameters. (After Fitch.)

*In 1878, it was reported as very serious in Suffolk county, in the vicinity of Quogue, near the eastern end of Long Island (*Report of the Entomologist of the Department of Agriculture for the year 1878*, p. 3).

Their color is blackish-brown. They are placed on end on the young plant, usually in rows of from two to seven. When the plants are grown, the eggs are deposited on the leaves near the end of the delicate branches.

The larva.—The young larva and the mature form are represented upon the upper portion of the stem, and on the left in the figure, it is given enlarged. Its greatest length is about one-fourth of an inch. "It is of an obscure olive or dull ash-gray color, often with a blackish stripe along the middle of the back. It is soft and of a flesh-like consistency, about three times as long as thick, thickest back of the middle, with the body much wrinkled transversely. The head is black and shining, and the neck, which is thicker than the head, has two shining black spots above. Three pairs of legs are placed anteriorly upon the breast, and are of the same shining black color with the head. As will be seen when it is crawling, the larva clings also with the tip end of the body; and all along its under side may then be seen two rows of small tubercles, slightly projecting from the surface, which serve as prolegs in addition to the tip of its body. Above these tubercles on each side is a row of elevated shining dots like warts, above which the breathing pores appear like a row of minute black dots." (Fitch.)

The beetle.—The beetle is a very pretty insect in its trim form, contrasting colors of yellow, red and shining-black, and its conspicuous ornamentation. Its average length is a little less than one-fourth of an inch. The head is black, with the first three joints of the short antennæ smaller and differently colored from the remainder. The finely punctured thorax is tawny-red, marked more or less distinctly on its crown with two black spots. The wing-covers are punctured in rows, and usually appear of a lemon color, broken into three spots on each, as in the accompanying figure, by a black stripe along their junction, a black transverse band a little behind their middle, and an interrupted one near their tips. Outwardly the wing covers are bordered with orange. The body beneath and the legs are shining black, the latter sometimes showing a yellowish band upon them.

Examples having the wing-covers marked as above, suggest the representation of a black cross upon the back, for which reason it is sometimes known in England as the "cross-bearer."



FIG. 71.—The Asparagus beetle (the "cross-bearer" form), its larva, and its eggs upon a young plant.

In some of the beetles, the wing-covers may be described as blue-black, with an orange margin on the sides and at the tip, and above with six small yellow spots. Fig. 72 from examples in my collection, received from a market in New York city, is the variety which Dr. Fitch seems to have had before him for his careful description. "Along the middle of each wing-cover is a row of three lemon-yellow spots. The anterior one of these is placed upon the base of the wing cover, and is usually egg-shaped with its pointed end directed backward. The middle spot is placed at a third of the distance from the base to the tip of the wing-cover. It is transverse, being a third more broad than long, and is thicker toward its inner end, which terminates at the third row of punctures from the suture, its opposite or outer end being confluent with the orange border. The hind spot is placed nearer to the middle spot than to the widened orange tip of the wing-cover. It is similar in most respects to the middle spot, but is frequently smaller and placed somewhat obliquely, its inner end inclining backward, and its outer end uniting with the orange border by a narrow neck."

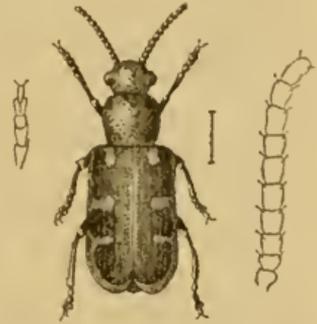


FIG. 72.—Asparagus beetle (a common six-spotted form), enlarged about six diameters, with further enlargement of antenna and front tarsus.

The above variety would hardly be recognized as identical with the form usually figured. The elytral spots have been described in general terms as very variable in shape and size. Fitch notes their great variation. It is interesting to find that such marked variation in individuals can co-exist with such permanency of feature, that the pattern so minutely described by Dr. Fitch is exactly that shown by the example figured from my collection.

Its Family Relations.

The family of *Chrysomelidæ*, to which the asparagus beetle belongs, is a very extensive one, and is estimated by Dr. Packard to contain from 8,000 to 10,000 species.* The Crotch Check List records the names of nearly 500 North American species. In appearance, these insects are of rather small size, oval or oblong in form, often quite convex above, with prominent eyes, short antennæ, a narrow cylindrical thorax generally, and often with the hind thighs much thickened. The family was formerly more restricted than at present—Westwood and others recognizing distinct families of *Crioceridæ*, *Cassididæ* and *Galerucidæ*, which more recently, together with other groups, which

**Guide to the Study of Insects*, 1869, p. 501.

had been regarded as of family value, have been united by Dr. Le Conte, Dr. Horn, and others, as the *Chrysomelidæ*, with ten sub-families, of which the *Criocerides* form one. Many of the members of this family as now constituted, are very destructive to our crops and especially to the products of the garden, in both their larval and perfect stages, by feeding on the leaves; the larvæ of some destroy plants by boring into the roots. We may cite as familiarly known representatives, the three-lined leaf-beetle, *Lema trilineata* (Oliv.); the striped cucumber beetle, *Diabrotica vittata* (Fabr.); the cucumber flea-beetle, *Epitrix cucumeris* (Harris); the grape-vine flea-beetle, *Graptodera chalybea* (Ill.); the turnip flea-beetle, *Phyllotreta striolata* (Fabr.); and the Colorado potato-beetle, *Doryphora 10-lineata* (Say).

Recent Introduction of another Asparagus Beetle.

The *C. asparagi* has for a long time remained the only representative of the genus *Crioceris*, in the United States. Recently, however, a second species has been introduced, which, it is feared, may prove more injurious to asparagus than its naturalized congenor. We quote from the *American Naturalist*, for February, 1883:—

“Mr. Otto Luggar, of Baltimore, Md., has already recorded the recent introduction from Europe of a second asparagus beetle, the *Crioceris 12-punctata* Linn., which in Europe occurs commonly wherever asparagus is cultivated, without, however, doing serious injury. Mr. Luggar found it first in the summer of 1881, near Baltimore, in small numbers and quite local, but it has recently proved even more troublesome than *C. asparagi*. From the latter species this new enemy may at once be distinguished by its less elongate form, and by the bright orange-red of the upper surface, each elytron being marked with six small black dots.”

Miss Ormerod remarks of this species that it is seldom found in England.

Natural History.

The history of *C. asparagi* is, in brief, as follows: The beetles destined to continue the species, survive the winter in dry, sheltered places, as beneath bark, in crevices of wood, and under the clapboards of buildings. Simultaneously with the appearance of the asparagus shoots in early spring, they emerge from their winter quarters, and commence to feed upon the tips of the plants. The sexes pair, and the female deposits her eggs upon any portion of the exposed shoots. The eggs hatch in an average period of eight days. The larvæ eat voraciously and grow rapidly, so that they complete their growth in about twelve days. They then leave the plants and enter the earth for a short dis-

tance or merely conceal themselves beneath dead leaves or other material on the surface. Constructing a slight cocoon, they undergo their transformation, and remain in their pupal state for about ten days. Thirty days complete the cycle from the egg to the perfect insect. Almost as soon as the beetles emerge, they pair, as the sexual instinct is strongly developed in them, as is shown in the frequency in which they come under our observation mated. The eggs are then deposited, and the beetles continue to feed upon the plants, eating holes into the bark of the more tender branches for several days: one was found by Dr. Fitch to feed for a fortnight in confinement. A second brood results from these, appearing about the first of July, followed by a third, probably in August. Hence we have the larvæ and the beetles with us, in their successive broods, through the spring and summer, into September.

Remedies and Preventives.

Hand-picking and beating.— Although this beetle has been known for nearly a century in Europe as a serious asparagus pest, yet no other remedies for its injuries, until very recently, have been suggested, so far as we know, except that given by Kollar, who states that “the only means of destroying these insects is picking off and killing the beetles and larvæ,” and by later writers, to shake them off into a pan of water, when they may be crushed under foot, or killed by pouring boiling water upon them. These methods would obviously be ineffectual for the destruction of the hosts that concentrate in our large plantations of this highly prized esculent on the sea-board, sometimes twenty acres in extent, or in the even larger plantations now cultivated in England.

Fowls for hunting them.— The only recommendation that Dr. Fitch, at the time of his writing, was able to make, was to turn in a flock of fowls and permit them to range over the plantation. They pursue with avidity the beetles, which are evidently attractive morsels to them, and they do not molest the plants — the asparagus being an exception to their fondness for many of the garden vegetables.

Lime dusting.— Mr. A. S. Fuller, of Ridgewood, N. J., has furnished to the *American Entomologist*, for January, 1880, a method for destroying this pest, which, as it presents the result of his personal experience, seems to be all that is needed for the purpose. Shortly after its appearance on Long Island, it was discovered, according to Mr. Fuller, that freshly-slacked lime, scattered over the plants, would instantly kill

*The largest cultivator in Deptford has eighty acres entirely laid out in asparagus beds.
— *Lib. Entertain. Knowl., Veg. Subst.*, p. 276.

every larva that it touched. The lime may be conveniently applied by using an old broom for a duster, or a Paris green sifter. With a pail full of dry lime, a man could in a short time dust an acre of asparagus. "The lime is best applied in the morning while the dew is on, for then a portion will adhere to the plants as well as the grubs, and during the day or days following it will be constantly dropping down or blowing about among the leaves and branches, thereby making the escape of any of the larvæ all the more uncertain. * * *

* * * For the past sixteen years, I have used lime as described, upon my asparagus beds, to keep the insect in question in check, and it has done it so effectually that about one application every alternate season has been sufficient" (Fuller). Not only is lime cheap and readily procurable everywhere, but it is also of benefit to the asparagus roots. It has also the additional merit as an insecticide, that it can be used upon the young plants while they are being cut for market, for the destruction of the first brood of larvæ, while Paris green or London purple may not safely be used.

Cutting away the young seedlings.—The Long Island gardeners have found great relief from the excessive ravages of this insect by cutting down in the spring at the time when the beetle is ready to deposit its eggs, all the young seedlings which are usually selected for oviposition as well as for food, and thus forcing the beetles to deposit their eggs upon the new shoots. These being cut for market almost daily do not permit the eggs to hatch, and by this means, the greater portion of what would be the second brood is destroyed.

Removing the seed-stems.—It has also been recommended to cut down all the seed-stems as soon as the asparagus season is over, and to repeat the process once or twice during the season, leaving the beds bare and smooth. It is difficult to see how this entire destruction of the leaves of the plant can fail of proving injurious to it, the action of leaves being deemed essential to the proper development; yet Mr. H. H. Sargent, in a communication to the *Gardeners' Monthly*, states that the earliest, best, and largest asparagus in his neighborhood was grown by this method of treatment, which had been continued for five successive years (*Country Gentleman*, Aug. 15, 1872).

As, however, the asparagus plant occurs in a wild state along the roadsides and in fields and woods upon Long Island, and presumably in New Jersey and other localities where it has been for some time cultivated, the above method could only serve to alleviate the evil, for a sufficient supply of food would thus be furnished the insect for its propagation and subsequent colonization upon cultivated tracts.

Phytonomus punctatus (Fabr.).*The Punctured Clover-leaf Weevil.*

(Ord. COLEOPTERA: Fam. CURCULIONIDÆ.)

FABR.: "Syst. Ent., 1755, p. 150, no. 119; Sp. Ins., 1781, i, p. 190, no. 166; Mant. Ins., 1787, i, p. 117, no. 221."

OLIVIER: in Enc. Method., v, 1790, p. 541, no. 315 (descript. as *Curculio punctatus*).

RILEY: in Amer. Nat., xv, 1881, p. 751 (discovery); Id., p. 913 (congeners, habits, eggs and larva); Id., xvi, 1882, p. 248 (*P. opimus* is same); in Ann. Rept. Dept. Agricul. for 1881, pp. 171-179, pl. 10, f. 1 (life-history, early stages, remedies, etc.).

LINTNER: in Elmira Husbandman for Sept. 14, 1881; in Count. Gent., xlvi, 1881, p. 647 (introduction, description, etc.).

LE CONTE: in Proc. Amer. Phil. Soc., xv, 1876, p. 124 (*Ph. opimus*); in Monthly Proceed. Ent. Sect. Acad. N. S. Phila., Oct. 1881, p. xxxvi (identical with *P. opimus*, Lec.).

This species is a late addition to our list of insect pests. It is an European species first described by Geoffroy in 1762, but without specific name; in 1775 it was again described by Fabricius as *Curculio punctatus*. The first public notice of its occurrence in this country was given by Professor Riley, in a verbal communication made at the meeting of the American Association for the Advancement of Science, held at Cincinnati, in August, 1881. While en route to the meeting, he had witnessed its operations in Yates county, in this State, where it was found feeding upon the leaves of clover, to which it was said to be destructive, both the larvæ and the perfect insects combining in the attack. The extent of its depredations or its abundance was not given. The interesting fact was stated that this newly-imported European beetle had first made its appearance in the locality where the clover-root borer, *Hylastes trifolii*, also introduced from Europe, was discovered in the autumn of 1878. It was deemed probable that the two species were brought over at the same time, but that the former, from its less rapid multiplication, had hitherto escaped observation.

Description of the Beetle.

The beetle measures over four-tenths of an inch in length, is of an oval form, and of a brown color, which is paler over four rows of punctures on the sides, and sometimes upon the sutural line. The beak is rather short, broad and blunt. The thorax is smooth, elevated, traversed by three pale lines; both it and the wing-covers are clothed with short, yellowish-brown hairs, and upon the ridges of the latter are arranged a number of black scale tufts. The prominent feature of the beetle, giving to it its specific name, is the series of close punctures arranged in ten deeply impressed lines upon each wing-cover.



FIG. 73. — The punctured clover-leaf weevil, *PHYTONOMUS PUNCTATUS* — twice the natural size.

The Cocoon.

The singular net-work cocoon constructed by the larva for its transformations, resembling some of those made by the caterpillars of moths, is shown in Fig. 74 at *a*, and at *b* in enlargement, nearly double its natural size. These peculiar open-work cocoons are made, it is believed, by all the species of the genus. They are composed of loose threads permitting the larva or pupa to be seen through the meshes, and, according to Westwood, they are attached to the underside of various leaves.* Professor Popenœ, in his *List of Kansas Coleoptera*,† gives this account of the cocoon of an allied species, *Phytonomus eximius* Lec., which is found on leaves of *Rumex Britannica*: "The pupal stage is passed in a cocoon spun by the larva, on the leaf-surface, usually next to a rib. The cocoon is formed of yellow-brown threads, loosely interwoven, so that the fabric resembles net-work. It is broad oval in outline. The pupa within is very nervous, and twists around rapidly when the leaf is touched." *Phytonomus comptus* (Say) spins a similar cocoon.

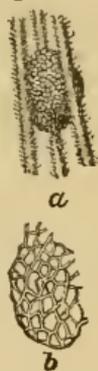


FIG. 74.--Cocoon of the punctured clover-leaf weevil, at *a*, of natural size, and at *b*, enlarged to show its reticulated structure. (After Riley.)

These net-work cocoons are not confined to the genus *Phytonomus*, for they are known to be made by *Curculio pimpinellæ*, of Europe, and also by *Cionus scrophulariæ* (Linn.), according to Westwood, occurring in both Europe and America.‡

Not Previously Known as a Clover-insect.

In Europe, where the genus is more numerously represented than in this country, two species, viz.: *P. nigrirostris* (Fabr.),§ and *P. meles* var. *trifolii*, are recorded by European authors as preying upon clover, but no mention is made of *P. punctatus* as attacking that plant. Dr. Hagen, as the result of an extended examination, informs me that he finds it not mentioned by any writer as injurious, nor any thing recorded of its history or food-plant, and that certainly up to 1871 the larva was unknown. In a list of known larvæ of Coleoptera published by Mr. Rupertsberger, in 1879, among fifteen species of *Hypera*, under which genus *Phytonomus punctatus* was formerly arranged, the

*Mr. J. A. Osborne has found the cocoons of *P. (Hypera) rumicis* as often on the upper as on the lower side of the leaf (*Entomologist's Magazine*, 1879, xvi, p. 16).

†*Transactions of the Kansas Academy of Sciences*, v, 1877, pp. 21-40.

‡Westwood: *Introduc. Mod. Classif. Insects*, i, 1839, p. 343. Mr. Osborne, however, states (*loc. cit.* p. 18), that all the cocoons of *C. scrophulariæ* seen by him were close and membranous, thick and tough. They are sparsely covered in the middle region with raised whitish "goose-skin" points, which appear to be produced by the subsequent filling up of small openings left in the original making of the cocoon.

§Occurs also, although rarely, in the United States, from Canada and Massachusetts westward to Michigan. (Riley.)

species is included, but no citation is given. Dr. Le Conte, whom I addressed for information, informs me that having gone nearly over the bibliography of the species, he finds no reference to its habits, except that it occurs abundantly in dry, sandy places. The insect, therefore, furnishes another illustration of a change in habits, unfortunate to us, which has frequently been found to attend the introduction of European insects into our country, whereby species, harmless in their native home, become injurious here, or if injurious there, are much more destructive when brought hither, freed from their former enemies, and with new and more favorable surroundings.

Its First Notice.

In the American Naturalist for November, 1881, Professor Riley has given an account of the operations of this insect in Yates county. It was first noticed in the latter part of April, in small patches in a clover field. By the end of July, the entire field had become badly infested, and on one portion of about two acres scarcely a whole leaf remained. Other fields in the vicinity were also attacked. The beetles were seldom seen, as they fell from the leaves as they were approached, after the habit of many of the *Curculionidæ*, and their color hardly permitted them to be recognized when on the ground. When not feeding, they hid just beneath the surface of the ground. During August and September, numerous eggs were laid by the beetles, some of them placed externally upon the plants, but the larger proportion were thrust into the old and hollow stems. A few of the larvæ which hatched from the eggs upon the plants, were nearly full-grown early in October, while those placed within the stalks, seemed, at that time, to be preparing for hibernation.

Accompanying the above statement of the habits of the insect is the following brief description of the egg and of the larva:—

The egg is elongate-oval, about twice as long as wide, pale yellow, and smooth when first laid, but becoming greenish-yellow, and roughened with hexagonal depressions before hatching. The average length is 1mm., and in most cases the larva has hatched in about one week from the time the egg was laid. The young larva is pale, with a dark head, but subsequently becomes greenish with a distinct whitish medio-dorsal line relieved by darker shades each side. The body is deeply wrinkled with prominent substigmatal and ventral swellings, the latter so well developed and so extensible that they perform the functions of prolegs giving the larva its strong resemblance to those of the *Tenthredinidæ*, and enabling it to easily crawl or clasp the edge of a leaf. When at rest it clogs sideways and in a curved position to the leaf, usually on the underside, grasping the leaf-hairs between the ventral swellings but especially in the transverse fold of the anus, by which it can hold and swing the whole body about as Syrphid larvæ are known to do. The surface of the body is sparsely beset with short stiff hairs, varying in number at different stages of growth. The largest specimen, evidently about full-grown, has up to this writing (October 3d), experienced three molts.

Still later (*Rept. Commis. Agricult.*, for the years 1881 and 1882), Professor Riley has published a detailed account of this insect — of its discovery and distribution in this country, its life-history, its natural enemies, description of its several stages, etc., to which the reader is referred for many interesting particulars. The excellent illustration accompanying the same (from which Fig. 74 was taken) is here presented (Fig. 75), by permission of the Department of Agriculture, to

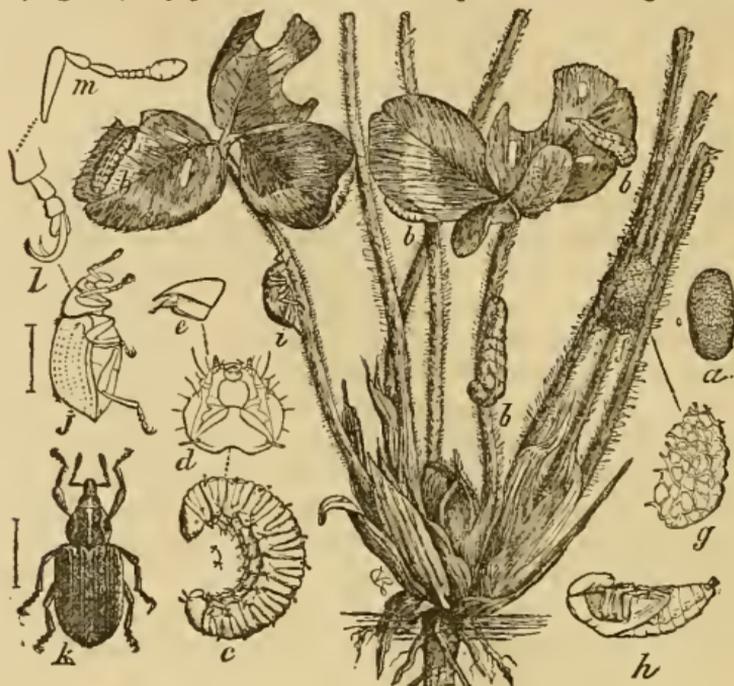


FIG. 75.—The punctured clover-leaf weevil, *PHYTONOMUS PUNCTATUS*; *a*, the egg, enlarged, with natural size beside it; *b, b, b, b*, the larva at different stages of growth, feeding; *c*, the young larva; *d*, its head from beneath, and *e*, its jaw, enlarged; *f*, the cocoon in natural size, and meshes of the same enlarged at *g*; *h*, the pupa; *i*, the beetle in natural size; *j*, side view of the beetle, and *k*, dorsal view of the same, enlarged from accompanying hair-lines; *l* and *m*, foot and antenna of the beetle, enlarged.

illustrate the earlier stages of the insect, and the character of its depredations. Its life-history, as presented, may be condensed as follows:—

Life-history of the Species.

The eggs are deposited during the latter part of summer, by the beetles which may be seen in July and August. The larvæ from them appear in September, and changing to pupæ in October, emerge as beetles in November. Some of them lay their eggs, from which the larvæ hatch and hibernate while quite small, within the old clover stems. Others of the beetles hibernate without oviposition, and lay

their eggs the following spring. The young larvæ are seen as early as April feeding upon the clover, but it is not before the latter part of May and in June that they have attained a sufficient size to render them very injurious and their depredations noticeable. At first, they feed among the folded young leaves or attached to the under side of a leaf; later they fasten to its edge, into which they eat irregular patches. The older larvæ are difficult to observe while feeding, as they are quite timid, and drop to the ground when approached. The feeding is done during the night, the day being passed in concealment among the roots and old stalks, or other shelter found upon the surface of the ground. After they have, with their increase of size, undergone three moltings, they spin up in their cocoons, placed usually a little beneath the surface of the ground. The larva remains unchanged within the cocoon for a few days, when it transforms to a pupa. About three weeks later, somewhere about the first of July, the beetle emerges.

From observations made at the Department of Agriculture at Washington, upon the insect, in confinement, during the autumn, the several periods of its different stages were found to average as follows: The egg stage, ten and a half days; first larval stage, nine days; second larval stage, eight and one-half days; third larval stage, nine days; fourth larval stage (from third molting to spinning of cocoon), twenty-five days; larva unchanged in cocoon, nine days; pupal state, thirty days. The entire time from the egg to the perfect insect, was one hundred and one days, or about three and one-third months.

During the summer, with its higher temperature, the development is doubtless considerably more rapid, as beetles were observed to emerge during the last days of June, from cocoons which had been spun about ten days previous.

Possibly not Lately Imported.

Very lately, it has been discovered by Dr. Le Conte, that a beetle which had been given to him by Dr. Melsheimer, twenty-five or thirty years ago, and which he had described in 1876 as *Phytonomus opimus*, is referable to *Ph. punctatus*, it being a variety in which the wing-covers are almost entirely gray—identical with a similar variety which is also associated with the typical form in Europe. A second one had also many years ago been received by Dr. Le Conte, from Canada. We give the description of Dr. Le Conte:—

Robust, black, densely finely punctured, and covered with gray scales, having a metallic lustre, sparsely and indistinctly pubescent. Beak one-half longer than the head, stout, curved, antennal grooves deep, suddenly flexed downward: there is a small oblique groove each side near the tip, a short nasal furrow, and another between the eyes which are transverse. The funiculus of the antennæ has the

first joint nearly as long as the second, which is nearly equal to the three following united. Prothorax subquadrate, a little wider than long, rounded on the sides in front, and feebly constricted; disc very obsoletely channeled. Elytra much wider than the prothorax, one-half wider than long, convex, humeri prominent, striæ with large shallow punctures, interspaces somewhat convex, first, third and fifth a little more prominent. Tibiæ not mucronate, not even the front pair. Length 7.6 mm.; .3 inch.

One specimen from Pennsylvania given me by Dr. Melsheimer, under the name adopted; another from Canada.

From the above facts, it would naturally be inferred that the species is not, as it was at first believed to be, a recent importation, but had simply been overlooked by collectors. But as so many years had passed without the occurrence of a third example, and as all at once it is discovered so abundant in a certain locality, it has been suggested that both the examples may have been obtained as cabinet specimens in exchanges with Europe and have become accidentally introduced among American species before they came into Dr. Le Conte's hands.

Distribution.

This destructive beetle has hitherto been recorded, so far as known to me, only in Yates county, N. Y., where it was first observed, and thence southwardly, into Schuyler county, near Watkins.* But the present summer (of 1882†), it has been heard of, in great numbers, in Wayne county, N. Y. Under date of July 31st, some insects were sent to me for identification, by Mr. George C. Watson, of Clyde, which were found to be this clover-weevil. It was stated in the letter accompanying them, that when first noticed, the larvæ and the beetles were feeding together, and that entire fields of clover had been destroyed by them since the removal of the hay-crop. As soon as this was removed, the insects ate every young leaf, so that the plants were apparently dead. After stripping the clover fields of the second crop, they migrated to adjoining wheat-stubble fields that had been seeded to clover in the spring, and consumed every bit of clover as they passed along. At the time of writing, their numbers appeared to be greatly diminished, and for the preceding two weeks, no larvæ had been observed.

The locality of the above attack, Clyde, Wayne county, is forty miles north of the locality in Yates county, where the beetle was first observed, and fifty miles north of the extreme southern point in the State which it appears to have reached. In Ontario county, intermediate to

* *Report Connis. Agriculture* for 1881 and 1882, p. 173 (Schwarz).

†The long delay (of more than a year) in the printing of this report has made it desirable to incorporate with it, in this and several other instances, items of information not belonging to the period for which the report is made, but of more value in their present connection than if postponed for another year.

Yates and Wayne counties, its presence is not reported, and it is probable that it does not occur there, at least to any noticeable extent, for upon examples having been communicated to Mr. Robert J. Swan, of Geneva, with an inquiry of their presence, answer was returned that they had not been seen by him in the county, nor by Dr. Sturtevant, Director of the N. Y. Agricultural Experiment Station, at Geneva.

Should the insect continue to extend itself over the clover fields of Central New York, with the rapidity of multiplication which it has shown in the two localities where it has planted itself, it cannot fail of proving a very injurious pest.

A single example of the species was taken by me in Bennington, Vermont (five miles beyond the line of Rensselaer county, N. Y.), about the middle of August. It was not recognized at the time of its capture, nor until some weeks thereafter upon the examination of some Coleoptera which had been set aside; and after this interval the mode of its occurrence could not be recalled. It certainly was not found upon clover.

Remedies.

As the larvæ will be found most numerous in the clover fields in the month of May, it has been recommended as the best means of lessening their injuries, that the clover should be heavily rolled at that time. Plowing under badly infested fields at this time would doubtless be still more effectual. The species seems to hibernate in the young larvæ state, and if it should be found practicable to burn the stubble during the late autumn or early spring, its numbers would be materially reduced; or the same result might possibly be attained by thorough rolling, if the nature of the surface permitted recourse to this means.

Sphenophorus sculptilis Uhler.

The Sculptured Corn-Curculio.

(Ord. COLEOPTERA · Fam. CURCULIONIDÆ.)

- S. sculptilis* UHLER: in Proc. Acad. Nat. Sci. Phila., vii, 1855, p. 416.
S. venatus (Say). FITCH: in Count. Gent., v. 1855, p. 373, and in Cultivator for July, 1855, 3d Ser., iii, p. 221; in Count. Gent., x, 1857, p. 91; and in Cultivator, 3d Ser., v. Sept., 1857, p. 273 (an erroneous determination).
S. venatus. GEDDES: in Trans. N. Y. St. Agricul. Soc. for 1859. xix, 1860, p. 331 (determination after Fitch).
S. zeæ. WALSH: in Pract. Entomol., ii, 1867, pp. 117, 119.
S. zeæ. GLOVER: in Rept. Commis. Agricul. for 1870, (1871), p. 68.
S. zeæ. PACKARD: Inj. Ins. New and Little Known, 1870, pp. 21, 22, pl. 1, f. 11; in Hayden's Ninth Ann. Rept. U. S. G.—G. Surv. Terr., for 1875, (1877), pp. 718, 719.

- S. zœæ*. RILEY : Third Rept. Ins. Mo., 1871, p. 59, f. 22.
S. zœæ. HORN : in Proc Amer. Philosoph. Soc , xiii, 1873, p 423, and on p. 424 as *S. sculptilis*.
S. sculptilis LE CONTE : in Proc. Amer. Philosoph. Soc., xv, 1876, p. 425.
S. sculptilis. SNOW . in Trans. Kans. Acad. Sci., v, 1877, p. 39
S. zœæ. LINTNER : in Count. Gent., xlv, 1879 p 439 , in 39th Ann. Rept. N. Y. St. Agricul. Soc. for 1879, (1880), pp. 46-48, figs. *a b c*.
S. zœæ. COMSTOCK : in Ann. Rept. Commis. Agricul for 1879, (1880), p 248 : Id for 1880, (1881), pp. 272, 273.
S. zœæ. HARRINGTON · in Ann. Rept. Ent. Soc. Ontario for 1880, (1881), p. 56, f. 42.
S. sculptilis. AUSTIN : Supp. to Ch List Coleop. N Amer, 1880. p. 54. no. 9437.
S. sculptilis. RILEY in Amer. Naturalist, xv, 1881. p 915; in Rept Commis. Agriculture for 1881 and 1882, (1882), p. 139.

During the latter part of June, a number of snout-beetles (*Curculionidæ*) were sent to me from Bordentown, New Jersey, with the statement that they were proving a serious annoyance to corn fields in that vicinity. Their operations were conducted in secret, being below the surface of the ground. Upon removing some of the earth from around the young shoots of corn which were wilting and dying, from three to five of the beetles would be found, it was stated, as the cause of the injury, clinging to the shoots that they had punctured with their beaks, and from which they were extracting the juices. They were regarded as a greater evil than the common cut-worms, as they continued their ravages later, even until after the middle of June.

Different Names of the Insect.

The beetles, upon examination, were found to be a species that had been brought to notice several years ago by Mr. B. D. Walsh,* as a corn depredator, and under the belief that it was not previously known, it was named from its food-plant and described by him in the *Practical Entomologist*, as above cited, as *Sphenophorus zœæ* ; but after it had been noticed by several writers under this name, as in the above references, it was discovered that it had been previously described by Mr. P. R. Uhler, under the name of *Sphenophorus sculptilis*, by which designation it is now known.

Examples of the species are in the collection of the N. Y. State Agricultural Society, placed therein and labeled by Dr. Fitch, probably about twenty-five years ago, as "*Sphenophorus venata* -- the hunter weevil." As the examples are unmistakably identical with *S. sculptilis*, their naming must be regarded as an erroneous identification with the *S. venatus* of Say, which Dr. Horn regards as synonymous with *S. placidus*, *S. rectus* and *S. immunis*. These four forms were all de-

*Later, examples identical with them and having an earlier history were found by me in the State Agricultural Society collection, as mentioned.

scribed at the same time by Say, with *S. venatus* first in order; but as the insect had been more widely distributed in entomological collections as *S. placidus*, it has been thought best to retain that name for the species. It belongs to the same group of *Sphenophorus* with *S. sculptalis*, and in some of its varying forms which have given rise to its several synonyms, it so closely resembles that species, that the mistaken identification above noticed might easily have been made.

Description of the Beetle.

The accompanying figures of the insect, together with the following description (mainly from Walsh), will serve for the identification of the beetle: Its body is long, subcylindrical, about three-tenths of an



Fig. 76.—The sculptured corn curculio, *SPHENOPHORUS SCULPTILIS*; *a* and *b*, dorsal and side views enlarged; *c*, a row of punctures additionally enlarged

inch in length; the snout or beak is nearly one-third as long as the body, of the thickness of a stout horse-hair, quite curved, slightly compressed, minutely punctured, with the tip seen from above dilated slightly and triangular. The head is black, finely punctured, with a large dilated puncture or a small oval pit between the eyes. The thorax is subtriangular, having before the middle (on the prothorax) a smooth diamond-shaped spot, on each side of which is another smooth spot of irregular shape, which, with two longer diverging spots behind, form an inverted **Y** on each side; the thorax elsewhere is covered with large punctures. The wing-covers are marked with rows of larger punctures placed wide apart in the grooves, represented in enlargement at *c* in Fig. 76; on the smooth places between the striæ is a row of more or less crowded punctures; on their base, near the outer edge, is a small, elongate-oval smooth spot or tubercle, and a larger one near the tip. On the tip of the abdomen beyond the wing-covers, are two short rows of stiff, fine tawny hairs. The legs are black, with the tarsi (feet) reddish-piceous. Beneath, the body is black and polished, and is marked with close punctures as large as those of the thorax.

We have no knowledge of the earlier stages of this insect.

Earliest Notices of Injuries.

Under date of May 27, 1855, a gentleman from Solsville, Madison county, N. Y., sent to the *Country Gentleman* for examination and name, specimens of beetles, stating that they were new to him and were committing great depredations upon the young corn. Two acres had been nearly destroyed in four days. They commenced at the top of the stalk or leaf, and ate it to the ground, and sometimes to the kernel. Often from three to six were found in a hill.

Dr. Fitch, to whom the specimens were referred, in a reply sent to the *Country Gentleman*, as above cited, determined them as the species described by Mr. Say, in a tract published at New Harmony, Ind., in 1831, under the specific name of *venatus*. Dr. Fitch placed it in the genus *Sphenophorus* of Schönherr, the term, meaning *wedge-carrier*, being drawn from the shape of the body of these insects, like two wedges having their heads placed together. His attention had been called to the injuries of this insect upon young corn in Washington county, N. Y., in the middle of June of the year 1847. Upon examination, he found it engaged in its nefarious work in the corn-fields of his neighborhood, where he continued to notice its operations until into the month of July. It proved to be quite a common insect in this locality, for he had frequently found it around the edges of stones in pastures, under the fallen leaves of groves, and among the dirt in gardens, from the month of March until July.

Under date of July 24, 1857, Dr. Fitch communicated to the *Country Gentleman* that a gentleman from Bainbridge, Chenango county, N. Y., sent the beetle to him with the following statement:—

It commences its attack when the blades of corn are only two or three inches long, and before they have unrolled, gnawing holes into them which are scarcely noticed except upon a particular examination, until after the leaves are unrolled and spread apart, when these holes become very obvious and are then mostly long and narrow, having become elongated by the lengthening of the leaf as it grows.

In a field of seven acres planted May 27th and May 28th, there was not a hill that had escaped these insects; and an adjoining field, planted a week earlier, was still more seriously injured, whilst a third field, planted a week later, wholly escaped them.

In the *Survey of Onondaga county* by Mr. George Geddes (*Trans. N. Y. State Agricul. Soc.* for 1859, xix, 1860, pp. 219-352, the following notice of the species occurs (page 331):—

A new enemy to young corn has appeared here within a few years, the *Sphenophorus venatus* of Say, or the Hunter weevil. This insect eats the leaves of the young plants, and in some cases it has materially injured the crop. This new acquaintance may prove a formidable enemy.

In 1861, it was again reported from Onondaga county, from the town of Skaneateles, in a communication dated July 1st, as follows:—

For the first time we are having the corn cut off by this ravenous bug. They are spreading rapidly, and their destructive propensities are about as marked as that of the locust. They first attack the root, girdling it above the seed and upper (lower?) roots. This causes the blade to wilt as if eaten by the cut-worm. They then feed on the stalk.

The above are the only notices that we have found of the beetle at this early period. It is strange that although its injuries received the

attention of Dr. Fitch, and that two communications, at least, were made by him upon it, yet not the slightest reference is made to it in any of his Annual Reports.

It is also worthy of note, that the injuries to corn, as above given, differ materially from those published later, and hereafter to be mentioned : in the former, the beetles are said to have eaten large portions of the young leaves or to have gnawed holes into them ; in the latter, simply to have pierced or punctured the stalks.

Later Depredations.

It will be observed that nearly all the injuries from this beetle, and especially those that have been the most severe, are recorded from the State of New York, and from contiguous territory in its central portion, viz., in the counties of Ontario, Tioga, Chenango, Madison and Onondaga.

Subsequent to 1861, it seems not to have been observed during the ensuing five years. In 1867, some examples were received by Mr. Walsh, from Onondaga county, N. Y., where it was "making sad havoc with a corn-field, destroying whole fields in some instances." Later in the same year, Mr. Walsh received other specimens from Tioga county, N. Y., with the statement that they were depredating on young corn, and that the sap flowing from the wounds made by them attracted myriads of ants, whence some had erroneously supposed that they were the authors of the mischief. The beetles were noticed upon young corn for the first time, in 1866, when they were even more injurious than in 1867, in which year some fields of corn near the Susquehanna river were nearly ruined by them. They were also quite abundant and destructive at Geneva, Ontario county, N. Y. during the above years, having increased to such an extent the second year that from six to twelve of the beetles could be taken from each hill (*Rural New Yorker*, June 29, 1867). At Concord, Pa., they were reported as destroying young shoots of corn by puncturing them with their proboscis. They were found near the top of the ground. Most of the corn attacked, died, and that which survived, as the leaves unfolded, showed the punctures, which looked like shot-holes (*Practical Entomologist*, ii, 1867, p. 117).

Dr. Packard (*Injurious Insects*, etc., for 1870, p. 21), quotes from a correspondent in Tioga county, N. Y., under date of June 14, 1869, the following :—

This is the fourth year that they have infested the newly planted corn in this vicinity. The enclosed specimens were taken on the 11th instant. I presume that they have been in every hill in my field. They pierce the young corn in numerous places, so that each blade has from one to six or eight holes of the size of

a pin, or larger, and I found a number last Friday about an inch under ground, hanging to young stalks with much tenacity. When very numerous, every stalk is killed. Some fields two or three years ago were wholly destroyed by this insect.

Subsequently, less has been heard of the ravages of this insect, and it is probable that the conditions have not continued so favorable for its multiplication. Specimens were sent to me for identification from Chesterfield, Essex county, N. Y., under date of May 30, 1879, with the statement that they were proving quite injurious to young corn, operating in the manner as above stated.

Geographical Distribution.

Dr. Packard records its occurrence at Hyannis, Mass., June 25, but not as committing serious depredations. It extends westwardly into Kansas (Snow). It is common in Illinois and Missouri, and has been received at the Department of Agriculture at Washington, from Florida and Alabama (Riley). Walsh gives its habitat as "Middle States, Georgia and Kansas," and Uhler, in its original description, "Western and Southern States."

Thought to Live in Decaying Wood.

Mr. Walsh had often met with the beetle near Rock Island, Ill., in company with several other species of the same genus, in decayed logs, floating in sloughs, and on one occasion he had found it absolutely swarming, in company with five or six other species of the genus, on the lake-beach at Chicago, close to the wood piers at the mouth of the harbor. From its occurring so abundantly in the above situations and from the other localities in the State of New York and elsewhere, where its depredations had been reported, nearly all of which were near lakes and rivers or other bodies of water, Mr. Walsh felt assured that its larvæ fed on moist wood, situated in places where it was continually washed by water, and that its great numbers upon the beach at Chicago was explicable by the larvæ having lived upon the decaying and moist wood of the large piers in the vicinity. He was "persuaded that this snout-beetle can only annoy the farmers in such situations where there is a large accumulation of decaying drift-wood, etc., in wet places, or at all events, a few miles from such situations." Prof. Riley (*Third Missouri Report*, p. 59) expresses the same opinion, based upon his belief that "the larva breeds in rotting and moist wood."

I can see no reason for supposing that the larva of this species should so far depart from what is known of the habits of the family, as to feed upon decaying wood. Westwood says of the *Curculionidæ*, "these insects are entirely herbivorous, some feeding upon leaves, others upon seeds, and some upon the stems of vegetables." Riley asserts (*Third*

Missouri Report, p. 10), of the members of the same family, "with the exception of an European species (*Anthribus varius*) whose larva was found by Ratzeburg to destroy bark-lice, they are all vegetarians, the larvæ inhabiting either the roots, stems, leaves or fruits of plants, and the beetles feeding on the same."

Wild Grass Probably its Original Food-plant.

A far more plausible explanation of the presence of the beetles upon floating wood in sloughs, swamps, lake-shores and near rivers may be offered in the supposition that the natural food of this species, in both the larval and perfect stages, is found within the stems of the coarse aquatic and swamp grasses that are natural to such localities, and that the beetles, upon emerging from their pupation within the grasses, had simply gathered upon the timber for convenient resting-places.

It is quite probable that the original food-plant of *S. sculptilis* was one or more of the following grasses: Indian rice (*Zizania aquatica*), growing on the banks and in the shallows of rivers, and abounding in the Cayuga marshes of New York* and banks of the Hudson and Susquehanna rivers; fresh-water cord-grass (*Spartina cynosuroides*), occurring on lake shores and river banks; blue joint-grass (*Calamagrostis Canadensis*), common in wet meadows in Central New York and elsewhere; reed-grass (*Phragmites communis*), having the same habitat and common in the Cayuga marshes; and (*Tripsacum dactyloides*), occurring in the Western States and probably common on the shore of Lake Michigan near Chicago, and found elsewhere in the West and South on lakes and rivers.

Although it would seem that the supply of these wild grasses could never fail of sufficing for the food of this and other curculios,† yet conditions might exist in certain years and in particular districts, as in this State in 1866-1868, when they would not be available for the deposit of the eggs and subsequent feeding. For example: It appears to be the habit of *S. sculptilis* to make its attack upon corn just at or below the surface of the ground. If unusual freshets or a very rainy spring should flood the marsh, river and lake-shore grasses, the beetle would be effectually excluded from its place of egg-deposit, just as the peach-tree borer, *Ageria exitiosa* Say, is prevented from laying its eggs by a mound of earth of a few inches in height placed around the base of the tree. Compelled to seek other grasses for oviposition, it would naturally be attracted to Indian corn if growing in the vicinity

*Tioga county, New York, where the depredations of this insect have been unusually severe, has the Susquehanna river on its southern border, and the lakes of Central New York and these marshes to the northward.

†Dr. Le Conte informs me that he has found different species associated in feeding on the roots of a grass growing in sand hills near the ocean beach.

—one of the grasses, and the one which, from the rich nutriment that it affords, might be expected to be chosen in preference to all others, when selection is to be made.

Food-plants of Allied Species.

The larvæ of many species of the *Curculionidæ* are known to live within the stems of growing plants — some within aquatic plants: the habitat is so common that the species need not be enumerated in illustration. On two occasions, *Lixus rubellus* Rand., was observed in large numbers, in the month of September and later, in a pond in Massachusetts, clinging to the flowers and leaves of *Polygonum amphibium*, under conditions which rendered it probable that the larvæ had lived in the submerged stems of that plant. Some of the beetles which were upon the wing, alighted upon the boat of the narrator of the above occurrence, as a resting-place, it may be presumed, in the absence of other floating wood.

Habits of an Allied Species.

Of another species of the genus — *Lixus concavus* Say, its operations upon its food-plant are so much like those of *S. sculptilis* upon corn, and, we believe, indicative of what is to be hereafter learned of the method of egg-deposit of the latter, that we transcribe the account:—

Lixus concavus Say, was found on the rhubarb or pie-plant, at Washington, in the act of boring into the stalk of the leaves and depositing its eggs in the holes thus made. On examining the plant, many of the leaves were found to be yellow and faded. These injured leaves mostly contained eggs, and although no larvæ were found at the time, it is highly probable that the larva of this insect causes considerable injury to the plants thus perforated, as an allied European species, *Lixus paraplecticus* is stated to reside in the stems of *Sium* or water-parsnip. (Glover: *Rept. Commis. Agricul.* for 1870, p. 71.)

Sphenophorus Larvæ Living in Corn.

Mr. Glover (*ibid.*, p. 68) mentions a *Sphenophorus*, sent to the Agricultural Department several years previous, from South Carolina, under the local name of “bill-bug.” It was not scientifically determined, and although a corn depredator, it is not probable that it was this species, for in another notice by him of the “bill-bug or corn-bug” in the *Report of the Commissioner of Patents for 1854 — Agriculture*, p. 67, which undoubtedly is an earlier notice of the same examples, the color of the beetle is given as “reddish-brown or reddish-black,” which would not apply to *S. sculptilis*; moreover the figures given in plate 4, while approximately representing this species, do not show the quite enlarged terminal joints of the antennæ which charac-

terize it. The gentleman (Senator Evans), sending the beetles to the Department at Washington, gave the following statement of them:—

The perfect insect eats into the stalk of corn, either below or just at the surface of the ground, where it deposits its egg. After changing into a grub, the insect remains in the stalk, devouring the substance, until it transforms into the pupa state, which occurs in the same cavity in the stalk occupied by the grub. It makes its appearance the following spring in the perfect state, again to deposit its eggs at the foot of the young corn plants. These insects destroy the main stem, or shoots, thus causing suckers to spring up, which usually produce no grain, or, if any, of very inferior quality to that of the general yield. Swamp lands or low grounds are the places most generally attacked.

Mr. Glover further states that General Fitzpatrick, of Alabama, and Colonel Pitchlynn, Chief of the Choctaw nation, both corroborate the above statement of the habits of the species, and represent it as very destructive in Alabama, and on the Red river, in Arkansas, but that the planters have greatly diminished its numbers by pulling up the roots of the corn after the crop has been housed, piling them up in heaps and burning the whole mass.

Similar additional testimony of the presence of the curculio larva in the stems of corn, is given by Mr. Glover (*ibid.*, p. 68): "A black curculio with curiously sculptured thorax, *Sphenophorus caryosus* (Oliv.), was sent from New Jersey, where it was said to be very destructive to young plants of maize in the field. It destroys them by piercing the stems, in which the larva lives and feeds."

A Species Breeding in Corn.

If the above statements of the larvæ of species of *Sphenophorus* living within the stalks of corn, from having been made by other than entomologists were not entitled to full credence, we have, quite recently, the unqualified confirmation of the statements, in the testimony of a skillful entomologist, Mr. L. O. Howard, of the Department of Agriculture. One of the larger curculios, *Sphenophorus robustus* Horn, was reported as doing considerable injury to corn in South Carolina, last year.* Mr. Howard having been sent from the Department to study its habits, found as follows:—

It actually breeds in corn. On the plantations along the bottom-lands of the Congaree and neighboring streams, as soon as the corn appears in the spring it is attacked by numbers of the adult beetles. Stationing themselves at the base of the stalk, and also burrowing slightly under the surface of the earth, they pierce the stalk and kill many plants outright, leaving others to grow up dwarfed and distorted. The whole field has frequently to be plowed over and replanted. The eggs are probably laid at this time or a little later, at or near the surface of the ground. The young larva, hatching, works downwards, and may be found at al-

**Sphenophorus pertinax* Oliv., also injures corn, in the South (Horn), and *S. parvulus* Gyll., in Missouri (Kiley).

most any age in the tap-root. A few individuals work upwards into the first section of the stalk, but only, it would seem, after having consumed all available pith below ground. At full growth, the larva will have consumed the pith of the stalk for from four to five inches, dwarfing the stalk, preventing the make of the ear, and causing the lower leaves to turn brown and wither. The larva has the general characters of other described larvæ of the genus. The pupæ are found in cavities opposite the first suckers, surrounded by excrement compactly pressed so as to form a sort of cell. The beetles make their appearance in the fall (one specimen issued as early as August 30) and hibernate as adults mainly in the stalks (Riley; *American Naturalist*, xv, 1881, p. 915).

S. sculptilis has Probably Similar Habits.

In view of the above history, it would seem that there can be no longer any doubt of the breeding-place of *S. sculptilis*. Its habits and transformations will have to be those of *S. robustus*, and as soon as opportunity offers for the examination, it may confidently be expected to be discovered placing its eggs in the punctures made by its beak, or that the larva will be found within the roots during the summer, after the injuries of the imago in wounding the young shoots and causing a flow of the young sap, have ceased. Its smaller size (0.30–0.36 inch), compared with that of *S. robustus* (0.48–0.56 inch), might permit of its occupancy of our northern corn without the tangible evidence of its presence as is given in the dwarfed canes and blighted ears of the Southern fields.

The Larvæ Should be Sought for in Corn.

It is important that the life-history of this species should be satisfactorily completed, by the establishment, through actual observation, of the above habits, which, in consideration of reasons presented, we have deemed it safe to assign to it; and it will not be difficult to do so. Stalks of corn, where the operations of the beetles have been observed in the spring, should be examined after the removal of the corn in the autumn, for the detection of the pupæ, which could easily be found if therein, within their burrows, readily disclosed by sections of the stalks near the roots. If young shoots pierced by the beaks of the beetles in early spring, were carefully examined,* the eggs, if present, should be discoverable at the bottom of the punctures — the wounds, which alone have hitherto attracted attention, being made perhaps quite as much for the deposit of the eggs, as for the extraction of the sap.

The Injuries Perhaps Underestimated.

Although this corn-curculio has not been generally recognized as a serious pest, and may not be injurious over a wide extent of territory, yet, as it has an extensive distribution, extending from the Atlantic to the States beyond the Mississippi, it is not improbable that it may

*I would be glad to have some of the punctured shoots sent to me for examination.

be the unsuspected cause of much of the injury to young corn which is charged to cut-worms and other insects. When, therefore, the young shoots are observed to be injured from some not apparent cause, search should be made for this beetle beneath the ground, where, if present, by carefully removing the surface soil, it will be found, near to, or with its beak inserted in, the plant.

Remedies.

Presuming that the history of the species is now substantially known, the following recommendations may be made for the arrest of its injuries:—

First, For the destruction of the beetle: Where it is known to occur in a field, it is probable that a handful of sand, well moistened with kerosene oil and dropped around and among the shoots of a hill, will, as the oil is carried into the soil by rains, kill the beetles. If, upon examination, this should be found ineffectual, then the soil should be carefully removed by hand from the hills showing the attack, and the beetles collected and destroyed.

Second, For destroying the eggs and young larvæ: If eggs be discovered in the punctures made by the beetle, then, just as soon as the effect of the attack is observed, the shoots should be pulled up. Their speedy drying, under exposure to the sun, would probably be fatal to the contained eggs or young larvæ, but it might be more prudent to collect them and carry them from the field.

Third, For destroying the pupæ: If this precaution should be neglected and the insect be found pupating in the stalks in the autumn, then by cutting off so much of the base of the stalks as may be found to harbor them, and burning them, as was done with the *Sphenophorus* occurring in Alabama and Arkansas (*ante*, p. 261), all the contained pupæ may be destroyed. Unless the species breeds also in some other plant, this method would effectually arrest its spread. Mr. Glover suggested that the roots and stalks might be gathered in heaps, and quick-lime applied in layers to them, which would kill the pupæ while the material would be particularly useful, upon its decomposition, as a manure where lime is needed for the soil.

INJURIOUS HEMIPTEROUS INSECTS.

Murgantia histrionica (Hahn).

The Harlequin Cabbage-Bug.

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

HAHN : " Wanzenartigen Insecten, ii, 183, p. 116, f. 196."

STAL : " Enumeratio Hemipt., ii, p. 37, no. 4."

WALSH : in Pract. Entomol., i, 1866, p. 110; in Prairie Farmer, xviii, 1866, p. 152.

LINCECUM : in Pract. Entomol., i, 1866, p. 110 (history, habits, etc.).

GLOVER : in Rept. Commis. Agricul. for 1867. (1868), p. 71 (fig. and brief notice);
Id. for 1870, p. 90; Id. for 1871, p. 84, f. 18; Id. for 1875, p. 16, f. 3 (nat.
history, remedies, etc.); lb., p. 137 (remedies); MS. Notes Journ.—Hemip.,
p. 68, pl. 2, f. 22 (references, localities, habits, etc.)—Prec. as *Strachia*
histrionicha.

RILEY : in Amer. Entomol., ii, 1870, pp. 79, 80, 154, 155, 177; Fourth Ann. Rept.
Ins. Mo., 1872, pp. 35–38, f. 17 (history, ravages, eggs, etc.).

BETHUNE : in Rept. Ent. Soc. Ontario for 1871, (1872), p. 87.

LINTNER : in Count. Gent., xl, 1875, p. 392 (remedies); Id., xli, 1876, p. 565; Id.,
xlili, 1878, p. 616 (remedies, etc.); Id., xlv, 1880, p. 679 (description,
history, remedies, etc.).

UHLER : in Bull. U. S. G.—G. Surv. Terr., i, 1876, p. 290, (p. 24 of sep. pag.), pl.
19, f. 9; Id., iii, 1877, p. 404.

PACKARD : in Hayden's Ninth Ann. Rept. U. S. G.—G. Surv. Terr., 1877, p. 755–
757, f. 27 (habits, description, distribution, etc.).

THOMAS : Sixth Rept. Ins. Ill., [1877], pp. 59, 60 (brief general notice).

A Southern Insect.

The Harlequin Cabbage-bug is a southern insect, the first information of which came from Texas in the year 1866, when it destroyed all the cruciferous plants in a number of gardens. Since that time, it has gradually worked its way northward. Although no complaints have yet been received of its ravages in the State of New York, it has probably at the present time, judging from its observed rate of progress, made its appearance in the southern counties of the State. It is therefore important that our cabbage and turnip culturists should, in advance, inform themselves of the appearance and history of this pest, which is steadily moving toward them, in order that those who hold the advance ground of the invasion may interpose every possible impediment in the way of its permanent occupancy and its northward extension.

During the last two years, several statements have reached me from localities in Virginia and Tennessee, detailing the injuries inflicted by this bug upon cabbages, and asking for remedies against it. A correspondent from Ivy Depot, Va., under date of Sept. 24th, writes : " I

send for examination, by mail to-day, some specimens of a bug that for the last year has utterly destroyed the cabbage crop in this section, and this year, during the months of August and September, has blighted and ruined over a thousand heads of cabbage in my garden. After the cabbages are all sucked dry, the bugs attacked my summer turnips, and totally annihilated them. They then commenced to suck the bunches of late grapes, and the shoots on some of my late corn, gathering in great numbers near the young silk."

Description.

The Imago.—The above insect is a true bug, of the order of *Heuip-tera* and of the sub-order of *Heteroptera*. It resembles in shape the well-known squash-bug, and feeds in the same manner by means of a beak, or proboscis, bent beneath its body when not in use. It measures

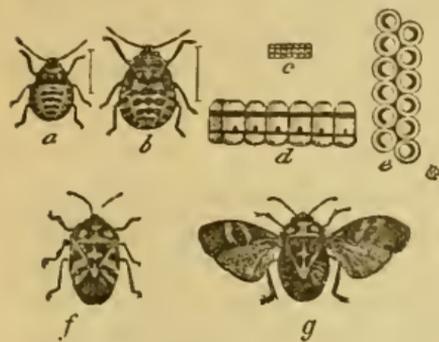


FIG. 77.—The Harlequin Cabbage-bug, *MURGANTIA HISTRIONICA*: *a* and *b*, the larva and pupa, enlarged; *c*, the eggs, natural size; *d*, side view of the eggs showing the bands; *e*, end view of same, showing the lid for the escape of the larva; *f*, the adult insect; *g*, the same, with expanded wings. (Riley.)

three-eighths of an inch in length, by nearly one-fourth in width. It is conspicuously marked in shining blue-black, dull orange and white, as follows: The black head has two short lines upon it of yellowish-white; the thorax is orange, with a ring of black on each side, centered with a triangular orange spot, or with the black diminished, and the ring either interrupted, or broken into two spots. The coriaceous portions of the wing-covers (characterizing the *Heteroptera*), are orange, crossed obliquely by two black bands, and their tips are black. The scutel (the large triangular piece covering the central portion of the body), is black, with a pale yellow spot at each anterior angle, a black terminal tip and a central cross of orange. Beneath, the joints of the abdomen bear upon their margin a row of triangular white spots, and intermediately there are three rows of parti-colored spots in orange and white. The adult insect is represented at *f* in Fig. 77, and at *g*, with wings expanded as in flight.

The Pupa.—The pupa resembles the perfect insect in marking and coloring, but may be at once distinguished by having wing-pads instead of wings: it is shown at *b*.

The Larva.—The larvæ are smaller, less angular, are without the large scutel and wing-pads, and are a pale green where the more advanced forms are orange. Their general appearance is shown at *a*.

The Eggs.—The eggs are beautiful objects, and are easily recognizable. They are cylindrical, with rounded extremities, placed on end, and cemented together by their sides. They are white, tinged with green apically, with two black bands, the upper one of which is twice as broad as the lower, and placed a little nearer to the extremity of the egg. The apex is strikingly marked with a black crescent bordering the slightly depressed lid (which opens upon a hinge for the escape of the larva), and occupying rather more than one-half of its circumference. The length of the egg is about one-half greater than its diameter, measuring 0.034 in. by 0.052 in. A cluster of the eggs, twelve in number, was found deposited within a box containing some of the bugs which had been sent to me for determination, from Nashville, Tenn., early in September. They were arranged in three rows of three, four and five eggs each. They are frequently found on cabbage leaves, placed in two rows, side by side, of six each. At *c*, in the figure, two rows of the eggs are represented in their natural size; at *d* and *e*, enlarged side and end views are given, showing the band and the apical lid.

Natural History.

The history of this insect has not been very minutely worked out. The eggs are deposited upon the young plants early in spring (middle of March or earlier, in Texas), by the individuals which have survived the winter, hidden under rubbish piles and other retreats. They hatch in about six days, when the young larvæ produced by them commence feeding on the juices of the plant by means of their sharp pointed proboscis which they insert in the leaf. After feeding for a while and undergoing some moltings, the precise number of which has not been observed, with a considerable increase in size, the wing-pads make their appearance, indicating the pupal stage. Some additional moltings carry it through to its perfect state. Under favoring circumstances, the entire development of the insect, from its hatching to its final stage, is accomplished within two weeks. Eggs are deposited for a second brood, which are again followed by additional broods in the Southern States—how many, it is not known, but they continue until arrested by the advent of severe cold. At their extreme northern limit, there may not be more than two broods.

Distribution.

First noticed in Texas, in 1866, as before stated, it seems, from that time, to have been making steady progress northward. It was observed in Missouri, in 1870, and five years later, it had reached the central portion of the State. Prof. Thomas, as State Entomologist of Illinois, recorded it from Jackson county, Ill.,—the latitude of the southern

boundary of Maryland. Uhler, in his List of Hemiptera of the Region West of the Mississippi, gives the following statement of its distribution :—

“ It inhabits Guatemala, Mexico, Texas, Arizona, Indian Territory, California, Nevada, Colorado, and from Delaware to Florida and Louisiana. In the Atlantic region it seems to be steadily but slowly advancing northward. Its introduction into Maryland has been effected since the late war, and now [1875], it is known as far north as the vicinity of the Pennsylvania boundary-line in Delaware. In the Mississippi Valley it appears to be equally common, particularly in the States of Illinois and Missouri.”

Its presence in Colorado as a serious injury to the farmers, and its occurrence at Denver, where it was observed by Prof. Uhler, proves its capability, although a Southern species, of sustaining itself even north of the isothermal line of 40° Fahr. Allowing it this range, will admit of its future extension into the Western States, at least over the southern portions of Minnesota and Wisconsin, and eastward, entirely over the States of New York and Vermont, the southern portions of New Hampshire and Maine, a large portion of the Province of Ontario, up to 48° of north latitude, and the Province of Quebec southward of a line north of the St. Lawrence River. This extension, we believe, will be only a question of time, for its progressive march seems as steady, although not so rapid, as was that of the Colorado potato-beetle. Its distribution over the northern portion of the United States cannot but operate as a serious check upon the culture of cabbage, and may prove even more disastrous than the introduction of the cabbage butterfly, *Pieris rapæ*. for the ravages of this latter insect are more within our control, and are also limited by parasitic agency.

Injuries.

The harlequin cabbage-bug is not confined to cabbages, but feeds also on turnips, radishes, mustard and other cruciferous plants, and Prof. Uhler has informed me that it also attacks cucurbitaceous plants. Mr. J. W. Moore, of Johnson Town, Northampton county, Va.,* to whom I am under obligation for information concerning this insect, has written me that last year it entirely destroyed the cabbage crop in his neighborhood, and that the present year, few cabbages having been set out, it has made sad havoc with his ruta-bagas, upon which they were still preying as late as the first of November. In only one instance have we heard of its attacking other plants than those belonging to the order of Cruciferae — that noticed in the commencement of

*The valuable notes upon injurious insects, together with examples of rare species, from time to time communicated to me by Mr. Moore, show a cultivated observation of insects and their habits, and a highly commendable desire to aid in the advancement of economic entomology.

this article, where it was reported as injuring late grapes and corn. When cabbage leaves are punctured by them, the leaf, it is said, immediately wilts, as if some poison had been injected into it, and soon becomes quite withered. Of so serious a nature is the injury, that a half-dozen grown insects, according to Dr. Lincecum, will kill a cabbage in a day.

Difficult to Destroy.

This bug is among the number of those dreaded insects whose depredations we know not how to prevent by any of the ordinary plant applications. Sprinkling the plants with salt, lime, ashes, dust, soot, etc., has been recommended, but these and all similar means prove of very little service, as the insect easily penetrates through them into the interior to obtain its food in the unaltered juices of the plant. Even the popular insecticides — hellebore, pyrethrum, Paris green, and London purple, as ordinarily applied, fail to destroy them, as the following experiments tried by me will show: Examples of the different stages, of larva, pupa and the perfect insect, were dropped into jars of the four insecticides above mentioned, and rolled over and over in the powders until thoroughly covered by them. They were then placed in separate boxes and examined from time to time. Those from the pyrethrum and hellebore jars showed for a few hours some difficulty in locomotion; the others appeared unaffected. The following day they were all in full vigor, with the exception of a single pupa, which was in a weak condition when placed in the hellebore, and its death within a day or two thereafter may not have resulted from its hellebore dusting. The hellebore and pyrethrum had been obtained fresh from the druggist expressly for the experiments. There is no reason to believe that the above substances, if applied in water to the insects upon their food-plants, would have proved more effectual, for as they can neither be absorbed by the leaves to any appreciable extent, or the arsenic of the arsenical preparations taken up in the circulation by the rootlets, the plant-juices, upon which alone the insect subsists, cannot be affected by even such poisonous applications.

Absence of Parasites.

No parasites are known to prey upon the species, nor is there knowledge of its being eaten by poultry or any bird. It is stated (Glover's *Manuscript Notes on the Hemiptera*, p. 44), that in South Carolina, another insect, belonging to the same order of Hemiptera — *Leptoglossus phyllopus* (Linn.) — has been seen in the act of destroying it, by impaling it upon its proboscis, and sucking its juices. Unfortunately this fratricide—the murderer and the victim both belonging to the *Pen-*

latomoidæ — has only a distribution throughout the Southern States,* but it is not impossible that it may be discovered following its prey in its northern extension. For a figure of the species, see Saunders' *Insects Injurious to Fruits* p. 386, f. 396.

Means of Destruction.

Sprinkling with hot water.— In a cabbage plat of modern extent, as in a garden, it is possible that the young bugs, while in their larval or pupal stages, may be killed by sprinkling them with hot water of as high a temperature as the young plants will bear, which may be ascertained by experimenting first upon a few plants. The thicker encasement of this insect enables it to endure a greater degree of heat than that which has been found to be sufficient to destroy the caterpillars of the cabbage butterfly, viz., 140° Fahr.

Trapping with cabbage leaves.— It is stated that the bugs have the habit of forsaking the plants on cold nights and hiding under leaves or sticks lying on the ground, and that advantage can be taken of this habit by providing them with an attractive shelter of cabbage leaves, placed between the rows, which may be lifted early in the morning, and the bugs which have sought their shelter, brushed off and destroyed. Wilted cabbage leaves appear to have a special attraction for them.

Burning rubbish piles.— It has also been recommended that, in the autumn, the waste leaves, weeds, stalks, etc., be collected in piles, to which the bugs may retire for hibernation as winter approaches. These should be examined occasionally, as soon as the nights become cold, and if many are found hidden beneath them, the piles are to be burned, and by this means the spring broods may be materially diminished.

Destroying the first broods.— Unquestionably the most reliable method of controlling this insect is to destroy the first brood. The eggs, from their being deposited in clusters, may be easily discovered on the young plants, if search be made for them, and destroyed. An easier method, however, involving less time and labor, is to destroy the young insects, by passing between the rows of the young plants every two or three days, and by a single tap with a stick knocking them into a vessel containing some kerosene oil. If, before striking the plant, it is inclined over the vessel (the insect quickly drops to the ground when disturbed), very few need escape. With the first brood thus disposed of, the subsequent depredations cannot be serious. Neglected gardens in the vicinity may send out individuals to lay the eggs for later broods, but their comparatively small number would allow of their being easily controlled.

*Uhler's *List of Hemiptera*, p. 32 of separate pagination, where also three congeneric species are given, which are also southern and western forms.

Hand-picking.—That the collection of the bugs for destruction, either by the method above given, or by the more tedious one of hand-picking is practicable and successful, is shown by the statement of Dr. Lincecum, of Texas (*loc. cit.*). “By the first of April I discovered that the insects had commenced on my radishes and cabbages, and I began picking them off by hand and tramping them under foot. By that means I have preserved my four hundred and thirty-four cabbages, but I have visited every one of them daily for four months, finding on them from thirty-five to sixty full-grown insects every day. Although many have hatched in my garden the present season, I have suffered none to come to maturity, and the daily supplies of grown insects that I have been blessed with are emigrants from other gardens.” Another gentleman from the same State, in the latter part of February, 1870, gathered and destroyed, within a few days, forty-seven thousand of the bugs.

Miss Ormerod's Suggestions.

From a statement in the Fourth Missouri Entomological Report, p. 38, that “the cabbage-grower in Europe is pestered with a bug (*Strachia ornata* Linn.), which bears a general resemblance to our insect in color and ornamentation,” I endeavored to obtain some information of the nature of its injuries, and the means used abroad for its destruction. In a letter from Miss Ormerod, in reply to my inquiries, she expresses regret at not being able to find any notice of its injuries except a brief note of Dr. Taschenburg (merely stating that it feeds on cabbage, has an extensive distribution, but is found in too small numbers to be regarded as injurious), or any published suggestion of remedies. In the absence of such publication she has very kindly communicated to me her ideas of what would prove serviceable in similar cases, in England, as follows:—

Noting that “the individuals which have survived the winter hidden under rubbish piles and other retreats,” are the originators of the first attack of the year, I would advise as far as possible clearing all unnecessary rubbish away. I do not know how you manage in America, but here there is often a great deal of needless rubbish left about in gardens, and on the ground around wood-stacks, hay-stacks and the like, and the remains are left of such stacks to afford shelter to every kind of insect vermin. I would gather these up and burn them on the spots where they are, if possible.

When cabbage ground has been infested during summer I would *trench*,—I mean dig, turning the top portion of the ground to the bottom, so that the “bugs” may be buried so deeply that they cannot come up again: I should think that one spade deep would be enough, but two spades or as gardeners here call it, two “spits” deep, is a very thorough application.

Gas-lime applied fresh from the works is a most excellent means of killing every thing it touches, insect or plant, and I look on a

dressing of this laid on the surface of the ground when the crop is cleared off as a most useful treatment. Of course, until atmospheric action has converted the poisonous matter into sulphate of lime, it is hurtful to a serious extent to the crop, but if it can be laid on *bare* ground and so left till purified it does good by killing the insects first, and as a good manure afterward.

If objected to in this form, I should think that it might be very serviceable if thrown as a dressing, after about three months' exposure to the air, amongst the infested plants. I find this form of application very serviceable both against slugs and cabbage-moth caterpillars, ("surface" caterpillars as we call them). There is enough scent of sulphur still remaining to make the application very unpleasant to these "pests," and at this stage the gas-lime has become a safe manure.

Paraffin is being found useful here either mixed with water, or as a dry dressing in sand or ashes. Just enough paraffin to moisten the sand, not clog it, and a very small quantity of this placed around the infested plants has been found serviceable.

I think that these two remedies might be of use from their scent pervading the air, and also as they would make the ground a very unpleasant nightly resort or temporary shelter.

Pæcilocapsus lineatus (Fabr.).

The Four-Lined Leaf-Bug.

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

Lygæus lineatus FABR.: "Ent. Syst. Suppl., 1798, p. 541, no. 324; Syst. Rhyng., 1801, p. 234, no. 152."

Capsus 4-vittatus SAY: Heterop. Hemip., 1832, p. 20; in Trans. N. Y. St. Agricul. Soc. for 1857 xvii, 1858, p. 784 (description).

Phytocoris bellus EMMONS: Nat. Hist. N. Y.—Agricul., v. 1854, expl. pl. 30, f. 1.

Capsus 4-vittatus. WLSH-RIL.: in Amer. Entomol., i, 1869, p. 246 (brief notice).

Capsus quadrivittatus. PACK.: Guide Stud. Ins., 1869, p. 550 (mention).

Phytocoris lineatus FITCH: Thirteenth Rept., in Trans. N. Y. St. Agricul. Soc. for 1869, xxix, 1870, pp. 513-522 (general account).

Capsus (Phyt.) quadrivittatus. LE BARON: First Ann. Rept. Ins. Ill., 1871, p. 61 (habits and description).

Capsus (Phyt.) quadrivittatus. SAUNDERS: in Rept. Ent. Soc. Ontario for 1871, (1872), p. 40 (food-plants and brief notice).

Lygus lineatus. GLOVER: in Rept. Commis. Agricul. for 1875, (1876), p. 125, f. 33. (brief mention); MS. Notes Journ.—Hemipt., 1876, p. 46, pl. 1, f. 9 (habits and food-plants).

Lygus lineatus. UHLER: in Bull. U. S. G.—G. Surv. Terr., iv, 1878, p. 506 (distribution), *Pæcilocapsus lineatus*, in lit., April, 1883.

Pæcilocapsus lineatus. SAUNDERS: Insects Injurious to Fruits, 1883, pp. 350-51, f. 364 (injurious to red currant).

Attack upon a Currant Bush.

During the month of June, this species was very numerous upon a black currant bush (*Ribes nigrum*) in my garden. Attention was first

called to it by the curling of the leaves, suggesting at first, as the probable cause, a serious attack by the currant Aphis, *Aphis ribes* Linn. Examination showed that instead of the characteristic bulges and blister-like elevations and brownish-red color caused by the Aphis, the leaves were more irregularly curled, and were dotted, often very closely, with small round spots, looking as if the surface had been eaten away. When, however, the real author of the injuries was detected, and its operations observed, it could be seen that the appearance produced was the result of the extraction of the parenchymal matter by means of the insect's proboscis through the puncture marking the center of each spot. If the leaf was held up to the light, a day or two after its becoming scarred, the spots were semi-transparent; later, they became partially opaque and presented a dull yellowish appearance.

The tender, terminal leaves of the bush were the first to be attacked. As they became thickly sprinkled with the spots, they dried and crumpled, and no longer giving sustenance to the bugs, they were deserted for the leaves next below on the stem. Leaf after leaf was thus attacked and injured, until a leaf entirely free from injury could, with difficulty, be found upon the entire bush — a large one — its branches spreading eight feet in extent. Only the more tender leaves toward the tips of the twigs died from their injuries, while the older and larger ones showed different degrees of drying, discoloration, and distortion.

First Notice of Attack.

The commencement of the attack of the insect was unnoticed, for it was then in its larval state, and its injuries were so inconsiderable as not to attract attention. It probably commenced its operations in the early part of May. They were first observed by me about the 10th of June. At this time, all, or nearly all, were in their pupal state: none had reached their final stage. Several of the pupæ which I had collected and confined in a glass jar with leaves to feed upon, changed to their perfect winged form on the 13th of June. The pupæ continued to be found upon the leaves until the 20th of the month, by which time, all had completed their transformations.

The Perfect Insect.

The insect is represented in Fig. 78. A careful description of it was made by me for publication — not recalling at the time, that one had already been presented by Dr. Fitch, in his 13th *Report on the Insects of the State of New York*. On comparing numerous examples of the insect with his detailed description, it was found to be so remarkably exact and so elaborately complete, as to render it decidedly preferable to my own. As its publication is confined to the volume in which it

was given,* and as there are many who may not have convenient access to the volume, it is herewith reproduced:—

“This bug is of an oval form, more than twice as long as wide, flattened, moderately convex both on the back and on the under side, with the surface on the upper side smooth and shining and destitute of any hairiness.



FIG. 78.—The four-lined leaf-bug *PEZOCAPSUS LINEATUS*, three times the natural size.

The *head* is small, more broad than the anterior end of the thorax, but scarcely half as wide as its broadest part, four times as broad as long. Viewed in front it is triangular. In the male it is orange-red, in the female orange-yellow. The nose is represented by an elevated oblong black spot, to the lower end of which the beak or trunk is joined. This reaches slightly beyond the base of the first pair of legs. It is tapering, four-jointed, orange-yellow, the first joint black in front, the second joint black on the sides, and the last half of the fourth joint black. The eyes occupy the outer corners of the head, and are smallish, protuberant, oval, and blackish-brown. The antennæ almost equal the body in length. They are slender, tapering, bearded with fine, short, inclined hairs, black, with their basal part pale yellow. They are four-jointed, the first joint thickest and slightly longer than the width of the head, thicker toward its tip, its surface glossy and uneven; second joint more slender than the first and double its length, scarcely thicker in and beyond its middle than toward its base; third and fourth joints quite slender and thread-like, the third rather longer than the first, the fourth but half the length of the third.

“The *thorax* is more broad than long, its sides straight and strongly converging, its base twice as broad as its apex, the basal edge straight in the middle and curving forward on each side with the outer corners bluntly rounded; the apex margined by a roundly elevated line of a lemon-yellow color, the surface convex and inclining obliquely downward and forward. Across its anterior third it is roundly elevated, smooth and polished, and of the same color as the head, this elevation having on its anterior face near its middle two shallow punctures, and commonly a similar puncture on each shoulder: and in the middle of its hind edge is a slight depression in which two shallow punctures close together may usually be seen. The remainder of the surface is minutely punctured and lemon-yellow, with four black stripes, which are larger in the males, the middle ones often as broad as long, more broad than the space between them, widening backward and almost twice as broad at their hind as at their fore ends, with their hind ends

* *Trans. N. Y. St. Agricul. Soc.* for 1869, xxix, 1870, pp. 517, 518.

slenderly separated from the hind edge ; the outer stripes slender and more than four times as long as broad, separated from the outer edge by a slender yellow line, and the space between them and the inner stripes nearly as wide as that between the latter. The scutel is large, triangular, lemon-yellow, sometimes orange in the males, its outer angles black, this color thus connecting the middle stripes of the thorax with those of the wing covers.

“The *wing-covers* at their base equal the thorax in width, and become slightly wider across the middle. They are of a leathery texture with the hind ends thin and membranous. The leathery portion is bright lemon-yellow, minutely and irregularly punctured, ending in a triangular piece which is separated by a transverse suture. On each wing-cover are two black stripes, continuous with those upon the thorax. Outer stripe commencing as a slender point on the anterior edge of the outer margin, gradually widening and receding nearly half its width from the margin as it extends backward, its rounded hind end commonly touching the transverse suture, and beyond this is a large black dot, upon the triangular piece slightly forward of its center. The inner stripe is usually broader than it is on the thorax, as is also the space between it and the outer stripe, whilst between it and its fellow the space is narrower here than on the thorax and scutel. The membranous ends of the wing-covers are black and united with the hind ends of the middle stripes, and the outer end of their curved vein is pale yellowish in the females. The wings are smoky black and translucent, with opaque black veins.

“The *under side* is orange-yellow, in the male red, and without spots or marks in some specimens, whilst others have a black dot on each side of the breast, a black spot on the end of the body, and sometimes, forward of this spot is a short band on each segment.

“The *legs* are long and slender, the hind pair much longer than the others and their thighs thicker. They are dull yellowish-white, translucent and glossy. The thighs are long, cylindrical and bearded with fine short hairs and along their under sides a few longer ones. Toward their tips are two black bands which are sometimes united more or less, the upper band commonly broader, and on the four forward legs both bands extending but half way round. The trochanters or small smooth lobes on the base of the thighs are frequently black, and the fore thighs sometimes have an oblong black spot or cloud immediately below the trochanters. Hind thighs usually with a black line on their outer side, extending their whole length above the bands. The shanks are a third longer and much more slender than the thighs, cylindrical, bearded with small black spines, their tips

black, and a short black line on their outer side below the knee. The feet are more slender than the shanks and are three-jointed, the two first joints a little longer than thick, the last joint nearly as long as both the preceding, and black except at its base, with a pair of brown claws at its tip.

“Varieties, *a*. The outer black stripe on the thorax wanting.

“*b*. The black dot at the end of the outer stripe on the wing-covers wanting.

“*c*. The black bands above the knees wholly wanting, or replaced by one or two dots on the outer and inner sides of the hind pair.”

The Pupa.

The pupæ, as in most of the Hemiptera, are equally active with the perfect insects (imagines), and feed in company with them, yet they are easily to be distinguished. They are much smaller in size. While the latter measure (average of ten examples) 0.27 in. in length, and 0.1 in. in width, the former average 0.16 in. long by 0.08 in. broad. They may at once be recognized by their wing-sheaths in the place of wings, which are black, with the exception of a pale yellow longitudinal stripe on their outer half, and reach only about one-half the length of the abdomen. The abdomen is black above on all of the eight segments visible, except on their posterior and lateral margins; beneath it is orange, with a central black streak on the last segment. The legs are pale; the femora (thighs) are blackish at the base, with three narrow black bands near their tip; the tibiæ (shanks) are also blackish at their base, and under a lens, numerous minute black spines may be seen; the tarsi (feet) are black at the base and tip.

Transformation.

The change from the pupa to the perfect insect was made in so short a time, that although more than a hundred examples underwent their transformation in a glass jar upon my table where they were frequently examined, yet in only one instance was the operation detected. It proved so interesting, particularly in the attendant gradual change of color, that it was watched, and the following notes thereof taken:—

When first discovered, the pupal integument had split upon the back and separated so as to show the larger part of the thorax of the inclosed insect, the basal portion of the wings and the intermediate scutellum (∇). The characteristic and conspicuous black marks pertaining to maturity were entirely absent—the only shades observable being orange, yellow and white; the thorax was pale yellow, the scutellum light yellow with its lateral angles orange; the wings were white. In this condition the insect rested for a few minutes, with the

terminal half of its wings still encased in their sheaths, and with no movement other than a tremulous motion of the feet. It then turned itself around for a few times and moved several steps over the leaf, when it took position with its head directed downward, its front pair of legs holding to the leaf and the others detached. Slowly the abdomen was withdrawn from its encasement and the colorless wings from their sheaths. Soon the yellow stripes of the wings began to appear and insensibly to deepen. As yet there was no indication of the black stripes traversing the thorax and wings, or of the black of the membranaceous wing-tips.

In twenty-five minutes from the observed commencement of the transformation (at 1 o'clock as noted), the wing-tips had fully expanded. The time occupied in the disengagement from the pupal case was not noted; it could not have varied much from five minutes. At 1 h. 15 m., there were indications of the black stripes in a duskiuess of color. At 1 h. 40 m., the lines had deepened to a leaden hue and the antennæ were dark. At 2 o'clock, all the stripes, the small spot toward the wing-tip, and the tip, had become blackish, and the bands on the legs were showing. When next observed, at 3 o'clock, the stripes were glossy jet black, and the mature coloring throughout had been assumed.

While change of color frequently attends insect moltings, and usually to a greater or less degree the larval molts of the Lepidoptera, it is rare that so marked a change as that above noted, ranging from white to black, can be observed, and in so brief a time.*

Continuation of the Attack.

The latter part of June (29th), the insects were still quite destructive in my garden, and had injured and disfigured a large number of plants, although effort had been made to check their depredations by daily killing numbers of them by hand. On July 16th, they were observed feeding on geraniums, the foliage of which they were rapidly destroying by the infliction of hundreds of unsightly and devitalizing blotches upon each leaf. The latest period of their continuance, owing to my subsequent absence from home for several weeks, was not ascertained.

Life-History Incomplete.

It will be seen from the above account that our knowledge of the

*A thorough discussion of *color* in insects—its nature, source, production, kinds, changes, mimicry, etc., and also of *pattern*—its origin, cause, purpose and variability—presenting the most advanced knowledge upon these interesting points—may be found in a paper "On the Color and Pattern of Insects" by Dr. H. A. Hagen, published in the *Proceedings of the American Academy of Arts and Sciences*, vol. xvii (N. S. ix), 1882, pp. 234-267.

life-history of this noxious insect is still incomplete. Dr. Fitch states that they pair about the middle of June, when they lay a crop of eggs from which another generation completes its growth before the end of the season. The oviposition has not been observed. Dr. Le Baron (*loc. cit.*) states that it deposits about twenty eggs, which are oblong, subcylindrical, flask-shaped, pale with white tips. It is believed to hibernate in its perfect stage, under decaying weeds, in crevices, etc., and to come forth in early spring to deposit its eggs on the stems of the plants which are the most attractive to it.

Food-Plants.

Its first appearance in my garden was upon the black currant, as stated, from whence it seemed to spread to the surrounding vegetation, as the morning-glory, phlox, chrysanthemum, pinks, geraniums, day-lily, London-pride, sweet-pea, pig-weed, plantain and clover. Dr. Fitch records it also on red currant, raspberry, bittersweet, wiegelia, burning-bush, sumach, dahlia, snapdragon, soapwort and tansy. In addition to the above, Dr. Le Baron records it as very injurious to parsnips; Mr. Wm. Saunders, as occurring on mint and Deutzia; and Dr. D. N. De Tarr has noted its occurrence the present year in his garden, in Albany, in addition to several of the preceding, on lettuce, common pea, radish, squash, cucumber and gooseberry.

Very Injurious to Dahlias.

It would seem from the above extended list of food-plants, to be a very general feeder on garden products, and it is certainly at times very injurious to several of them. Dr. Fitch has given the following account of its injuries to one of its favorite food-plants: * "In the year 1858, I learned from A. F. Chatfield, the florist in Albany, that upon all his dahlia plants that year, when the first flower-bud put out, these bugs assembled upon it, puncturing and poisoning it so that it withered. Two or three new flower-stalks would then shoot forth from the base of this one, the buds of which would be attacked and destroyed in the same manner. Others would then put out from the bases of these, to share the same fate. Thus it went on, the whole season through. An enormously broad mass of leaves and stalks, fully three feet in diameter, thus grew from each of the dahlia roots in his garden, without a single flower from all the multitude of flower buds which had thus been developed. D. S. Heffron, of Utica, informed me that in the summer of 1864, these prettily striped yellow bugs so infested his dahlias that only three or four little imperfect flowers were produced. And in all the gardens in and around Utica that year, the

*Thirteenth Report, in *Trans. N. Y. State Agricul. Soc.* for 1869, xxix, 1870, p. 514.

flower-buds were so universally killed by this insect that no dahlias were there to be had."

Destructive to Rose-buds.

Dr. Fitch also states that he has met with this insect, puncturing the flower-buds of the rose and causing them to perish. This may be the explanation of the destruction annually in my garden of a large proportion of the buds upon several of my rose-bushes, for which I have been unable to discover any cause. Shortly after the formation of the earliest buds, a large number have been observed to turn black, and their stems for about an inch downward, also to blacken. The buds soon shrivel, dry up, and bend over toward the black shriveled stem. I have repeatedly cut open the buds and stems thus affected, and carefully examined them, without being able to find either egg or insect within them. For successive years, upon detecting this attack, I have also cut off the buds at some distance below the affected part of the stem, and inclosed them in jars, in the hope of obtaining from them the insect depredator, but without success.

Energy of Attack.

The attacks of this insect appear to be characterized, when it has attained its adult stage, by a peculiar energy or vigor through which injuries are inflicted which apparently exceed the ability of the comparatively few depredators observed in the work. While very rarely are more than two or three of the bugs seen upon a leaf, yet were its entire surface covered by them, the destruction could not be more complete. In illustration of this, the following statement of their operations upon a day-lily, as observed by me, may be of interest. They manifested an especial fondness for the tender and succulent leaves of some clusters of this plant growing in my garden, and almost before the attack upon it was observed, the foliage had been entirely destroyed. A leaf which was picked for preservation as illustrative of its work, measuring six inches in length by four broad, had, by count, between two of its veins, selected as offering an average amount of injury, one hundred and seventy-one of its characteristic markings—rounded, transparent or translucent spots, as the parenchymal matter had been more or less completely removed, varying from one-twentieth to one-tenth of an inch in diameter. As there were eighteen of these intranervular spaces, there is obtained for the entire number of these spots upon the leaf, three thousand and seventy-eight.

Distribution.

Unfortunately, this insect has an extensive distribution, and occurs

over a large portion of the United States, east of the Rocky Mountains. Say, when describing it fifty years ago, records it from the North West Territory, Missouri, Indiana, Pennsylvania and Georgia. Uhler mentions it as occurring in many parts of the North West on the eastern side of the Rocky Mountains. It is also recorded from Ohio (Riley), Illinois (Le Baron), Maryland (Glover), and from Ontario (Saunders).

Remedies and Preventives.

Futility of poisonous and other applications.— This yellow-lined leaf-bug being a member of the order of Hemiptera, and one of the true bugs, obtains its food, not by means of biting jaws and mastication of the leaves, but by the aid of a proboscis or sucking beak which it inserts in the tissues of stalks, stem, leaf or bud, and draws thence the juices upon which it alone subsists. It is evident, therefore, that these insects, living as they do upon the sap of plants, may not be destroyed by means of poisons applied to the surface of the stems and leaves. The delicately pointed sucker would penetrate the poison even when thickly coating the leaf, without imbibing any portion of it.

It has been thought that they could be kept from plants through applications which would be disagreeable to them, as dust, lime, ashes, soot, soap-suds, tobacco-water, carbolic-acid washes, etc. None of these, however, have, on trial, been found effectual. Cresylic-acid soap has been recommended for this purpose,* but as a series of experiments made with this material, of the extreme strength of one pound to five gallons of water, to prevent the injuries of another destructive bug of an allied genus, viz., *Lygus lineolaris* Beauv.,† proved entirely unsatisfactory, there is no reason to believe that it will be found to be of any value as against *Pæcilocapsus lineatus*.

Burning garden rubbish.— The following will be found serviceable means for arresting the depredations of this species, and the best that we are prepared to offer. The female passes the winter in sheltered places, and probably, judging from allied species, to a large extent, in decaying vegetable matter lying upon the ground : the twisted folds of dead leaves would seem to offer an excellent retreat for them. If, therefore, at the close of the season, all the dead leaves, vines, plants, bits of wood, and like worthless rubbish, be collected in piles and burned, not only will the garden be placed in suitable order for the opening of the ensuing spring, but the natural retreats of this bug, and of a number of other injurious insects of similar habits of hibernation will be broken up, and many will be burned in their hiding places. Clean culture and an annual autumnal cleaning up and destruction of all

**American Entomologist*, i, 1869, p. 246.

†*Id.* ii, 1870, p. 293.

worthless vegetable matter, cannot be too highly recommended, as aids in freeing the garden and field from the onerous tax of insect depredation.

Destroying the insect before oviposition.—As soon as the leaves of the currants, roses and other early shrubs commence to unfold in the spring—in all gardens where this insect abounded the previous year, watch should be kept for its first coming abroad from its winter quarters. Nearly all the individuals will be females, with their abdomen swollen with their burden of eggs ready to be deposited. They will be found sluggish in their movements, and their conspicuous coloring and marking render them easy to be seen. As an incentive to watchfulness now, it need only to be borne in mind, that for every one captured and killed before oviposition, there will be at least a score less of indefatigable depredators upon the choicest products of the garden throughout the early summer months, and hundreds less of the augmented later brood.

The "jarring" method and its success.—Later, when the larvæ (distinguished by the absence of wing-pads) and pupæ have collected at the tips and on the tender leaves of the plants, they should be sought for on the under side of the leaves where they hide. When occurring in such numbers that hand-picking becomes too laborious, they may be shaken in a pan of water and kerosene, and killed. This should be done in the cool of the morning, while they are comparatively inactive, and not so ready to fall to the ground at the slightest disturbance. It is important also, that as many as possible be destroyed while yet in the larval and pupal stages, during May and early June, for with the acquirement of wings they become more active, show increased timidity, and are more ready to drop from the leaves. Though for the most part, they seek safety in hiding, yet occasionally they resort to flight.

That the injuries of this insect are largely to be prevented by the methods above given, is evident from a statement made in the *American Entomologist* (vol. ii, 1870, p. 293), of the success that attended the efforts to preserve a pear orchard from the threatened destruction of its blossom buds by *Lygus lineolaris*—a species almost identical in habits to *P. lineatus*, but more numerous and of greater destructiveness. A gentleman had made various applications to his trees, and among them, cresylic soap, but without avail. "Not discouraged by this want of success, Mr. A. afterward went over all his pear trees, about two thousand in number, with a basin of soap-suds early in the morning, and shaking each branch, caused the bugs to fall into the water. It took about three hours' time of three men, and by commencing early they were enabled to get through before it became warm

enough for the bugs to become active. After pursuing this course for three successive mornings, during which time *many thousands were killed, he had the satisfaction of seeing his trees unmolested, and thus saved.*"

○ *Enchenopa binotata* (Say).

The Two-Marked Tree-Hopper.

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

- *Membracis binotata* SAY: in Long's Expedition to St. Peter's River, 1824, pp. 301, 302; American Entomology (Le Conte edit.), 1869, i, p. 201.
- √ *Membracis binotata*. HARRIS: Treat. Ins. N. Eng., 1852, p. 195; Ins. Inj. Veg., 1862, p. 224.
- *Enchophyllum binotatum* FITCH: in Fourth Ann. Rept. St. Cab. Nat. Hist., 1851, p. 47.
- *Enchophyllum binotata*. EMMONS. Nat. Hist. N. Y.,—Agricul., v, 1854, pl. 13, f. 17; *Thelia binotata*, lb., p. 156.
- *Enchenopa binotata* FITCH: in Trans. N. Y. St. Agricul. Soc. for 1856, xvi, 1856, p. 464; Third. Rept. Ins. N. Y., 1859, p. 146, no. 190 (generic criticism).
- *Enchophyllum binotatum*. WLSH.—RIL.: in Amer. Entomol., i, 1869, p. 248 (food plants and habits).
- *Enchenopa* (*Membracis*) *binotata*. GLOVER: in Ann. Rept. Commis. Agricul. for 1876, p. 28, f. 11 (description and habits).
- *Enchophyllum binotatum*. LINTNER: in Connt. Gent., xlv, 1880, p. 711, c. 1, 2 (egg-covering, food-plant, and remedies).
- *Enchophyllum binotatum*. RILEY: in Amer. Entomol., iii, 1880, p. 254 (secretion, eggs, etc.); in Amer. Nat., xv, 1881, p. 574 (egg-covering).
- *Enchenopa binotata*. SAUNDERS: Insects Injurious to Fruits, 1883, p. 242 (on grape-vines).

The Insect Infests a Bitter-sweet.

In September, a communication was received from Miss A. Goodrich, of Utica, N. Y., stating that a vine of *Celastrus scandens* (bitter-sweet) running over her front door, was infested with some enemy that was seriously injuring it. Specimens of the insect and of the infested vine were inclosed, and my attention was called to a white substance upon the bark, beneath which, it was stated, numerous minute creatures were imbedded. What was the insect, it was asked, and was the white substance a web deposited by it, and could the pest be driven away, or must the vine be destroyed.

The insect was one of our tree-hoppers, commonly known as "the two-marked tree-hopper" from the two yellow spots upon the ridge of its back, and scientifically, as *Enchenopa binotata* (Say).

There are a number of species of these hoppers, possessing the same habit of puncturing the leaves and the tender portions of various vines

and fruit-trees. From the injuries that they inflict, and the difficulty of preventing them, they are among the greatest pests of gardeners.

Description of the Insect.

Of this particular species, Dr. Harris gives the following account :
 " There is a little tree-hopper, which is found during the mouths of July and August on the wax-work, or *Celastrus scandens*, accompanied usually by its young. When fully grown, it is nearly three-tenths of an inch in length, including the horn of the thorax ; it is of a dusky-brown color, with two yellowish-spots on the ridge of the back ; and the first four shanks are exceedingly broad and flat. It is the two-spotted tree-hopper, *Membracis binotata* of Say. When seen sideways it presents a profile much like that of a bird, the head and neck of which are represented by the curved projecting horn of the thorax ; and a group of these little tree-hoppers, of various sizes, clustered together on a stem of the wax-work, may be likened to a flock of old and young partridges. They appear to pass through all their transformations on the plant, are fond of society, and sit close together, with their heads all in the same direction." Fig. 79 represents the insect so faithfully, that by its aid, it may be readily recognized.



Fig. 79.—The two-spotted tree-hopper, *ENCHENOPA BINOTATA*—side and dorsal views.

When seen sideways it presents a profile much like that of a bird, the head and neck of which are represented by the curved projecting horn of the thorax ; and a group of these little tree-hoppers, of various sizes, clustered together on a stem of the wax-work, may be likened to a flock of old and young partridges. They appear to pass through all their transformations on the plant, are fond of society, and sit close together, with their heads all in the same direction." Fig. 79 represents the insect so faithfully, that by its aid, it may be readily recognized.

Say's Original Description.

The species was originally described by Say in a Zoölogical Report, contributed by him to the Narrative of the Long Expedition to the source of St. Peter's River. From the volume in the N. Y. State Library (now quite rare) we transcribe the title,* and the original description :—

Membracis binotata.

Thorax with a compressed horn extending above the head, and two spots on the back.

Inhabits the United States.

Body fuscous, punctured ; head longer than broad, rounded at tip, minutely

*Narrative | of | an Expedition | to the | Source of St. Peter's River, | Lake Wioneppek, Lake of the Woods, | &c. &c. | Performed in the year 1823, | by order of | the Hon. J. C. Colhoun, Secretary of War, | under the command of | Stephen H Long, Major, U. S. T. E. | Compiled from the Notes of Major Long, Messrs. Say, | Keating and Colhoun, | by Wm. H. Keating, A. M., &c. | In two volumes. | Philadelphia: 1824. |

Appendix to vol. II, Part I. Natural History. § Zoölogy, by Thomas Say [pp. 253-400].

punctured; *thorax* with a projecting horn before, which rises above the line of the back, compressed, carinated above, each side, and beneath, and incurved toward the tip; between the lateral and inferior carinae are three elevated lines converging toward the eye; superior carina of the horn continued upon the back to the tip; lateral carina of the horn continued upon the side to the middle of the thoracic edge; carina of the back slightly undulated, with two yellowish spots, of which one is on the middle and the other near the tip smaller and placed nearer to the anterior one than its own length; tip acute; *anterior* and *intermediate tibiae* dilated, foliaceous; *posterior tibiae* with two serrated lines behind; *hemelytra* opaque, much longer than the abdomen; *wings* hardly longer than the abdomen.

Length, including the horn, seven-twentieths; exclusive of the horn, more than one-fifth of an inch.

The eyes are nearly equidistant between the tip of the horn and of the hemelytra. It very closely resembles the *lancoolata* Fabr., an inhabitant of South America, of which it may possibly prove to be a variety.

The Egg-coverings Described.

The pieces of bitter-sweet accompanying the insects received from Utica were nearly covered, on one side with small, white masses, which at a cursory glance might be mistaken for some Coccis insect covered with its farinose secretion. Their appearance is shown in Fig. 80. They are about one-eighth of an inch long by one-tenth broad, attached to the vine by their greatest diameter, and curving upward from it to a height at the summit equal to about one-half their breadth. When touched by the finger, they are found to be quite adhesive and apparently waxy, as portions may be drawn away in long threads. Examined carefully, they show something like a lamellose structure, with the layers, ten to fifteen in number, curving slightly toward the anterior and larger end of the mass. If examined more critically under a lens, these apparent lamellæ render themselves into what might be called threads, which alternate at their meeting on the summit from the opposite sides, after the manner of a braid, as shown in Fig. 81, which presents an enlarged view of one of the masses. In some of them, the threads are not confluent throughout, but spaces occur between them, through which the bark may be seen. A section of the mass discloses an interesting structure of the lower portion, suggestive of a vertebral column and connected ribs.



FIG. 80.—Egg-coverings of the two marked tree-hopper, *EXCHENOPA BINOTATA* on bitter-sweet (*Celastrus*)



FIG. 81.—Egg-covering; enlarged to three diameters.

Some of these peculiar masses were sent by me to Professor Riley, who identified them as the *egg-coverings* of the insect above described, and subsequently gave a brief notice of them in the *American Entomologist* of October, 1880 (vol. iii, p. 254).

Nature of the Egg-covering.

The egg-covering of this insect is, in all probability, a special secretion, deposited and arranged in such manner as may best serve for a protective covering to the eggs. The insect has not, to our knowledge, been observed in the act of constructing it, nor are similar coverings, so far as we know, provided by other members of the *Membracidae* for a like purpose, such as the Buffalo tree-hopper — *Ceresa bubalus* (Fabr.), the one-striped tree-hopper — *Thelia univittata* (Harr.), the thorn-bush tree-hopper — *Thelia crategi* Fitch, the unadorned tree-hopper — *Smilia inornata* (Say), or the unarmed tree-hopper — *Stictoccephalus inermis* (Fabr.),—all common species in the State of New York. The egg-deposits of some of these have been described, but no mention is made of any covering protecting them.

The appearance and touch of the egg-covering of *E. binotata* are so decidedly waxy, that it was but natural to believe that such was their character, for many of the insects belonging to the order of Hemiptera are known to secrete wax to such an extent that it is collected and utilized. Of the *Fulgoridae* — a family next in place to the *Membracidae*, Westwood says: "The species of this family emit the white waxy secretion in some cases to a remarkable extent. It is either cottony, or arranged in lamellæ, and is evidently analogous to the wax secretion of bees" (*Introduc. Class. Insects*, ii, p. 429). Some of the *Coccidae* — an allied family — are also wax secretors. One of the species produces, from numerous secretory sacs or follicles, lodged just beneath the skin of the abdomen, the important article of commerce known as "Chinese wax," "vegetable wax," "vegetable spermaceti," or "pela." In the *American Naturalist*, v, 1871, pp. 683-685, may be found an interesting account of its production.

The material of the egg-covering of the two-marked tree-hopper* is found not to be of a waxy nature. Some pieces of the Celastrus vine bearing the masses were submitted to Dr. Hagen, and he has given me the result of his examination as follows: "The curious white cover consists of strings about 0.20 mm thick, which are composed of small bubbles or cells of about 0.016 mm diameter. A portion placed on a slide and brought over a lamp did not melt, but grew black, like coal, proving it not to be wax. When boiled with water it assumed a milky appearance, and the bubbles or cells disappeared. It is therefore simi-

*The "two-marked tree-hopper," as designated by Dr. Fitch, is preferable for the common name of this insect, that it may not be confounded with the *two-spotted* tree-hopper, *Thelia bimaculata* Fabr.

lar to the froth of *Cicada spumaria*,* dried. Each string is apparently laid separately by the insect from an apparatus near the tip of the abdomen. It is surely *albuminous*."

The above examination shows the material to be similar to that secreted by the *Cercopidae* (next to the *Membracidae* in a natural order), or frog-spittle insects for the shelter of their larval and the pupal forms, which may often be seen on pines, willows, grasses, and various weeds, looking exactly like masses of spittle adhering to the plants. Of these strangely housed insects which may often be met with in the State of New York, are *Aphrophora pavellela* Say, *A. Saratogensis* Fitch, *A. quadrangularis* Say, *Clastoptera Proteus* Fitch, and *C. lesteacea* Fitch.†

Egg-Coverings Mistaken for Insects.

The general resemblance of the egg-coverings to some of the Coccus insects has been mentioned (*ante*, page 283), and it has lately been discovered that the mistake was actually made of naming two species of insects from the coverings occurring on two species of plants.

In the American Naturalist for 1881, at page 574, is this statement from Professor Riley: "In hastily looking over the collection of the late Dr. Fitch recently, we were somewhat amused to recognize the white and ribbed waxy material covering the egg-punctures of *Euchophyllum binotatum* labeled as *Dorthisia viburni* and *D. celustri*. This covering does bear a superficial resemblance to the exudations of *Dorthisia*, though a glance suffices to show that it has no structure connected with it."

The above statement leaves in doubt the actual labeling of the specimens by Dr. Fitch, and all who know the extremely careful and accurate habits of observation that characterized the distinguished entomologist, would incline to the belief that what seemed a grave blunder, would, if farther examination were made, resolve itself into a mistake of some less scientific person through whose hands the collections had passed. My attention being specially called to the matter, search was made of the writings of Dr. Fitch, outside of his regular reports, where perhaps the descriptions of the "Dorthisias" might be found, but they were nowhere to be discovered. Later, however, among the collections of the N. Y. State Agricultural Society, arranged by Dr. Fitch, evidence was found which showed conclusively that the blunder had

**Cicada spumaria* of Linnæus, now known as *Philenus spumaria*, was originally described from Northern Europe, but it is now known to inhabit also England, Germany and Switzerland. In this country it is found in one or other of its numerous varieties in Utah, Dakota, Sitka, Lake Winnipeg, and, on the eastern side of the continent, in Nova Scotia, Canada, Maine and New York. (Uhler.)

†For an interesting account of some of the "spittle-insects," see the *American Entomologist*, i, 1869, p. 228.

indeed been made, and incidentally, that "we are *all* liable to mistakes."

In one of the wall-cases of the collection is a branch of *Viburnum* which bears upon one side, numerous closely compacted and overlapping egg-coverings of *E. binotata*, and in the same case was a loose label (the material in the case had been repeatedly handled since its first arrangement, and very little of it ever had the labels attached), written by Dr. Fitch as follows: "Osier *Dorthisia* (*Dorthisia Viburni*). A scale-insect, resembling white wax, upon limbs of the Osier (*Viburnum lentago*)." In the same case is a branching specimen of about eighteen inches in length, of the bitter-sweet (*Celastrus scandens*), upon which are numerous egg-coverings, but fewer than on the *Viburnum*. Near it was another label, also by Dr. Fitch, with this inscription: "*Dorthisia Solani*. A wax-like scale insect which blights the Bitter-sweet (*Solanum dulcamera*)." Did Dr. Fitch subsequently discover that the particular bitter-sweet upon which these forms occurred was not the *Solanum*, but the *Celastrus*, and did he then change the specific name to *Celastris*, on other specimens labeled by him? There is no *Solanum* in the case, and the labels, beyond question, referred to the two above-named specimens.

There is every probability that the *Dorthisia* species of Dr. Fitch are but manuscript names, and this may be offered in palliation of the blunder, for it may be inferred that but a cursory examination was given them when named. Such an examination as would have been required for published description, could hardly have failed of disclosing their unorganized nature. The labeled specimens were placed in the Agricultural Society collection in or about the year 1868.

In Fig. 82 (after Westwood), *Dorthisia cataphracta*, of Europe, is given. A comparison of it with that of the egg-covering of *E. binotata* (see Fig. 81), will show the general resemblance that they bear to one another. Comparison may also be made with the figure of a native species of *Dorthisia* (undetermined) occurring on the burdock (*Arctium lappa*), according to Professor Comstock, in the *Report of the Commissioner of Agriculture* for 1880, plate ix, fig. 3.



FIG. 82.—DOR-
THESIA CATA-
PHRACTA, of
Europe.

Eggs of the Insect.

Upon removing one of the egg-covers, a scar in the bark will show where the insect has, by means of its ovipositor, inserted its eggs. At first, the puncture thus made closes upon itself, so as to be scarcely noticeable, but later, the rupture of the circulatory vessels and an increase in the size of the eggs produces a scar which may readily be seen upon raising the covering. Upon carefully removing the bark

and portions of the adjacent tender wood, the eggs are disclosed. They will be found arranged after the same manner as in *Cicada*, inserted through a single opening, in two parallel series, separated by a small interval. There are in each row from six to twelve eggs, partly overlapping one another as in Fig. 83 *a*. They are elongate, almost cylindrical, of a delicate green color, pointed at the more deeply buried end, and rounded and of a yellowish tint at the opposite end: their form is shown at *b*. They are of so tender a character that it is hardly possible to remove them, or even to uncover them for examination without injury. Dr. Hagen has examined them microscopically, and has written me as follows of them, under date of October 28th:—

FIG. 83.—
Eggs of the
Two-spotted
tree-hopper; *a*
their overlap-
ping position
in the twig;
b, their shape
as seen in sec-
tion.

I find the eggs to measure, in length 0.42--0.5mm, in breadth 0.1--0.11mm. The chorion is *very* finely transversely striated, as at *a* (Fig. 84). The contents of the egg are inclosed by a particular membrane *b*. Near the tip are three small slits, *c*, probably the micropyle. The chorion is hard and easily broken. The contents of the egg are greenish-yellow; the cells very fine.

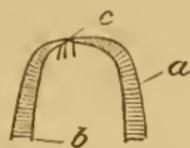


FIG. 84.— Structure of the egg of the Two-spotted tree-hopper.

Food-plants.

The insect occurs upon many plants in addition to the bitter-sweet. Dr. Fitch (*4th Rept. State Cabinet, sup. cit.*) includes it among the species affecting the butternut, upon which it may always be found during the latter part of summer, and further states that it is common on numerous plants and trees. According to the *American Entomologist*, i, p. 248, it punctures tender grape stems and causes them to wilt; and occurs quite commonly on the red-bud (*Cercis Canadensis*), and on the hop-tree or tree-trefoil (*Ptelea trifoliata*)—the latter its favorite home. Mr. Glover (*Rept. Commis. Agricul. for 1876*), reports it as puncturing the leaves of the butternut and locust. In Maryland, it is of common occurrence on the locust. Mr. Uhler has informed me that it is known to oviposit in *Eupatorium*.

Natural History.

The history of the insect is still incomplete. The young larvæ have been found by Professor Riley on the 10th of May. After passing their first and third molts [second not mentioned] on May 18th and June 5th, they changed to perfect insects on June 12th. The larvæ are described as being without the horn-like

* *American Entomologist*, iii, 1880, p. 254.

projection of the thorax seen in the adult, and they appear to lack, in this stage, the ability to hop which they display later, and from which they derive their common name of "tree-hoppers."

The time of oviposition is not known. It is probably not prior to the middle of August in the State of New York, for upon the 8th of that month, I have observed the mature insect abundantly upon locust,* when none of the egg-coverings were discoverable. It may be presumed to occur during the latter half of August, for Miss Goodrich, in reply to special inquiries made, has informed me that the coverings with the eggs in the wood beneath them were first observed by her in the early part of September, upon her return to her home after an absence of most of the summer. From their fresh appearance at this time, it was quite probable that they had been quite recently placed. Her attention was drawn to them by "the extreme beauty of the web-like shields of purest white threads. Later [in October], the thread-like appearance was lost, as if by a running together of the threads."

Remedies and Preventives.

It is difficult to save from destruction a vine which has become so badly infested by this insect as the one from which the specimens were sent to me. Whenever it is evident from the numerous egg-coverings that large numbers of the eggs have been deposited, the portions most badly infested should be cut away and burned, during the autumn. The larvæ which emerge from the portion of the vine remaining, in the spring, may probably be destroyed by showering them with hot water, if care be taken to apply the water upon the sides of the vine where the insects are resting. If one prefers to incur the risk of an increase of the depredators, rather than sacrifice a large portion of the vine, the experiment might be tried as soon as convenient after the discovery of the coverings, of removing them by means of a stiff bristle-brush or otherwise. If, as there is reason to believe, the coverings are essential to the preservation and development of the eggs (perhaps exceptionally tender) then their removal, by the consequent exposure would result in the destruction of the eggs.

The insects, when they have matured and acquired wings, may be driven away before their oviposition, to other food-plants where they will prove less obnoxious, by frequently shaking the vine and not permitting them to become domesticated. They are timid creatures and easily frightened from their haunts.

*These individuals have been pronounced by Professor Uhler as a form of *E. binotata*, although differing in several particulars from examples taken upon the *Celastrus*, as in their smaller size, the larger yellow spots upon the ridge of the thorax, the anterior tip of the thorax but slightly enlarged and expanded laterally (not suggesting the head of a bird), and less curved downward toward the head.

APPENDIX.

(A.)

ENTOMOLOGICAL REPORTS OF Dr. ASA FITCH.

Upon the resumption of economic investigations of the Insects of the State of New York under legislative authority and direction, after an interval of ten years, and upon the appearance of the first of the series of annual reports upon such investigations directed to be made, it seems proper that the labors of the distinguished entomologist by whom the preceding investigations were so ably conducted during a long term of years, should be referred to, and some desirable information in regard thereto communicated.

As the entomological reports of Dr. Fitch during the years 1855-1872 constituted the first series of the kind published in this country — followed by those of Messrs. Walsh, Riley, Packard, Le Baron, Thomas and Comstock — it should be of interest to recall, after the lapse of more than a quarter of a century, the circumstances under which they had their origin, the results that they were expected to accomplish, and the character of the investigations which they were directed to embrace.

We accordingly extract from the *Transactions of the N. Y. State Agricultural Society* for the year 1854, that portion of the prefatory matter to the [First] “Report on the Noxious, Beneficial and other Insects of the State of New York,” contained in pages 700-703, under the following title :*

ENTOMOLOGICAL SURVEY.

At a meeting of the Executive Committee of the New York State Agricultural Society, held at the Astor House, in the city of New York, on May 4, 1854,

Mr. Johnson stated to the Board that the Legislature had made an appropriation of \$1,000 for an examination of insects, especially of those injurious to vegetation, and authorizing the appointment of a suitable person to perform the work.

On motion of Mr. Johnson, it was

Resolved, That Asa Fitch, M. D., of Washington county, be appointed to perform the work, and that he be furnished with such accommodations as he may desire, in the rooms appointed for the laboratory, in charge of the Society, and

*This does not appear in the separate editions of the Report subsequently published.

that the President and Mr. Johnson, Corresponding Secretary, be a committee to prepare instructions for said entomological examinations.

The following instructions to the Entomologist were prepared by the committee and delivered to Dr. Fitch:—

ENTOMOLOGICAL EXAMINATIONS.

The Legislature, at its last session, having appropriated the sum of \$1,000, to be expended by the Society in an examination of the Insects of the State, especially those injurious to vegetation; the Executive Committee having appointed Asa Fitch, M. D., of Salem, Washington county, to make the examination, the following regulations for the guidance of the examiner were prepared by William Kelly, President, and B. P. Johnson, Secretary of the Society, the committee appointed for the purpose.

As our State has had a thorough examination made of all branches of its Natural History, except its Insects, it is of the highest importance that the remaining branch — not less in importance than the others — should receive attention. The committee feel assured that in the selection of Dr. Fitch they have secured a person every way competent to discharge the duties imposed in a manner creditable to the Society and the State.

In carrying out this examination it is desirable that equal prominence be given to economical as well as to scientific entomology, that being the part of this science which is specially important to the community at large. It has been objected to the volumes of the Natural History of the State, that they are too purely scientific in their character to be of special value to the great mass of our citizens, and in the work now to be performed it is obvious that it will be of very little consequence to know that a particular kind of moth or fly is an inhabitant of this State, unless we are also informed of its history and habits, and whether it is a depredator upon any substance which is of value to man. The habits and instincts of our insects are a proper subject of inquiry as much as their names and the marks by which they are distinguished from each other. The whole history of every noxious species should at least be traced out as fully as circumstances will permit.

The examiner is therefore directed, in the first place, to make for the present season, the insects which infest our fruit-trees the leading object of examination. Those infesting our forest-trees, our grain and other crops, our garden vegetables, our animals, etc., will remain to be particularly studied hereafter. The examiner is desired in his examinations to search out every insect which is a depredator upon our apple, plum, pear, cherry, peach, and other fruit-trees, and study out all the facts in the history of each species, both in its larva and in its perfect state, as far as he shall have opportunity to do it. In this way a broad foundation will be laid to which additions can be made, which future observations may show to be necessary.

Should any important insect depredator appear the present season in any other situation than upon the fruit-trees, the opportunity for studying it should not be neglected, for the same species may not appear again in many years under circumstances as favorable for becoming acquainted with its real history.

Secondly : What time is not necessarily occupied in examining the insects in-

festing our fruit-trees should be devoted to collecting and classifying the insects of the State, and to naming and describing such species as have not been described.

A report to be prepared at the end of the season, to be submitted to the Legislature, showing what has been accomplished during the season, to be divided into two parts. The first, upon economical entomology, giving an account of all that has been ascertained respecting the insects infesting our fruit-trees, and any other injurious species that may have been obtained. The second, upon scientific entomology, giving a systematically arranged catalogue of all the insects of the State, so far as they are known, with a brief description of such new and undescribed as may be discovered.

The work should be pursued with a view of eventually securing to the State as full and complete accounts of all the insects of this State as far as to place this important science (which is at the present so greatly in the background, and so partially and imperfectly explored upon this side of the Atlantic) in as perfect a position and as favorable a situation for being acquired as its nature will admit of. Should there be time, in addition to the above, to perform other labor, it is desired.

Thirdly: That a commencement should be made in writing out full descriptions of the species pertaining to some particular order, with observations upon the time of appearing, habits, etc., with a view of future publication, so as to secure a complete account of all the insects of the State pertaining to that order.

Lastly: Suits of specimens to fully illustrate both the economical and scientific entomology of the State should be gathered in connection with the other parts of this work, to be placed in the Cabinet of Natural History; and in the Agricultural Museum, specimens of the wood, leaves, and fruits, and other substances depredated upon by each and every species of our noxious insects, showing the galls or other excrescences which they occasion, the holes or burrows which they excavate, the webs or other coverings for themselves which they construct, with preserved specimens of the worms, caterpillars, etc., by which each of these deformities is produced.

Such further examinations as Dr. Fitch may deem necessary to carry out fully the objects desired to be accomplished, as from time to time may be deemed advisable, the committee desire may be made.

[Signed]

WILLIAM KELLY,
B. F. JOHNSON,

Committee.

Under the above appointment and instructions, Dr. Fitch presented to the State Agricultural Society, his *First Report on the Noxious, Beneficial and Other Insects of the State of New York*, bearing date of March 14, 1855. It was published in the Volume of the Society's Transactions for 1854, in the year 1855. The Report having received the approbation and high commendation of a committee of the State Agricultural Society, and also a select committee of the Legislature to whom it was referred (*see Trans. N. Y. S. A. S. for 1854, pp. 693-700*), the continuance of the appropriation for carrying on the Entomological work was asked of the Legislature. It was granted, and an-

nual appropriations were made thereafter, for several successive years, and until the infirmities of an advanced age no longer permitted Dr. Fitch to continue his valued investigations.

The Fitch Reports, which have been universally held in high estimation both at home and abroad by entomologists, agriculturists, and many others, are fourteen in number. They are published in the Transactions of the State Agricultural Society, as follows :—

NUMBER OF REPORT.	TRANSACTIONS N. Y. ST. AGRICULTURAL SOCIETY.				
	Volume	For the Year	Publish- ed in	Current Pages	No. of Pages.
First	xiv	1854	1855	705-880	176
Second	xv	1855	1856	409-559	151
Third	xvi	1856	1856	315-490	176
Fourth*	xvii	1857	1858	687-753	67
Fifth	xviii	1858	1859	781-854	74
Sixth	xx	1860	1861	745-868	124
Seventh	xxi	1861	1862	813-859	47
Eighth	xxii	1862	1863	657-691	35
Ninth	xxiii	1863	1864	778-823	46
Tenth	xxiv	1864	1865	433-461	29
Eleventh	xxvi	1866	1867	487-543	57
Twelfth	xxvii	1867	1868	889-932	44
Thirteenth	xxix	1869	1870	495-566	72
Fourteenth	xxx	1870	1872	355-381	27

Of the above reports, the twelfth, thirteenth and fourteenth have only been published as above stated: the others have appeared separately, as follows :—

First Report | on the | Noxious, Beneficial and Other Insects, | of the | State of New York, | made to the State Agricultural Society, pursuant to an Appropriation | for this Purpose from the Legislature of the State. | — | By Asa Fitch, M. D., | Entomologist of the N. Y. State Agricultural Society; Member of the | Entomological Society of France, of Pennsylvania, etc. | — | Albany: | C. Van Benthuyzen, Printer to the Legislature. | No. 407 Broadway. | 1855. | Pamph., 8vo., pp. 180, including Index. Title-page cover, and title-page. A few copies were bound in cloth.

*Appended to this Report, on pp. 755-812, Dr. Fitch has republished the following rare tract: "Descriptions of New Species of Heteropterous Hemiptera of North America, by Thomas Say. New Harmony, Indiana. December, 1831." Of this publication, only two copies were known to be extant. It was here reproduced from a transcript which Dr. Fitch had made of one of the two copies, which was in the possession of Dr. Harris. It contains 143 species.

This Report is mainly devoted (145 pages) to the insects injurious to fruit-trees, viz., the Apple, the Pear, the Peach, the Plum (1 species of insect), the Cherry, and the Grape-vine. It also notices insects infesting the Hickory, the Pine (1 species of Insect), the Cabbage and the Gooseberry (each 1 species).

First and Second Report | on the | Noxious, | Beneficial and Other | Insects; | of the | State of New York. | Made to the State Agricultural Society, pursuant to an | appropriation for this purpose from the | Legislature of the State. | — | By Asa Fitch, M. D., | Entomologist of the N. Y. State Agricultural Society; Member of the | Entomological Society of France, of Pennsylvania, etc. | — | Albany: | C. Van Benthuyzen, Printer to the Legislature. | No. 407 Broadway. | 1856. | Cloth, 8vo., pp. 336 including Index. Plates 1-4, and 37 wood-cuts not numbered in the text.

This Report treats of Insects injurious to the Apple-tree (in 75 pages); to Forest-trees (in 21 pages), viz., the Pine, Larch, Maple, and Poplar; and to Field crops, viz., Wheat, Corn, and Hops.

Third, Fourth, and Fifth Reports | [same as preceding to] | C. Van Benthuyzen, Printer. | No. 407 Broadway. | 1859. | cloth, 8vo., separately paged: Third Report, pp. i-vii + 3-172, plates 1-4, 1 wood-cut: Fourth Report, pp. 1-67, 4 wood-cuts in text: Fifth Report, pp. 1-74, 9 wood-cuts in text. Index of 11 pages (unpaged) to the 3 reports, referring to the 360 sections contained therein.

The Third Report notices the Insects of our Fruit-trees (56 species of apple insects), including the nut-trees, and, in a supplement, a few miscellaneous insects: The Fourth Report, Insects injurious to Evergreen Forest-trees; and the Fifth Report, the Insects of Deciduous Forest-trees.

Sixth, Seventh, Eighth and Ninth | Reports | on the | Noxious, Beneficial and other Insects, | of the | State of New York. | Made to the State Agricultural Society, pursuant | to an Annual Appropriation for this purpose | from the Legislature of the State. | — | By Asa Fitch, M. D., | Entomologist of the N. Y. State Agricultural Society; | Member of the Entomological Society of France, | of Philadelphia, the Albany Institute, etc. | — | Albany: | Van Benthuyzen's Steam Printing House. | 1865. | Cloth, 8vo., pp. 260, plates 1-4, 4 wood-cuts.

The Sixth and Seventh Reports are devoted to Insects infesting Grain crops (90 pages upon the wheat-midge); the Eighth and Ninth to Insects infesting Gardens.

[Ninth] Report of Dr. Fitch on the Noxious and other Insects detrimental to Agriculture. Also an address delivered before the N. Y. Agricultural Society. Albany: C. Wendell, Legislative Printer. 1865. Pamphlet, 8vo., pp. 56, with index.

The address is upon the Hop-Aphis, referred to on page 320. The Pamphlet is not now accessible to me, and therefore the above is the only reference to it that may be made at present.

Tenth and Eleventh | Reports | [same as preceding to] Van Benthuysen & Sons' Steam Printing House. | 1867. | Pamph., 8vo., pp. 90, including Index (the Tenth Report occupies 29 pages), 18 figs.: cover with half-title, viz., Tenth and Eleventh Reports | of the | Noxious, Beneficial and other Insects. | By Asa Fitch, M. D. |

The Tenth Report contains notices of "Insects infesting Gardens" — Nos. 14–18, viz., the cucumber-beetle, the three-lined potato-beetle, the hop-aphis, the barberry-aphis, and the flattened centipede.

The Eleventh Report contains the onion-fly, *Anthomyia ceparum* Linn., the punctured flea-beetle, *Psylliodes punctulata* Mels., the cabbage-fly, *Anthomyia brassicæ* Bouché, the radish-fly, *Anthomyia raphani* Harris, the cabbage-Aphis, *Aphis brassicæ* Linn., an extended notice of wire-worms, and notices of a few other insects.

The Reports of Dr. Fitch should be, and are we believe, regarded as indispensable to the library of every American entomologist. Inquiries are frequently made of where and how they are to be procured, for unfortunately, complete series are but rarely to be met with. It will, therefore, be of service to make the following statement in relation to them, referring to the table of their publication given upon page 294.

Two or three of the bound volumes originally published,— the one containing the first and second reports, and the one containing the sixth, seventh, eighth, and ninth — may be obtained, by purchase, by addressing the Secretary of the State Agricultural Society, at Albany, Mr. T. L. Harison. The third report is only to be had at second hand as it may by chance be met with. Of the remaining ones of the series, viz., the fourth, fifth, and tenth to fourteenth inclusive, copies (of some of them only a few), in the volumes of the Transactions of the Society in which they were published (see table), are still in possession of the Society, and may probably be procured from the Secretary through purchase or exchange.

In consideration of the value of these reports and their increasing rarity, provision was made, in 1873, through an appropriation of the Legislature of the State, for their revision and republication.*

The revision was completed by Dr. Fitch and presented to the Legislature, and a resolution for printing two thousand copies under the direction of the Board of Regents of the University was passed by the Assembly,† but for some reason (it is believed from political considerations), it failed to receive the concurrence of the Senate.

*Chapter 760 of the Laws of 1873 (page 1147) appropriates fifteen hundred dollars to Dr. Fitch "for revising and completing for publication his survey of the noxious and other insects of the State."

†See Journal of the Assembly for 1875, April 16th, p. 864.

When a few years ago, it was proposed to make another effort for the publication, the manuscript could not be found, nor has the search subsequently made for it been successful: it is feared that, not having been properly cared for at the time, and through ignorance of its value, it was destroyed. As it should have been deposited in the State Library, it is still hoped that it may be brought to light in the removal of the greatly overcrowded material of the Library to the quarters being prepared for it in the New Capitol. As a possible aid to its discovery, the above somewhat circumstantial statement is made.

Miscellaneous Entomological Papers of Dr. Fitch.

In addition to the Annual Reports made to the N. Y. State Agricultural Society, as noticed in the preceding pages, the following entomological papers have been contributed by Dr. Fitch to the *Transactions of the Agricultural Society*, the *Quarterly Journal of Agriculture and Science*, the *Country Gentleman*, the *Cultivator*, and to other agricultural and scientific publications. It has not been possible to complete the list. Additions to it may appear hereafter.

1845. Insects Injurious to Vegetation.—No. 1. (American Quarterly Journal of Agriculture and Science, i, 1845, pp. 250–254, pl. 3.)

Describes and figures (in colors) the following species of Coleoptera: *Saperda* [*Oberca*] *tripunctata*, *S. bivittata*, *S. calcinata*, *Clytus* [*Glycobius*] *speciosus*, *C. [Cyllenc] pictus*, *C. [Neoclytus] caprea*, *Desmocerus palliatus*, and *Purpuricenus [humeralis]*.

1845. Insects Injurious to Vegetation.—No. 2. Insects of the genus *Cecidomyia*, including the Hessian Fly and Wheat Fly. (Ib., pp. 255–269.)

Gives general characters of the order of Diptera and of the family of *Tipulidae*, with the generic features, habits, and foreign and American species of the genus *Cecidomyia*; together with a detailed description of *Cecidomyia sulcis*, its galls, habits, enemies and destroyers, illustrated by a steel plate of eight colored figures.

1845. Insects Injurious to Vegetation.—No. 3. The Wheat Fly. (Id., ii, 1845, pp. 233–264.)

Discusses the insect under the following heads: Its foreign history, its domestic history, its habits, its natural enemies, artificial means for arresting its ravages, description of the clear-winged wheat-fly (*Cecidomyia tritici*), the spotted-winged wheat-fly (*C. caliptera*), and species resembling the wheat-flies, *C. thoracica* and *C. togata*.

1846. On the Wheat Fly and Chinch Bug. (Ohio Cultivator, February 1, 1846.)

Cited from the catalogue of the Museum of Comparative Zoölogy at Cambridge.

1846. The Wheat Fly. (Transactions of the N. Y. State Agricultural Society, for 1845, v, 1846, pp. 255-290, 1 pl.)

As stated in a foot-note: "This essay originally appeared in the Quarterly Journal of Agriculture and Science, vol. ii, no. 2; to the editors of which acknowledgments are due for the illustration with which it is accompanied. The essay has been revised, and new paragraphs added by the author."

Also published separate; second edition, Albany, 1846, pp. 38, pl. 1.

1846. Insects Injurious to Vegetation. No. 4. The Hessian Fly. (American Quarterly Journal of Agriculture and Science, October, 1846, iv, pp. 244-264.)

Treats of the species under the following heads: Its introduction into America—Its civil history and bibliography—Its name and synonyms.

1847. Insects Injurious to Vegetation. No. 5. The Hessian Fly—continued. (Id., for January, 1847, v, pp. 1-27.)

Treats of its character, transformations and habits—Its parasites—Remedies—and concludes with a summary of the preceding history.

1847. Winter Insects of Eastern New York. (Id., for May, 1847, v, pp. 274-284.)

Describes the following new species of Neuroptera and Diptera: 1. *Boreus nivoriundus*, the snow-born Boreus. 2. *Boreus brumalis*, the mid-winter Boreus. 3. *Perla nivicola*,* the small snow-fly. 4. *Nemoura nivalis*, the large snow-fly or the shad-fly. 5. *Culex hyemalis*, the winter musketoe [corrected in MS. note to *Anopheles hyemalis*].† 6. *Chironomus nivoriundus*, the snow-born midge. 7. *Trichocera brumalis*, the mid-winter Trichocera. 8. *Podura nivicola*, the snow-flea.

1847. List of Noxious Insects. (Id., for September 1847, vi, pp. 145-152.)

Classified under nine headings: 1. Infesting Grain, 28 species are named. 2. Infesting Meadows and Pastures, 23 species. 3. Infesting Garden Vegetables, 38 species: some English species are included in the preceding. 4 to 9. Infesting Flowers, Orchards, Forest-trees, Domestic Animals, Dwellings, and attacking Man; no species are mentioned. As infesting "old books, herbaria, cases of insects, old furniture, etc.," *Atropos pulsatorius* (Linn.) Leach, the book-louse, is described (page 150). As occurring "on wheat-heads, straw, grain and flour in the field, barn and mill," *Psocus tritici*, the wheat-louse, is described (page 151). As occurring "in forests on the surface of melting snow, buckets of maple sap, and pools of water," *Podura nivicola* is redescribed. As occurring on grape-vines, sucking their juice, *Otiocerus Coquebertii* Kirby, is described.

1847. The Hessian Fly: its History, Character, Transformations and Habits. (Transactions N. Y. State Agricultural Society, for 1846, vi, 1847, pp. 316-373, 1 pl. [7].)

Originally published in the *American Journal of Agriculture and Science*, vols. iv, v, and now revised by the author.

*Is *Capnia pygma* Burm.

†Is *Anopheles quadrimaculatus* Say.

This essay contains many details of history and habits, which are not repeated in the notice in the *Seventh Report on the Insects of N. Y.* (pp. 134-144 of 6th-9th Reports, 1865.) Remedial measures are discussed at length, under the following heads: 1. A Rich Soil. 2. A Late Sowing. 3. Grazing. 4. The Roller. 5. Mowing. 6. Fly-proof Wheat. 7. Steeps for the Seed. 8. Oats as a Decoy. 9. Wheat as a Decoy. 10. Deeply Covering the Seed. 11. Procuring Seed from Uninfested Districts. 12. Sun-drying the Seed. 13. Drawing Elder Bushes over the Young Plants. 14. Sprinkling Fine Salt, Ashes, or Caustic Lime over the Young Plants. 15. Burning and Plowing up the Infested Stubble.

The above was also printed separately, in a pamphlet, 8vo., Albany, 1846, pp. 63, 1 plate; and also, Albany, 1847, pp. 60, 1 plate.

1847. The Grain-moth — *Tinea granella*. (The Cultivator, New Series — vol. iv, January, 1847, pp. 13, 14 — 54 cm.)

Gives a general account of the species (description, habits, transformations, and remedies), with critical remarks upon the Angoumois moth, *Anacamptis? cerealella*.

1848. The Currant-Moth, *Abraxas? Ribearia*. (Transactions of the New York State Agricultural Society, for 1847, vii, 1848, pp. 461-469, 1 pl., 11 figs.)

Gives a popular description of the larva, with an account of its habits and transformations, the nature and extent of its injuries, and remedies useful against it. The insect is also scientifically described in its larval, pupal and perfect stages, under the above name, being doubtfully referred to the genus *Abraxas*. In the plate, the three stages are represented, with some structural enlargements.

1849. Catalogue of the Insects in the State Cabinet of Natural History, December 1, 1848. (Second Annual Report on the State Cabinet of Natural History, 1849, pp. 25-39.)

Gives a classified list of 608 examples, representing 358 species, of which 32 species are Lepidoptera, 30 Neuroptera, and the remainder Coleoptera. [This collection is no longer in existence, having been destroyed by *Anthrenus varius* during the subsequent twenty years.]

1850. [Insects infesting Sheep and other Domestic Animals], contained in "A Historical, Topographical and Agricultural Survey of the county of Washington." (Transactions of the N. Y. State Agricultural Society, for 1849, ix, 1850, pp. 753-944.)

Notices, popularly, the following insects, in pp. 797-804: The sheep-tick, *Melophagus ovinus*; *Ornithomyia avicularia*, infesting owls; the *Æstridæ* — the bot-flies of the horse, *Æstrus equi* and *Æstrus nasalis* (p. 799); the gad-fly of cattle, *Hypoderma bovis*; the sheep gad-fly, *Cephalemyia ovis* (p. 800); sheep maggots, *Lucilia Cæsar* (p. 801), *Lucilia cadaverina*, *Calliphora vomitoria* (p. 802), and *Calliphora fulvibarbis*; *Musca domestica* and *Stomoxys calcitrans* (p. 803); also remedies and preventives for sheep maggots (p. 804)

1851. Catalogue with References and Descriptions of the [New York] Insects [of the suborder Homoptera] collected and arranged for the State Cabinet of Natural History. (Fourth Annual Report on the State Cabinet of Natural History, 1851, pp. 43-69.)

The catalogue embraces all of the New York Homoptera known to Dr. Fitch, represented in 266 examples. It contains notes upon 138 species, of which 82 are described as new, occurring in the several families as follows: In the *Cicadidæ*, 4 species are noticed; *Fulgoridæ*, 14 species, of which 6 are new; *Membracidæ*, 31 species, of which 14 are new; *Cercopidæ*, 8 species—4 new; *Tettigoniidæ*, 46 species—32 new; *Psyllidæ*, 6 species—all new; *Aphidæ*, 26 species—18 new; *Coccidæ*, 3 species—2 new. The following 6 genera are proposed and described: *Carynota*, *Cyrtoisa* [error for *Cyrtosia*], *Telamone*, *Heleochara*, *Erythroneura*, and *Empoa*.

1851. Wheat Insects — Joint-Worm. (The Cultivator, New Series, viii, October, 1851, pp. 321-324.)

Injuries of the joint-worm as related by a correspondent: A species of *?Capsus* observed upon the wheat: The "joint-worm" described and critically compared with the Hessian-fly worm, and with Miss Morris' wheat-midge (an undetermined species), and is found to be different from these or any known species.

1852. *Cantharis vittata*. (Journal N. Y. State Agricultural Society, for October, 1852, iii, p. 55 — 18 cm.)

Notes upon the striped blistering-fly, *Cantharis vittata*, which had entirely destroyed some potato vines near Albany. Remarks upon their blistering properties, with directions for collecting and preparing them for use.

1854. Apple-tree Pests — Schönherr's Weevil and the Orchard Moth. (Trans. N. Y. State Agricultural Society, for 1853, xiii, 1854, pp. 178-187.)

Account of *Pachyrhynchus Schonherri* of Kirby, identical with *Curculio Noveboracensis* of Forster, eating the buds and young twigs of apple-trees in Michigan; also, of a caterpillar stripping all the leaves from the orchards in Washington county, N. Y., which is named as *Argyrolepis pomoriana* n. sp. An allied species is described and named as *Argyrolepis sylvaticana*, or the Forest-moth. In a postscript to the above, which had been published in the *Salem Press* of July 12th, Dr. Fitch corrects an error in relation to the orchard moth, and now names it *Chatochilus pometellus*, Dr. Harris having meantime published a description of it as *Rhinosia pometella*, in a newspaper dated the 19th of July. Dr. Fitch also describes and names an associated species as *Chatochilus contubernalellus*.

Appended to the above, are two letters from Dr. Harris, in which he notices the Michigan weevil as *Ithycerus Noveboracensis* [its present name], and the "Palmer-worm" or *Rhinosia pometella*, (pp. 188-192). [Dr. Fitch was the first to describe the larva of this insect, while at the

same time he named (as *Argyrolepiæ pomoriana*) a moth as its parent which was quite a different insect, belonging to a different family.]

1854. Insects of Algiers from the Museum of Natural History of Paris, confided to Asa Fitch, M. D., for the Agricultural Society of New York [136 named species as per list sent].

Remarks upon the Insects named in the above List, by Asa Fitch. (Id., for 1853, xiii, 1854, pp. 369-379.)

In this paper Dr. Fitch, in remarking upon *Colias Edusa*, one of the species received, indicates as New York insects, *Colias Philodice* Godart, *Colias Chrysotheme* Boisdu., *Colias Phicomone* Boisdu., *Colias nastes* Boisdu., *Colias santes* n. sp., and *Colias Edusa*. In the notices of the Coleoptera he gives several instances of retarded development among the *Buprestidæ*.

1855. [Entomology. No. I.]—Osage Orange Insect. (The Country Gentleman, for Jan. 18, 1855, v, p. 38 — 77 centimeters.)

The Osage-orange has been highly esteemed and extensively used in Illinois, Wisconsin and Iowa, as a hedge-plant, from its adaptation to the climate and its freedom from insect attack. White-ants have been reported as injurious to it, but it is probable that they only attack the roots after they are dead.

The insect now sent by Mr. Robert W. Kennicott, as occurring on an Osage-orange hedge in Granville, Ohio, is a species of *Lecanium*, for which if new, Mr. K. had proposed the name of *Coccus maclurei* [from the generic name of the plant, *Maclura auriantica*]. It is probably identical with the fig-tree bark-louse, *L. caricae* of Fabricius, but if new, it should bear the name of *L. macluræ*. Dr. Fitch figures the scales and describes them, and gives their natural history, drawn from allied species. The proper remedies would be to remove the scales and scrape the branches with a wooden-bladed knife, subsequently washing with gas-tar water or fish-oil; or, if these are not convenient, then with strong soap-suds, at intervals of a few days, two or three times. For this, the spring of the year would be the best time. The trunk and limbs, as a protection from future attack might be whitewashed, or coated over with clay dissolved in water to the consistency of thick paint.

[No notice of this Osage-orange depredator, as such, at least, appears in the New York Reports. It is probably the same insect subsequently described (in 1860) by Dr. Fitch as *Lecanium aceris-corticis*, from maples in Albany, and identical with the *Lecanium macluræ* of Walsh and Riley (*Amer. Entomol.*, i, 1863, p. 14), and with the species described by Rathvon (*Pennsylvania Farm Journal*, iv, August, 1854, pp. 256-258) as *Coccus innumerabilis*, now known as *Pulvinaria innumerabilis* (Rathvon).]

1855. [Entomology. No. II.]—The Hunter Weevil. (The Country Gentleman, June 14, 1855, v, p. 373 — 56 cm. = 2 cols. The Cultivator, July, 1855, Third Series, iii, p. 221 — 40 cm.)

Gives the characters of weevils, to which this insect belongs. It is identified as the *Sphenophorus venatus* of Say, described in 1831, and the

meaning of the scientific name is given. It is a common species and had been observed since 1847 by Dr. Fitch, eating the leaves of corn, and hiding under leaves and in other localities. [See *Sphenophorus sculptilis*, page 264, ante.]

1855. [Entomology. No. III.]—The Chinch Bug. (The Cultivator, August, 1855, Third Series, iii, p. 238 — 37 cm.)

In reply to a communication from a correspondent in Indiana, giving an extended account of the operations of the insect in corn and wheat-fields, it is identified as the chinch-bug, and speculations upon the origin of the name are offered. Originally described by Say as *Lygæus leucopterus*, it is referred by Dr. Fitch to the genus *Micropus* of Spinola. *Micropus Spinolæ* Signoret, had recently been discovered and described, from the environs of Paris.

1855. Entomology. No. IV.—The Apple Plant-Louse. (The Country Gentleman, July 19, 1855, vi, p. 48 — 84 cm. The Cultivator, Sept. 1855, Third Series, iii, pp. 278, 279 — 80 cm.)

Gives directions for communicating specimens of insects. Six species of apple plant-lice and bark-lice known, two of which are undescribed. The Apple plant-louse examined, is identical with the *Aphis mali* of Europe. Their description, natural history, secretion of honey-dew, their enemies, and remedies; of the latter are soap-suds, tobacco water, and smoke; the "Parapetticoat" of Dr. Lindley described.

1855. Entomology. No. V.—Insects which destroy Plant-Lice. (The Country Gentleman, Sept. 6, 1855, vi, p. 158 — 84 cm.)

Compares the offensive smell of a tree badly infested with the lice, to that of stale fish: Remarks upon the rapid multiplication of the aphides: The lady-bugs make the greatest havoc among them, and their method of attack and their general habits are given: A general account is given of the Aphis-lion — the larva of the lace-wing fly, of the family of *Hemerobiidæ*, which also destroys large numbers of plant-lice.

1855. Entomology. No. V, contin.—Insects which destroy Plant-Lice. (The Country Gentleman, Sept. 13, 1855, vi, pp. 174, 175 — 55 cm.)

The Syrphus fly is mentioned as the third enemy of plant-lice, and its habits narrated. They are also liable to the attack of one of the *Ichneumonidæ*, of the genus *Aphidius*. The manner of oviposition, and the development of the insect within the aphid is detailed. Gathering these plant-lice enemies by a beating net, from hedges and forests, and transferring them to infested trees, is recommended.

1855. Entomology. No. VI.—Gaylord's Wheat-Caterpillar. (The Country Gentleman, Nov. 22, 1855, vi, p. 331 — 37 cm. The Cultivator, January, 1856, Third Series, iv, p. 19 — 28 cm.)

The caterpillar feeds on kernels of wheat, when in the milk and ripe: they are described — habits are given — have long been known in Western New York, but the perfect insect is unknown. It is believed to belong to the *Platypteridæ*. Mr. Gaylord describes the caterpillar in *Trans. N. Y. St. Agricul. Soc.*, iii, p. 147. See also *Cultivator*, 1839,

vi, pp. 21 and 43. Differs from Dr. Harris' wheat caterpillara (Treatise, p. 354).

1855. Entomology. No. VII.—The Wheat Thrips and Three-banded Thrips. (The Country Gentleman, Dec. 13, 1855, vi, p. 385 — 84 cm.)

Specimens sent from Geneva, Wisconsin, as injuring the blossoms of wheat and clover early in July; characters of the *Thripididæ* given; their numerous food-plants; abundance, habits and injuries of the grain Thrips, *Thrips cerealium*, in England. The several stages of the Wisconsin species are described, and it is named *Thrips tritici*. A species common upon wheat in Washington county, N. Y., on the 1st of June, is described, and named *Colcothrips trifasciata*. It had been seen upon flowers of tansy [*Tanacetum vulgare*] the last of July.

1856. Entomology. No. VIII.—Cut-Worms. (Country Gentleman, March 6, 1856, vii, pp. 154, 155; continued in no. for March 15, id., p. 171 — 104 cm. The Cultivator, April, 1856, Third Series, iv, pp. 115, 116 — 78 cm.)

In reply to inquiries, states that cut-worms appear to occur in all soils. Their "biography" is given, and five different kinds are described, which have not been reared to the perfect state, so that their species are unknown. Two of our most common cut-worm moths, viz., *Agrotis subgothica* Haworth, and *Agrotis devastator* Brace, are described; and methods of subduing cut-worm ravages are given.

1856. Entomology. No. IX.—The American Vaporier Moth. (The Country Gentleman, April 3, 1856, vii, pp. 217, 218; contin. in no. for April 10, id., p. 235 — 106 cm. The Cultivator, May, 1856, Third Series, iv, pp. 154-156 — 80 cm.)

Discourses of the great beauty of the caterpillar, and describes the insect in its several stages (egg to imago). Describes its two principal parasites, viz., *Trichogramma? orgyie* n. sp., and *T.? fraterna* n. sp. Some of its ravages are mentioned, and for their prevention, destruction of its eggs is recommended.

1856. Entomology. No. X.—Borer in Apple Trees—The Buprestis. (The Country Gentleman, July 10, 1856, viii, p. 27 — 70 cm. The Cultivator, August, 1856, Third Series, iv, pp. 240, 241 — 51 cm.)

Gives a statement of the operations upon apple-trees of some undetermined Buprestidæ, with a general account of the thick-legged Buprestis, *Chrysobothris femorata*, and method for preventing its ravages by the use of soft soap.

1856. Entomology. No. XII.—The Rose-Bug. (The Country Gentleman, July 31, 1856, viii, p. 75 — 70 cm. The Cultivator, Sept. 1856, Third Series, iv, pp. 270, 271 — 54 cm.)

Erroneously reported as poisonous to fowls. Its favorite food-plants are mentioned, with description of the beetle, the natural history of the

insect, and its natural enemies. Remedies and preventives for its ravages, and State bounties for its collection and destruction recommended.

1856. The Joint-Worm in Barley. (Journal N. Y. State Agricultural Society, for December, 1856, vii, p. 75 — 13 cm.)

Insects destructive to Barley, in Cazenovia, N. Y., identified as *Eurytoma hordei*, for the first time noticed in this State.

1857. Entomology. No. XIII.—The Prickly *Leptostylus*—a Worm under the bark of Apple-Trees. (The Country Gentleman, Jan. 29, 1857, ix, p. 78 — 77 cm. The Cultivator, March, 1857, Third Series, v, pp. 77, 78 — 58 cm.)

Account of its operations as observed by Mr. Clark, in Wisconsin. Identified as the *Leptostylus aculiferus* of Say and described by Dr. Fitch. Repeated applications of soap recommended for its prevention, and suggestions made for its detection in its retreat.

1857. Entomology. No. XIV.—Insects Imbedded in the Interior of Wood. (The Country Gentleman, March 26, 1857, ix, pp. 201, 202 — 68 cm. The Cultivator, May, 1857, Third Series, v, pp. 138, 139 — 46 cm.)

Remarks upon the importance of accompanying requests for information upon insects submitted, with the statement of what is known of them. Description of the Pigeon Tremex, *Tremex Columba* Linn., in its larval and pupal stages: mention of the trees which it infests and the decay that results. No method known by which we may destroy the larvæ. Many are killed by a parasite. Attack upon a tree may be arrested by a thick straw encasement preventing egg-deposit.

1857. Entomology. No. XV.—Grasshoppers. (The Country Gentleman, July 16, 1857, x, pp. 42, 43 — 96 cm. The Cultivator, August, 1857, Third Series, v, pp. 245, 246 — cm. 70.)

Inquiries from Scott county, Minn., in relation to a grasshopper which came from the Northwest by millions, and were in June of the following year, consuming every green thing [evidently *Caloptenus spretus*]. Dr. Fitch presents a picture of locust visitations and devastations in the old world. The immature species sent to him cannot be named, although evidently not the *Acridium femur-rubrum*, which species is sometimes gregarious and migratory, and approaches the locust of the east in its ravages. Our knowledge of the means of controlling locust ravages is better than of any other insect, from the study given it from the earliest times. It is by collecting and destroying the eggs and young insects. The extent to which this has been done in Europe, China and elsewhere, is stated, and also how it may best be done.

1857. Weevil in Seeds from the Patent Office. (Journal N. Y. State Agricultural Society, for July, 1857, viii, p. 29 — 11 cm.)

Insects discovered in a package of Patent Office seed, labeled "Spring Barley from Italy," found to be the grain-weevil, *Calandra granaria*

of Linnæus. The same insect has been very destructive to seeds in the collections of the State Agricultural Society. Dr. Fitch remarks: "Schœnherr has given the generic name *Sitophilus* to this species and its kindred, but as the larva of this insect has long been known in Europe by the popular name *Calandre* from which Clairville derived the name of his genus *Calandra*, of which genus this insect must be considered the true type, we regard the name proposed by Schœnherr to be illegitimate and untenable."

1857. The May Beetle. (The Genesee Farmer, for August, 1857, xviii, 2d Ser., pp. 239-241.)

After remarks upon the importance of ascertaining the correct scientific name of an insect, a severe criticism is made upon "the disingenuous statement of Dr. Harris," that he had proposed the genus *Phyllophaga* for this insect in 1826. Before its publication in 1827, *Lachnosterna* had been designated for it by Rev. Mr. Hope. It had long been known under the specific name of *quercina*, but this must give way to *fusca* of Frohlich, under which it was described in 1792. The exceeding destructiveness of the beetle, at times, is stated, it having entirely stripped cherry and plum trees of their leaves. The larvæ, usually solitary, sometimes become gregarious, when their injuries are intensified. The insect's life-history is not known, but is believed to be analogous to that of the cockchaffer of Europe. For the destruction of the grubs, when they abound in grass-lands, the fields should be fenced, and swine turned in to root them out. For destroying the beetles, trees where they collect should be shaken for them. Some trees which gave the first night two pailfuls, gave the fifth night but two beetles.

1857. Entomology. No. XVI.—The Hunter Weevil in Young Corn.—Beetles upon, and Worms in, Potato Vines.—Gooseberry Insects. (The Country Gentleman, August 6, 1857, x, p. 91—35 cm. The Cultivator, September, 1857, Third Series, v, p. 273—34 cm.)

In reply to inquiries made from Bainbridge, N. Y., of "a new corn insect," and telling of its injuries to the young blades of corn, the insect is identified as *Sphenophorus venatus* Say, and the recommendation made that children should be employed to collect and kill the beetles. The potato beetle is recognized as the black blistering-beetle, *Cantharis atrata*, and the borer in the vine as an unknown species of *Gortyna* [now known to be *Gortyna nitela* Guen.]. The larva infesting gooseberries in Ashfield, Mass., is not identified.

1857. Wheat-Midge. (Journal N. Y. State Agricultural Society, for November, 1857, viii, pp. 67, 68—27 cm.)

Dr. Fitch's determination of the wheat-midge as identical with the *Cecidomyia tritici*, of Europe, had been dissented from by M. Amyot, of Paris, but was subsequently accepted by the French Entomologists. Not being accompanied in this country with any parasite, the measures are stated which have been taken for the importation of its European parasite.

1858. Entomology. No. XVI, bis.—Experiments. Soap on Apple-Trees.—Powdered Charcoal on Cucumber Plants. (The Cultivator, August, 1858, Third Series, vi, pp. 238, 239—43 cm.)

Abrazas? ribearia identified, as sent from Ilion, N. Y., and reference made to its description in *Trans. N. Y. St. Agricul. Society* for 1847, p. 461; hand-picking recommended for its destruction. The efficacy of the soap protection of apple-trees from the borer, *Saperdu bivittata*, having been questioned, Dr. Fitch experimented with it, with the following results: in twelve trees not soaped, twenty-four borers had been discovered during the year, while in twenty-two soaped trees, not one borer could be detected. Powdered charcoal failed to protect from the cucumber-beetle, while boxes open at top and bottom gave effectual protection, as also against "the cut-worm, the large stinking squash-bug, and all [?] other insect depredators."

1858. Entomology. No. XVII.—The Fall Web-Worm. (The Cultivator, November, 1858, Third Series, vi, pp. 341, 342—55 cm.)

The insect was extremely abundant the present year. Its scientific name in both genus and species, means "the weaver." The moth is briefly described, its natural history given, together with its larval habits and the construction of its web. It prefers for food the ash, and next in order, cherry, walnut, plum, apple and willow. There are two other Ermine moths. While *Hyphantria textor* is spotless, *H. punctata* n. sp., has a black dot on the center of each front wing (*Trans. N. Y. St. Agricul. Soc.*, for 1856, p. 383), and *H. cunca*, of Drury, has numerous small black spots on the front wings.

1858. Wheat-Midge. (Transactions N. Y. State Agricultural Society, for 1857, xvii, 1858, pp. 319, 320.)

Extract from a letter of Dr. Fitch, narrating a comparison made by the distinguished French entomologist, M. Amyot, of our wheat-midge with the *Cecidomyia tritici* of Europe, and the pronounced identity of the two. Also, absence of any wheat-midge parasites in this country, and steps taken for their importation from Europe.

1858. Say's Heteropterous Hemiptera. (Transactions N. Y. State Agricultural Society, for 1857, xvii, 1858, p. 754.)

Preface to description of new species of Heteropterous Hemiptera of New York, by Thomas Say, New Harmony, Indiana. December, 1831 (*Ib.*, pp. 755-812). Printed from a transcript copy made by Dr. Fitch from one of the two copies known to be extant.

1859. Entomology. No. XVIII.—The Golden Tortoise Beetle. (The Country Gentleman, Jan. 20, 1859, xiii, p. 50—66 cm.)

Gives its operations on convolvulus and other food-plants, characters of the family of tortoise-beetles or *Cassididae*, and generic distinctions. Describes, with figures, this species, *Coptocycla aurichalcea*, of which *C. punctata*, although an older name, should be regarded as a synonym, for reasons given.

1859. A New Barley Insect. (Journal N. Y. State Agricultural Society, for April, 1859, x, pp. 114, 115 — 25 cm.)

From infested barley-straw sent from Cazenovia, N. Y., sixty flies were obtained which are of a different species from the *Eurytoma hordei* of Dr. Harris. The name *Pteromalus? tritici* is proposed for it.

1859. A New Barley Insect. (The Country Gentleman, April 21, 1859, xiii, p. 250 — 20 cm.)

From some barley joints, received from Cazenovia, N. Y., sixty examples of *Chalcidids* were bred, of one species, one-fourth of which were males, and no parasites among them. They are found to be quite uniform, and different from the Massachusetts barley-fly, and both species different from the Virginia joint-worm. They are the only insects of the family yet discovered which feed on vegetation, all the other species being parasitic on other insects. They appear to be more nearly allied to *Pteromalus* than to *Eurytoma*, where placed by Dr. Harris.

The distinctive features of the three species, viz., the black-legged or Massachusetts Barley-fly (*Pteromalus? hordei* Harris), the joint-worm fly (herein named *Pteromalus? tritici*), and the yellow-legged Barley-fly (*Pteromalus? fulvipes*), are briefly given, in advance of publication in next Annual Report.

1859. The Thousand-Legged Worm. (The Country Gentleman, July 14, 1859, xiv, p. 27 — 16 cm.)

Reply to an inquiry, from Armstrong county, Pa., of a worm killing the young cucumber, radish, beans, onions, and the large strawberry: the latter, when near ripe, often contains fifty of them. They had been destroyed by hot water after drawing them by *thousands* beneath boards laid on the walks in the evening. Dr. Fitch could not determine the species, not having studied the group. They belonged to the genus *Julus*, and are usually regarded as inoffensive, living only on decaying matter, as *Julus Americanus* Beauv., our largest species, often found in old rotten logs. Hardly a bucket of water had been drawn from Dr. Fitch's well during the season that did not have one or two of these worms in it, which had crawled from their retreats among the stones, and fallen in. When discovered in garden vegetables, they are probably attracted by decay or putrefaction following some insect attack. The strawberries may have been first eaten by ants or other insects.

1859. Entomology. No. XIX.—Beetles Infesting Grape-vines. (The Country Gentleman, Sept. 15, 1859, xiv, p. 171 — 56 cm.)

In reply to inquiries from Westfield, N. Y., describes and figures the spotted Pelidnota (*Pelidnota punctata*); describes the Light-loving Anomala (*Anomala lucicola*) with its varieties, viz., the Gloomy Anomala (*marens* Fabr.), the Spotted-necked Anomala (*maculicollis*), the true Light-loving Anomala (*lucicola* Fabr.), and the Black Anomala (*atrata* Fabr.); notices briefly the Rose-bug (*Macrodactylus subspinosus*), and cites the conflicting evidences that fowls do and do not eat it; gives the natural history of the grape-vine flea-beetle (*Haltica chalybea*), and recommends as a remedy, that the beetles be searched for in their retreats and destroyed early in the spring.

1859. Entomology. No. XX.—The Parasitic Destroyer of the Curculio. (The Country Gentleman, Oct. 6, 1859, xiv, p. 221 — 60 cm.)

The Curculio regarded as our most injurious insect; at first, in 1746, it seemed confined to nectarines, later it attacked the plums, and still later, apples and cherries. A parasite had lately been received from St. Catharines, Canada West, with its history as observed. It is an internal parasite, and of this class, the "four very extensive families named *Ichneumon*, *Bracon*, *Chalcis* and *Proctotrupes*" are compared by their venation and other features, with a figure of the wing of the curculio parasite in illustration. The new parasite belongs to the Bracon family, and is shown to be a *Sigalphus*, and the specific name of *curculionis* is deemed an appropriate one. Its description with figure is given, together with its habits and operations as drawn from those of allied known species. The black-knot, in which this parasite is bred, is a vegetable fungus analogous to the smut on corn.

1859. Maple Leaf-Cutter. (The Country Gentleman, Ib., p. 225 — 11 cm.)

In reply to inquiries made of some insects sent from North Clarendon, Vt., the examples are identified as *Ornix acerifoliella* Fitch, described in the Second Report on N. Y. Insects (pp. 269-273 of 1st and 2d Reports). [The species has been subsequently referred to the genus *Incurcaria* of Haworth. Lord Walsingham thinks that *Tinea iridella* Chambers (*Canad. Ent.*, 1873, v, p. 86), may be the same insect.]

1860. Address, on our most Pernicious Insects, delivered at the Annual Meeting [of the State Agricultural Society], February, 1859. (Transactions N. Y. State Agricultural Society, for 1859, xix, 1860, pp. 588-598.)

Treats of five species of wheat insects, viz., the Wheat-midge, Grain weevil, Hessian fly, Joint-worm, and Chinch-bug; and four of fruit trees, viz., the moth of the apple-tree caterpillar, the apple-tree borer, the peach-tree borer, and the Curculio.

1860. Address of Asa Fitch, M. D., Entomologist of the Society, on the Curculio and Black Knot on Plum Trees. (Transactions N. Y. State Agricultural Society, for 1859, xix, 1860, pp. 599-612.)

The Curculio thought to be our most injurious insect. It was first noticed near Philadelphia, in 1746, but we are still ignorant of its life for three-fourths of the year. The beetle is described, and its earliest appearance abroad said to vary from 1st of April to middle of May. It continues until late in autumn. An account of the nature of its injuries in various fruits is given. A new brood appears in July, some of which oviposit in the black-knot. The excrescence is described; on its surface the fungus, *Sphaeria morbosa*, is always found. But the black-knot itself, is not a fungus, nor is it produced by insect attack. Later, it is believed that the curculio oviposits in the bark of plum-trees and butternut-trees. Its only known parasite, *Sigalphus curcu-*

lionis, had recently been discovered and described. For remedies, the jarring method was not sufficient. Showering, at first appearance of the curculio, with whale-oil soap and tobacco-water is recommended. Plum-trees bordering water-courses have escaped attack.

1860. The most Pernicious Species | of | United States Insects, | and
| the Curculio, | two Addresses delivered at the Annual
Meetings of | the New York State Agricultural Society, | A.
D., 1859 and 1860 | — | by Asst Fitch, M. D., | Entomologist
of the Society. | — | Albany. | Printed by C. Van Benthuysen.
| 1860. | Pamph. with half title cover, pp. 28.

Published as a separate of the two preceding papers.

1860. Ravages of Insects on Forest and Fruit Trees — Remedy.
(Transactions N. Y. State Agricultural Society for 1859, xix,
1860, pp. 775, 776.)

Notice of a Scale-insect infesting trees in Albany, believed to be a new species and named by Dr. Fitch as *Lecanium acericorticis*. [This species is now accepted as identical with *Pulvinaria innumerabilis* (Rathvon), for an admirable article upon which by the late J. Duncan Putnam, see the *Proceedings of the Davenport Academy of Natural Sciences*, ii, 1880, pp. 295-347, pl. xii, xiii.]

1860. Entomology. No. XXI. — Locust Leaf-miners. (The Country Gentleman, February 2, 1860, xv, p. 82—40 cm.)

Describes and figures the mines in locust leaves sent from Plymouth, Md., which are large and irregular, and have only the upper layer of the parenchyma eaten. Such mines had not been seen by Dr. Fitch and the insect therefore could not be determined. The eggs had been placed on the underside of the leaf, in the angles where the principal veins branch from the midvein. At first the young larva feeds on the lower parenchyma, which it deserts for the upper layer, the excavated portion below showing subsequently as a small brown spot on the lower surface of the leaf. It probably leaves the leaf for its final transformation. It may possibly be the Locust Hispa, *Anoplites scutellaris*, of whose operations no account had been given. It cannot be the Flattened locust leaf-miner, *Anacampsis Robiniella*, or the slender locust leaf-miner, *Argyromiges Pseudacaciella* [both of Fitch], which, although they form a similar white blister-like spot on the surface of a leaf, yet it is always on the lower surface, it being the lower layer of the parenchyma which their larvæ eat.

1860. The Entomologist. No. XXII. — The Seventeen-Year Cicada.
(The Country Gentleman, March 29, 1860, xv, p. 210—50 cm.)

Newspapers are announcing the coming of the 17-year locust the present year. The name of locusts and grasshoppers are synonymous. Their multiplication and ravages, at times, were well known. The name of locust had probably been given to the 17-year cicada by the first European settlers, when they were alarmed by their numbers and noise when seen for the first time. The name of *locust*, as applied to them, should be discarded for that of *cicada*, but the desirable change

may not be accepted, so long as the wheat-midge continues to be called the "weevil." The protracted larval stage of the cicada is most remarkable. Linnæus, with his usual felicity in application of names, should have designated it as *Cicada Methuselah*. The regularity of its almost simultaneous appearance is also remarkable. It is desirable that the geographical extension of the coming brood should be ascertained, so that its future visitations may be definitely predicted. The time of appearance of other broods is mentioned, and reference is made for further information of the species to the *Transactions of the N. Y. State Agricultural Society* for 1854, p. 72.

1860. The Hunter Weevil. (The Country Gentleman, June 14, 1860, xv, p. 384 — 8 cm.)

Identification of the species (*Sphenophorus venatus* Say), from Onondaga county, N. Y., and pronounced identical with the "bill-bug or the corn-bug," of the Patent Office Report for 1854.

1860. Ravages of Insects on Forest and Fruit Trees — Remedy. (Journal N. Y. State Agricultural Society, for July, 1860, xi, No. 3, pp. 21, 22 — 22 cm.)

In a letter to Hon. B. P. Johnson, Dr. Fitch remarks upon a species of scale-insect depredating upon the trees in the parks and gardens in Albany, giving its natural history, and suggesting oil or grease as the best remedy to be used against it. He compares it with the *Lecanium aceris* of Europe, and as it seems to differ from that species, he had given it in his manuscripts the name of *Lecanium acericorticis*, or the maple-bark scale-insect. [Is *Pulvinaria innumerabilis* (Rathvon).]

1860. The Entomologist. No. XXIII.—The Striped Flea-beetle. (The Country Gentleman, July 12, 1860, xvi, p. 36 — 40 cm.)

Insects sent from Solsville, Madison county, N. Y., as attacking beans under ground, when well-sprouted and within a half-inch of the surface, boring minute holes on the inner side of each half of the bean stunting it and causing it to turn black — are recognized as the striped flea-beetle, *Haltica (Phyllotreta) striolata* of Illiger. Its favorite food is mustard, but it is very fond of young cabbage plants, the cultivation of which it sometimes arrests in the vicinity of New York. Its underground habit of feeding seems to be unusual to it. The insect is described and its somewhat confused synonymy given. Dusting with lime, ashes, soot, etc., is recommended for arresting its ravages, as also, frequently driving them from the plants, as they are timid insects.

1860. The Entomologist. No. XXIV.—The Pear-blight Beetle. (The Country Gentleman, November 8, 1860, xvi, p. 302 — 44 cm.)

The insect is sent from Southampton county, Pa., as having destroyed a number of apple-trees. It attacks also the plum and apricot. It is the *Scolytus pyri* of Professor Peck [now known as *Xyleborus pyri*], and a description is given of it, with a statement of its habits. In the middle of summer, twigs are seen to wither. On examination, a small perforation like a pin-hole may be seen at several of the buds, upon

the bark. From these the burrows proceed, extending upward into the pith. The beetle also infests the trunks of trees, probably in its first brood. The remedy for the twig-blight is found in cutting off the blighted twigs as soon as observed, and burning them. For the attack upon the trunk, no remedy is known.

1861. The Entomologist. No. XXV.—The Quince Tingis. (The Country Gentleman, February 14, 1861, xvii, p. 25—45 cm.)

Insects sent from Leominster, Mass., with account of serious injuries to quince trees for the past three years, from July until late in the autumn. The eggs are laid and the insects work on the underside of the leaves, causing them to color and shrivel as if scorched by fire. The general appearance of the *Tingidæ* of the Hemiptera, to which the insect belongs, is described, looking like little drops of dried froth made up of numerous air-bubbles. This species is similar to *Tingis pyri*, of Europe, and is almost identical with *Tingis arcuata* of Say. Dr. Fitch had described a form found on butternut leaves as *T. juglandis*, but he has since come to the conclusion that it is but a straight wing-margined form of *T. arcuata*. The quince form is described and figured, and compared with *T. arcuata*, and is named *Tingis cydoniæ*. Its young form is also described. No remedy is known for its injuries. For destruction of noxious insects, the Hydropult, made by the American Hydropult Co. of New York, is highly recommended. By means of this, a number of alkaline washes and bitter infusions may be conveniently showered, and often with great success. [No notice of this species appears in Dr. Fitch's Annual Reports.]

1861. The Entomologist. No. XXVI.—The Wheat-Midge. (The Country Gentleman, April 1, 1861, xvii, p. 226—39 cm.)

For about thirty years, the midge has existed in the State of New York, as a formidable wheat pest. Last summer it was remarkably diminished or wholly extinct. Two species occur together in our wheat fields, the *C. tritici* and *C. cerealis* of similar habits, but the last is much the more rare. The habits and transformations are given. The *C. tritici* may be readily recognized when it enters our windows attracted by lights on warm and sultry evenings in June, by the bright yellow color of its body unlike any other minute fly that occurs in the same situation. They usually appear in the wheat-fields in New York, about the 15th of June. A guide for looking for them in other localities would be, at the time when the first solitary fire-flies are seen abroad, and when the white flowers of the locust-trees commence to fade and drop to the ground.

1861. The Entomologist. No. XXVII.—Disappearance of the Wheat-Midge. (The Country Gentleman, May 2, 1861, xvii, p. 290 — 36 cm.)

In 1859, the wheat in Central New York was reported as not injured by the midge. The following year, the insects were abundant about lamps in Washington county (Eastern New York), during the middle of June, but in July, no larvæ could be found in wheat-heads in a circuit of several miles. The same exemption from attack was found

upon examination in the wheat in adjoining counties in Vermont. In Canada West, the wheat was also uninjured the preceding year. In Western New York, the insect continues to be as common as heretofore. It appears then, that over a large extent of country, its injuries have greatly diminished, and in some places entirely ceased. Wheat may again be sown with every prospect of abundant return. The midge may again increase and become as great a pest as before, yet it seems more probable that its greatest injuries have passed, and that they will never again be repeated to the same extent, in this country.

1861. The Entomologist. No. XXVIII.—The Apple-tree Borer. (The Country Gentleman, June 6, 1861, xvii, p. 370 — 18 cm.)

In reply to inquiries made from Kansas of a borer injuring the young limbs of apple-trees in the manner detailed, the insect is identified as the *Bostrychus bicaudatus* of Say [now known as *Amphicerus bicaudatus*]. A description is given of it, and it is represented as common in the orchards of Michigan and Illinois, ranging from Pennsylvania to Mississippi, but not known to occur in New York or New England. Directions are given how to discover its attack, and for destroying it by cutting off and burning the infested twigs, or, when it enters at a fork of the limbs as stated in the inquiry, by thrusting in a wire until the beetle is reached and killed.

1861. The Army-Worm and Cut-Worm. (The Country Gentleman, July 4, 1861, xviii, p. 18 — 20 cm.)

The Cut-worms that sever the young cabbages, leaves, etc., so well known to all gardeners, are the progeny of the dark-colored "millers" that enter our houses on summer evenings, of which there are many species belonging to the genus *Agrotis* [*Agrotis*], of the *Noctuidæ*.

The Army-worm Dr. Fitch supposes to be "one of our common cut-worms multiplied to excess and having become gregarious and migratory like the locust." Specimens of the worms had been sent from Illinois which resembled the cut-worm except in its brighter colors, the result perhaps of its greater exposure to light. The moths had been received from Maryland, but in too poor a condition for identification, and its species was therefore at the present unknown. The "black worm" which had been so remarkably destructive over large districts, at intervals, in New England (several instances cited), are believed to have been traveling swarms of one of our common cut-worms.

1861. The Entomologist. No. XXIX.—The Army-Worm Moth. (The Country Gentleman, July 25, 1861, xviii, p. 66 — 49 cm.)

Dr. Fitch tells the story of his specific identification of the army-worm moth, which is of sufficient interest to justify its quotation. A specimen of the army-worm and the moth bred from it, had been sent to him from a correspondent in Illinois, in a tin tube of alcohol, the moth proving when extracted to be "a soft, shapeless black mass. On carefully disentangling and spreading its wings, and drying it, my first step was to compare it with the broken and effaced specimens received last year from Maryland. I hereupon saw that the Army-worm in Maryland last year and that now in Illinois were undoubtedly one

and the same insect. And now, by a searching look from one to the other of these soiled and imperfect specimens, I was able to gather from them certain marks by which I thought I could recognize this insect if I chanced to have any other specimens of it in my collections. Upon looking over the moths of the cut-worms, I find nothing like this among them. Turning then to another group, lo, here I have it! — two perfect specimens received a few years since in a fine collection from Professor D. S. Sheldon of Iowa College. *Laus Dei!* The riddle is now read. What for nearly a score of years I have been so anxious to obtain, I now have! I know what the moth of this Army-worm now is! And in the fulness of my joy hereupon, I thank you, Prof. Sheldon, and you Dr. Bartlett, and Dr. Jenkins, each and all, that you have collectively furnished me with such clues as have enabled me to make this discovery."

The above is followed by the history of the species — its naming by Haworth and renaming by Guenée, as given in the New York Reports (6th-9th, pp. 123, 124), and a description of the moth, as reproduced in p. 125, *loc. cit.*

1861. The Hunter Weevil. (The Country Gentleman, August 1, 1861, xviii, p. 80 — 7 cm.)

Identification of the species sent from Skaneateles, N Y, together with statement of its ravages.

1861. The Grain Aphis. (The Country Gentleman, August 8, 1861, xviii, p. 96 — 11 cm.)

Numerous examples of the insect from various parts of New York, Connecticut and Massachusetts had been received for name, at the office of the Country Gentleman, in reply to which a letter of Dr. Fitch to Mr. B. P. Johnson, is published.

The insect is identified as *Aphis avenæ* Fabr., or *Aphis granaria* of Kirby and Curtis. Early in the season it attacks wheat, rye and barley, and as these grains harden, it deserts them for the oats, which it injures more severely. Its manner of attack is noticed. Various species of Ichneumon flies, Syrphus flies, and Lady-bugs have attacked it strongly, and will probably subdue it. Chloride of lime dusted over the plants might disengage a gas which would destroy them, and experiment with it is asked for.

1861. The Entomologist. No. XXX.—The Grain Aphis. (The Country Gentleman, August 15, 1861, xviii, p. 114 — 74 cm.)

First became numerous a year ago — observations upon it the present season — its identification as *Aphis avenæ* of Fabr.; *A. granaria* of Kirby and Curtis — its habits — a parasitic attack upon it, and other insect enemies, — all of which is reproduced, with additional matter, in the Fitch Reports, 6th-9th, pp. 91-100. Following the above, is a note upon the wheat-midge, representing it as again injurious in Washington county, although no larvæ were to be found in the wheat the preceding year, whence it appears that the insect has some other place in which to breed: recommends the importation of its natural parasites.

1861. The Grain Aphis. (The New York Observer, of October 17, 1861.)

Referred to in Dr. Fitch's *6th-9th Repts. Ins. N. Y.*, p. 91, but has not been seen by me.

1861. Snapping Beetle—Blight on Apple-Trees. (The Country Gentleman, August 22, 1861, xviii, p. 130—15 cm.)

A correspondent from Plattsburg, N. Y., whose trees are dying from the scaling off of the bark, sends a beetle supposed to occasion the trouble.

The beetle proves to be one of the *Elatерidæ*—species unknown. The injury results from some other cause, perhaps is of the same nature as the "fire-blight" of the pear-tree.

1861. An Important Caution. (The Country Gentleman, September 5, 1861, xviii, p. 161—11 cm.)

Where a grain-field has been infested with the Grain aphis, no animal should be pastured on the stubble of that field for three weeks after the harvest. The Lady-bugs which have gathered there to feed upon the aphis secrete a yellow acid juice from their joints, which is believed to be poisonous to animals eating many of the beetles. Some hogs having been turned into an oat-field the third day after its cutting, one became enormously swollen and died about noon, and others of them were seriously affected. A span of horses also became swollen upon being turned into an oat-field.

1862. Insects the past Year [1861]. (Transactions N. Y. State Agricultural Society, for 1861, xxi, 1862, pp. 27-31.)

Brief notice of insects studied during the year, viz., Grain-aphis, Army-worm and Wheat-midge. Remarks upon the great fecundity of the Aphis, the descendants of a single individual in twenty days amounting to upwards of two millions. The Army-worm determined for the first time. Number of parasites upon the Wheat-midge in Europe.

1862. The Entomologist. Entomological Events of the past Year. (Country Gentleman, for February 20, 1862, xix, p. 124—54 cm.)

Read as a letter, at the winter meeting of the N. Y. State Agricultural Society, in February, 1862. Gives the observations and studies of Dr. Fitch during the preceding year, upon the Grain Aphis, the Army-worm and the Wheat-midge.

1862. The Entomologist. No. XXXI.—Insect Tumors and Wounds in Raspberry Stalks. (Country Gentleman, for May 22, 1862, xix, p. 335—52 cm.)

Infested galls upon wild raspberry, *Rubus strigosus*, from Lockport, N. Y., and identical ones upon the Antwerp variety of raspberry, *Rubus Idæus*, from Poughkeepsie, N. Y., gave some gall insects which were apparently an undescribed species of the family *Cyniphidæ* and of the

genus *Figites*. They are accordingly named *Figites rubus-caulis*, or the raspberry-stalk gall-bee. The insect and its habits are described, together with its gall.

Some raspberry canes were received, showing a row of small holes bored into them for the reception of small, shining white eggs, causing the canes to crack open and show the pith. Dr. Fitch had seen the same in wild raspberry, also in willow, and in cherry. In 1858, the apple-twigs in some orchards in Akron, O., were extensively injured in the same manner. Watch was set for the depredator — it was caught in the act — sent to Dr. F., and by him identified as the Buffalo tree-hopper, *Ceresa bubalus* Fabr.

[Professor Riley, in his *Fifth Report on the Insects of Missouri*, p. 121, states that the above punctures are the work of another insect, viz., the Snowy cricket, *Acanthus niveus* Harris. The punctures made by *C. bubalus* are different, as figured (*loc. cit.*, fig. 50) and described.]

1862. The Buffalo Tree-Hopper. (The American Agriculturist, for June, 1862, xxi, p. 172.)

Communicates a portion of the matter relating to this insect contained in the 12th Report on the Insects of N. Y. (*Trans. N. Y. St. Agricultural Society*, xxvii, 1867, pp. 889-893).

1862. The Entomologist. No. XXXII. — The Asparagus Beetle. (The Country Gentleman, for July 31, 1862, xx, pp. 81, 82 — 73 cm.)

The Asparagus plant grows wild in Europe, Africa and the West Indies. Since first introduced in this country, perhaps two hundred years ago, it has been exempt from the insects that attack it in Europe, until the present time, when its principal European pest, the *Crioceris asparagi*, has been discovered in Queens county, on Long Island. The beetle and its larva are described and figures presented of them. In considering the means of combatting the insect, the fact is stated that the long experience with it in Europe had given no better method than that of hand-picking; it is therefore probable that the same method will have to be employed here. This need not be regarded as an irksome and endless task — it may become a pleasant pastime. It is believed to be possible to exterminate it, by diligently collecting it by hand from the few plants that it may be necessary to grow, and cutting down all others during two or three months, commencing early in June. An organized effort for its prompt extermination through Horticultural and Agricultural Societies, and the appointment of efficient town committees, is recommended.

1862. The Entomologist. No. XXXIII. — The Maple Psocus. (The Country Gentleman, September 4, 1862, xx, p. 162 — 35 cm.)

Insects received from Prospect Hill, N. Y., where on August 11th, they were infesting fruit and ornamental trees. Their first appearance, in a wingless state, was about the 1st of August; later (when sent) they were winged. They were said to be remarkably timid creatures.

occurring on the shady side of the branches, from which they sucked the sap.

The same species had been observed by Dr. Fitch, July 29, 1854, on maple, and on the shad-bush (*Amelanchier botryapium*) [*A. Canadensis* var. *botryapium*]. It belongs to the *Psocidæ*, of which the "book-louse" is a familiar example — called also, "dust-louse," from its being at times found abundantly in the sweepings of neglected chambers, — known from its clicking call to its mate, as the death-watch [is *Clothilla pulsatoria*]. It eats dried plants and insects — is readily destroyed by camphor.

The Maple *Psocus* is the largest of our species. Dr. Fitch had previously given it the MS. name of *Psocus aceris*, and it is now described, [It is the *Psocus venosus* of Burmeister: see Hagen's *Neuroptera of North America*, 1861, p. 10.]

1863. A brief account | of the most important | Injurious Insects | of the | United States | — | By Asa Fitch, M. D. | New York State Entomologist. | — | Albany: | Luther Tucker & Son, 395 Broadway. | 1863. | Pamph., 12 mo. pp. vi (including title-page, cover and index of subjects and illustrations) + 293-321, from the Illustrated Annual of Rural Affairs.

Contains general remarks upon insects, describes their several stages, gives their divisions into orders and mentions other groups. Among their economic divisions are noticed (often at considerable extent): I. Insects injurious to fruit-trees; of which are these: the curculio, apple-tree caterpillar, fall web-worm, apple-tree borer, peach-tree borer, and apple bark-louse. II. Insects injurious to grain crops; among which are the wheat-midge, Hessian-fly, four species of *Eurytoma*, chinch-bug, Angoumois moth (*Butalis cerealella*), grain-aphis (*Aphis avenæ* Fabr.), grain-weevil (*Calandra granaria* Linn.), and cut-worms. III. Insects injurious to gardens, as, the cucumber-bug, squash-bug, flea beetle, rose-bug, and asparagus beetle. The above insects are illustrated in thirty-four figures.

1863. Insects.—The Grain Aphis, Wheat Midge, etc. (Transactions N.Y. St. Agricultural Society, for 1862, xxii, 1863, pp. 32-38.)

An essay read by Dr. Fitch at the Rochester State Fair, evening meeting, October 1st, 1862.

The Grain Aphis has existed in Europe from time immemorial. It was named and described by Linnæus eighty-one years ago, as *Aphis avenæ*. European accounts of it are meager and imperfect, but its history had been completed by Dr. Fitch recently. Its sudden irruption last year in New York and New England was our first observation of it. This year it extended westward over Canada into Michigan. It had probably existed in this country in limited numbers for many years, having been observed on wheat seventeen years ago. No aphis had hitherto shown such a sudden excessive multiplication. During the last of June two great changes occur: the scattered individuals on leaves and stalks congregate on the heads, and change from grass-green to yellow.

This species is an exception to the ordinary generation of aphides, in that it deposits no egg in the autumn, but hibernates beneath the snow. No eggs have been observed, nor males—it apparently produces young indefinitely. The winged forms produce two young in a night—the wingless, four: these last bring forth young in three days. Various insects that prey upon them are noticed.

[The above (except the assembling and change of color) is additional to the account given in 6th-9th Repts. Insects N. Y., pp. 91-98.]

Remarks upon the Wheat-midge and other insects were made in a general discussion following the essay.

1863. Loenst-Tree Borer. (Transactions N. Y. State Agricultural Society, for 1862, xxii, 1863, p. 88.)

Notices the occasional attack of the *Clytus robinie* [*Cyllene robinie*] upon the honey-locust, *Gleditsia triacanthus*, as well as upon the common loenst; also, *Ctenucha Latreillana* [*C. Virginica* Charp.] as a rare species.

1863. The May-Beetle. Worm on Grape-Vines. (The Country Gentleman, for June 18, 1863, xxi, p. 399—13 cm.)

Identification of the May-beetle, *Lachnosterna fusca*, as injuring cherry-trees, after dark, at Bailey's Cross Roads, Va., occasionally stripping them, and also plum-trees, of all their leaves. Shaking upon sheets, killing with boiling water, and feeding to swine or poultry, recommended as the best remedies.

Spilosoma Virginica identified, as feeding on the young tender leaves at the extremity of the shoots of grape-vines, in West Haven, Conn. The insect is briefly described, and hand-picking recommended as the best remedy for it.

1863. A Grape-Vine Beetle and Rose Bug. (The Country Gentleman, for July 23, 1863, xxii, p. 65—20 cm.)

The Grape-vine flea-beetle, *Haltica chalybea* Ill. [*Graptodera chalybea*], attacks the eye or bud when it first begins to swell, in Cumberland, Md. It had been very abundant and injurious in the same manner, in different parts of New York, the past and present year.

The Rose-bug attacked the grape blossoms and continued to destroy the grapes until about half-grown. In Saratoga county they had destroyed the young plants of Indian corn, and stripped the leaves and fruit from grape-vines in some gardens at Saratoga Springs. For full account of this insect, reference is made to *Trans. N. Y. State Agricultural Society* for 1855, pp. 477-484, and for notices, *Country Gentleman*, 1856, viii, p. 75, and in August, 1859.

1864. Aphis on Apple-tree buds. (The Country Gentleman, for June 2, 1864, xxiii, p. 351—10 cm.)

Aphis mali received from Mr. J. J. Thomas, who finds the opening flower-buds of his apple-trees in the early part of May, thronged with the insects nestling close down among the pubescence. The insects are the young of the apple-tree aphis hatched from eggs which had been deposited late in the autumn in the crevices beneath the bark. They

hatch just as the buds begin to swell, when they crowd to them, where they are nourished until the leaves become sufficiently developed for their sustenance.

1864. The Hunter Weevil. (The Country Gentleman, for June 16, 1864, xxiii, p. 384 — 6 cm.)

Received from Dutchess county, N. Y., where they were drawing the juices from young corn beneath the ground. Identified as *Sphenophorus venatus* Say, and references made to previous notices in the *Country Gentleman*.

1864. The Entomologist. No. XXXIV.—The Buffalo Tree-hopper. (The Country Gentleman, for June 16, 1864, xxiii, p. 386 — 63 cm.)

Describes the punctures made in raspberry twigs and the eggs deposited in the pith, in straight rows of from one and a half to three inches long, which had been identified by Mr. Howe, of Akron, O., as made by the above-named insect, *Ceresa bubalus*.

A punctured twig, in part, in section, to show the eggs, is figured, together with the insect, which is described. The punctures in the raspberry twig may have been made by another species of *Ceresa* of similar habits, "for it is only in the apple-tree that the *C. bubalus* has been actually seen in the act of depositing its eggs." About 100 similar punctures in two rows, of $3\frac{1}{4}$ and $1\frac{1}{2}$ inches each, probably the work of one insect, had been seen by Dr. Fitch in an elder-stalk. The oviposition of the insect is described, also the hatching of the eggs, and the young insects. Shaking the trees or shrubs that the insect infests, to drive it away, is recommended.

1864. The Five-marked Coccinella, destroying Plant-Lice. (The Country Gentleman, for July 21, 1864, xxiv, p. 47 — 19 cm.)

A gentleman writing from L'Original, C. W., states that upon a cherry-tree infested with plant-lice, he discovered numerous larger insects, which, in the belief that they were a greater pest, he endeavored to destroy by beating from the tree and killing, but their large number compelled him to abandon the task. The next day, on examining the trees again, he found that the plant-lice had nearly disappeared, and the other insect was busily feeding upon them. Two examples were sent to Dr. Fitch for determination. One had eaten the other when received, and the survivor, having undergone its transformation to the perfect state, proved to be *Coccinella 5-notata* of Kirby.

1864. The Entomologist. No. XXXV.—The Nebraska Bee-killer. (The Country Gentleman, for July 28, 1864, xxiv, p. 63 — 84 cm.)

Received from Otoe county, Nebraska, where it is "very destructive to the honey-bee, killing a great number of them, and also of the rose-bugs." It is briefly characterized as a dipterous insect of the genus *Trupanea* of Macquart, and as it differs from the half-dozen known United States species, it is named from its habits, *T. apivora* [now placed in the genus *Promachus*]. A minute description of the fly is

given, with mention of the habits of the *Asilida*, to which this fly belongs. The observation, upon a single occasion, ten years previous, in the month of October by Dr. Fitch, of *Erax rufibarbis* is narrated — never since met with by him. The piping noise of these flies, like that of the bumble-bee when inclosed in a net, is mentioned, and also, their fetid, carrion-like odor. After the four Nebraska specimens had "been dead a fortnight, and freely exposed to the air the latter half of the time, the disgusting scent still remained, and so powerful was it that on two occasions, nausea was produced" by their presence on a table. This odor may perhaps only attach to them at their period of sexual intercourse. [This notice is also published in the Eighth Report on the Insects of N. Y. (6th-9th Reports, 1865, pp. 251-255), together with additional observations upon the habits of the insect in destroying bees and other insects.]

1864. A Curious Insect. (The Country Gentleman, for August 5, 1864, xxiv, p. 79 — 20 cm.)

The two-spotted tree-hopper, *Enchenopa binotata*, received from Council Bluffs, Iowa, as infesting bittersweet. When confined in a glass vessel, it was said to spring against the sides with such violence as to break off its head [the tip of its thorax]. Dr. Fitch states that it is often found in New York on butternut and on dogwood.

1865. The Entomologist. No. XXXVI.—The Aphis on Hops. (The Country Gentleman, for April 27, 1865, xxv, p. 274 — 56 cm.)

This aphis was first observed in this country two years ago, and since its first detection, has been very destructive — at times destroying entire yards. Newspapers are mentioning three hop maladies, viz., the plant-louse, the honey-dew, and the black-blight, but these are but forms of the same thing. The connection of the last two with the aphis is shown. The insect proves to be the same as the long-known and destructive *Aphis humuli*, of Europe. The excessive number of plant-lice in some years is subdued by numerous predaceous and parasitic destroyers, which at the present time are very abundant. Soap applications will kill the young of the hop-louse. All can be killed by tobacco-smoke, which is unfailing. Perhaps it could be employed by confining it in a large cloth thrown over the vines.

1865. Plant Lice — The Hop-Aphis. (The Country Gentleman, for August 3, 1865, xxvi, p. 82 — 27 cm.)

In reply to inquiries of the winter retreat of this insect, it is stated: Most of the plant-lice, at the end of the season, become oviparous, and deposit their eggs under the loose bark or other shelters of the vegetation upon which they feed. If the hop-aphis oviposited upon the vines, the eggs would be killed when the vines are destroyed in the autumn. This point in its history has not been fully given by the English writers who have treated of it, during the many years that it has engaged their attention. In *Morton's Encyclopedia of Agriculture*, ii, 55, Dr. Plomley makes the statement, "as the result of his personal observation, that the hop-fly in May proceeds originally from *sloe bushes*."

He also positively asserts that the autumn generation deposit their eggs in sloe bushes, whence their progeny emerge into the hop grounds in the following season." This statement is corroborated by the fact, that from another species of wild plum, *Prunus mahaleb*, M. Fonscolomb described a new species of aphid, as *Aphis pruni-mahaleb*, which subsequent researches showed to be identical with the hop-aphid. Dr. Fitch is of the opinion, that after the death of the small and wingless lice with the death of the vines, the winged ones fly away to the nearest plum-trees, where they sustain themselves upon the leaves until they have deposited their eggs, destined, if not previously destroyed, to hatch the following spring.

1865. Entomological Correspondence. (The Country Gentleman, for September 21, 1865, xxvi, pp. 190, 191 — 70 cm.)

The Yellow-necked Apple-tree Worm, occurring in Lockport, N. Y., about the 1st of August, upon hundreds of young apple-trees, some of which they stripped of their leaves, is briefly described, together with the moth that it produces, viz., *Datana ministra* (Drury). Reference for a full account is made to *Trans. N. Y. State Agricultural Society* for 1855, p. 467. The best remedy is to sever the twig with the congregated caterpillars and drop them in a fire.

Locust Hispa. Received from Locust Bay, L. I. The beetle, *Anoplitis scutellaris* Olivier [now *Odontota scutellaris*], is briefly described and its natural history given. It is represented as very numerous at Glen Cove, where the trees ravaged by it look as if burned by fire. The insect has not been observed in the interior of the State.

Black Prickly Worms eating the Leaves of Canada Thistles are identified as *Cynthia cardui*. It is parasitized by *Banehus fugitivus* Say.* Some notes upon the butterfly are given. [For accounts of thistles and briars completely stripped by these caterpillars, see *Count. Gent.* of Sept. 7, 1865, p. 155, and id. for Oct. 5, 1865, p. 219.]

1865. Address delivered before the Annual Meeting of the State Agricultural Society, Albany, February 8, 1865. (*Transactions N. Y. State Agricultural Society*, for 1864, xxiv, 1865, pp. 111-116.)

Attack of the hop plant-louse, the previous year in New York; nature of the attack, producing "honey-dew" and "black-blight": the insect identified with the *Aphis humuli*, of Europe; its enemies; remedies considered; soap-suds not reliable; tobacco-smoke recommended.

1866. Joint-Worm in Wheat on Long Island. (The Country Gentleman, for July 19, 1866, xxviii, p. 49 — 20 cm.)

The larvæ reported as infesting the joints of wheat at Glen Cove, L. I., are probably the joint-worm, *Eurytoma tritici*, noticed in the *Cultivator*, October, 1851, viii, p. 322, and in *Trans. N. Y. St. Agr. Soc.* for 1861, pp. 830-841. As they are chiefly lodged at the lower joint, if the wheat is cut above this point, the stubble may be turned under, burying the insects while in their larval state so deeply that they will be destroyed.

**Limneria fugitiva* (Say). For other Lepidoptera (six species of moths) upon which it is parasitic, see *Fourth Report on the Insects of Missouri*, 1872, p. 41.

1866. Beetle on the Grape. (The Country Gentleman, for August 30, 1866, xxviii, p. 142 — 11 cm.)

The Brown Colaspis, *Colaspis brunnea* Fabr., received from Walpole, Mass., destroying grapevines, July 21. Dr. Fitch had frequently collected it from the wild grapevine, the cinquefoil or *Potentilla*, and some other plants, but not from the cultivated grape before the present year. Dusting with ashes, soot, or some other powder, should prevent its ravages.

1866. Insects which Injure Grain Crops.—I. The Wheat-Midge. (The Country Gentleman, for November 8, 1866, xxviii, p. 306 — 68 cm.)

Gives an account of *Cecidomyia tritici*, and refers to *C. graminis* Fitch and *C. ininica* Fitch, which are treated of more fully in the first 90 pages of the *Sixth Report on Noxious Insects*. Eight figures are given in illustration, similar to those of the Report cited.

1866. Insects which Injure Grain Crops.—II. The Hessian Fly. (The Country Gentleman, for November 29, 1866, xxviii, p. 354 — 60 cm.)

Gives an account of the Hessian fly, *Cecidomyia destructor* Say, illustrated with figures of the fly, diseased and healthy wheat-plants, the larva and pupa, lower joint of a diseased wheat straw, and one with sheath torn off showing the worms. Notices also two parasites upon the Hessian fly, viz., *Semiotellus destructor* of Say, and another observed by Mr. Herrick, of Yale College, inserting four or five of its eggs in a single egg of the Hessian fly. This species Dr. Fitch proposes to designate as *Platygaster Herrickii*. [Prof. Cook has observed a similar egg-parasite of the Hessian fly (perhaps the same as the above), which Dr. Packard refers, with doubt, to *Platygaster error* Fitch (*Bull. No. 4, U. S. Entomolog. Commis.*, 1880, p. 21, f. 1).]

1866. Ants Enemies to Cut-Worms. (Transactions N. Y. State Agricultural Society, for 1865, xxv, 1866, p. 133.)

Reply to letter of W. C. Watson, narrating an attack of a black ant upon a cut-worm. Similar attacks observed by Dr. Fitch and explanation offered; also, injuries of the little yellow ant (*Myrmica molesta*) to corn and other vegetation.

1867. Currant Borers. (The Country Gentleman, for June 13, 1867, xxix, p. 386 — 14 cm.)

Brief notice of the operations of the American currant-borer, *Psenocercus supernotatus* (Say), in the pith of a currant stalk, and reference for figure and a full account of it, to the 3d Report on the Noxious Insects of the State, in *Trans. N. Y. State Agr. Soc.* for 1856, pp. 416-423.

1868. Excrescences upon Grape Leaves. (The Country Gentleman, for August 20, 1868, xxxii, p. 127 — 41 cm.)

Treats of four grape-leaf galls that had come under observation. The first had been described in *Trans. N. Y. State Agr. Soc.* for 1854, p.

862, as *Pemphigus vitifoliae*. The second, not named, were rough water-like galls, size of musket shot of different sizes, upon the under side of leaves, in July and August, opening upon the upper side, and occupied by small oval lice of a dull yellow color. The third, observed the middle of August, smooth, succulent, greenish-yellow, size of large and small musket shot, growing in the leaf, and bulging out equally on both sides, having no opening, but an internal cavity in which no insect could at the time be perceived. It occurred on the wild grape, *Vitis labrusca*. The fourth had not previously been seen, and was probably new. They were thorn-like, growing on the under side of the leaves in July, straw-colored, of a regular conical form, projecting outward at a right angle from the surface, which they covered entirely; four times as long as thick, from three to four-tenths of an inch long, of a dry, firm texture, and fluted or ribbed lengthwise. Opposite their base, on the upper side of the leaf was a small pit. They contained a small yellow maggot, the description of which is given, and which is apparently a species of *Cecidomyia*.

1869. A Curious Water Insect. (The Country Gentleman, for February 25, 1869, xxxiii, p. 154 — 23 cm.)

The larva of the insect captured from under ice a foot thick, identified as *Aeschna heros* Fabr., with larval description and habits.

1869. Garden Insects. (Illustrated Annual Register of Rural Affairs, 1869, v, pp. 91-104, figs. 1-16.)

Notices, among others, the following insects: The onion-fly (*Anthomyia ceparum*), pp. 91-96; the striped blister-beetle (*Cantharis vittata*); the radish and cabbage flies (*Anthomyia raphani* and *A. brassicae*); centipedes, cut-worms, and the flea-beetles; the garden flea (*Smythurus hortensis*); the cabbage-moth (*Cerostoma brassicella*) [is *Plutella cruciferarum* of Zeller], and the cabbage butterfly (*Pieris oleracea*).

1869. Garden Insects. 2d Article. (Ib., pp. 197-212, figs. 1-22.)

Notices additional garden pests, of which the principal are the following. The cabbage aphid, pp. 198, 199; the cucumber beetle, pp. 200, 201; the squash-bug; squash Coccinella (*C. borealis*); the asparagus beetle, pp. 204, 205; the tomato-worm (*S. quinquemaculata*), pp. 205, 206; the Southern tobacco-worm (*S. Carolina*); the 10-lined potato-beetle (*Doryphora 10-lineata*), pp. 207, 208; the 3-lined potato-beetle (*Crioceris trilineata*); the striped blistering-fly, and wire-worms, pp. 210, 211.

Notice of the Entomological Labors of Dr. Fitch.

The following notice of the labors and writings of Dr. Fitch is extracted from a "Report on some Injurious Insects of the Year 1879," presented by me to the State Agricultural Society at its Annual Meeting, January 21, 1880.

It seems eminently fitting that in connection with the preceding notes upon the economic relations of some of our insects, reference should be made to one

who labored long and successfully in the department of Economic Entomology — whose contributions therein gave him an exalted name among entomologists, and to whose enthusiastic, long-continued and valuable labors that branch of natural science is largely indebted for the honorable position it now holds in our country.

Dr. Asa Fitch died at his residence at Salem, Washington county, N. Y., on the 8th of April 1879, at the age of 70 years. His entomological studies commenced about the year 1840, at which time he prescribed for himself such an admirable plan for the direction of his future labors in the field of Entomology, that we will be pardoned for quoting it at length. He wrote thus: —

“ I have undertaken a very great work, and have laid for myself a task both hard in the plan and difficult in the execution. To unite in one very limited body the most essential facts of the history of insects, to class them with precision and accuracy in a natural series; to delineate the chief traits in their physiognomy; to trace in a laconic and strict manner their distinctive characters, and follow a course which shall correspond with the progress of the science and the eminent men who have contributed to its advancement; to single out the useful and obnoxious species, those which from their manner of living excite our curiosity; to mark the thousand sources where the authors of the original knowledge may be consulted; to render to Entomology that amiable simplicity which she has had in the times of Linnaeus, of Geoffroy, and of the first productions of Fabricius, and yet present her as she is to-day, with all the richness which she has acquired from observation, but without surcharging her with it; to conform her, in one word, to the model which I have under my eyes, the work of Cuvier — such is the end which I have taken upon myself to attain.”

During the years 1845 to 1851, Dr. Fitch contributed a series of valuable papers on *Winter Insects* and others, to Emmons' *Quarterly Journal of Agriculture and Science*. In 1850, he prepared a descriptive catalogue of the United States insects of the suborder of Homoptera, which was published the following year in the *Fourth Annual Report of the N. Y. State Cabinet of Natural History*. These now scarcely accessible papers richly merit republication.

In the year 1854, his connection with this Society was commenced, in his selection by the Executive Committee of the Society to examine and report upon the Noxious, Beneficial, and other Insects of the State of New York, under an appropriation by the Legislature for that purpose. His first Report was presented under date of March 14, 1855. Under the continuation of the annual appropriations for the purpose, subsequent Reports were annually presented with the exception of three intervals of a year each — to the number of fourteen — the last one published in the Transactions of the Society for the year 1870. In 1872, by an act of the Legislature, the office of State Entomologist was abolished — the impaired health of Dr. Fitch not permitting him longer to discharge the duties of the position.

The series of the Fitch Reports is regarded by entomologists, and others who are prepared to appreciate their merit, as very valuable contributions to science. They are characterized by an untiring zeal, minuteness of observation, fulness of detail, faithfulness of delineation and dignity of expression. They consist largely of the results of original research; and so highly were these researches

estimated abroad, that he was elected to membership in the Entomological Societies of France and of Russia, and a gold medal was bestowed upon him by the Central Agricultural Society of France, in appreciation of his services to science. [*] Among his foreign correspondents he numbered Westwood and Curtis of London, Andrew Murray of Edinburgh, Dr. Gerstaecker of Berlin, Dr. Signoret and M. Selys de Longchamps of Paris, and many others of the most eminent entomologists of Europe.

It may properly be claimed that the New York Reports led the way for similar investigations in other States of the Union, and to the interest which they aroused, we are indebted for the valuable series of Riley's Reports on the Insects of Missouri—nine in number, and comprising over 1,800 pages and numerous illustrations of a high order,— the Reports of the State Entomologists of Illinois, and others.

[*The medal was awarded to Dr. Fitch, in the year 1858, after the publication of his First and Second Reports, in consideration of their value to Agriculture. The following description of the medal and translation of the Report accompanying it, is extracted from the New York State Agricultural Society's Transactions for the year 1858 :

The medal weighs an ounce, nearly—bears on the obverse side the portrait of the *Father of French Agriculture*, surrounded with the inscription, "OLIVIER DE SERRES, N. EN 1583, M. 2, JT 1619;" on the reverse an agricultural wreath, around which are the words, "SOCIETE IMPERIALE ET CENTRALE D'AGRICULTURE;" and on its inside, "A MR. ASA FITCH, A ALBANY, STATE OF NEW YORK, 1858."

The following is the Report :

[TRANSLATION.]

IMPERIAL CENTRAL SOCIETY OF AGRICULTURE, PARIS—REPORT.

The Society has lately received, through Mr. Vattermare, an important work, by Mr. Asa Fitch, of the State of New York, on Insects which are injurious in Agriculture, and it has charged the section of Natural History to make a report to the Society upon it.

The work is composed of two reports, addressed to the Agricultural Society of New York, and published by the Legislative Assembly of the State. It treats principally of the insects which attack fruit trees, and contains a large number of observations, accurately made, relative to the habits of these animals, and also very judicious application of these facts to the treatment of plants infested by them. On account of the peculiarity of these investigations, which embrace a multitude of minute and often isolated details, it would be difficult in this report to present an analysis of the work of Mr. Fitch, but we believe it to be our duty to recommend it to the attention of Naturalists, who are engaged in the study of the relations of Entomology to Agriculture. The larger part of the facts mentioned by the author belongs to the history of varieties which are only found in America, and consequently do not directly interest French Agriculture; still there will be found many observations from which Entomologists of every country will be able to profit, and we think that it is the duty of the Imperial Central Society of Agriculture to encourage all good works undertaken in such a useful direction.

The section has the honor, therefore, to propose to the Society to award to Mr. Asa Fitch a Gold Medal, with the bust of Olivier de Serres, in acknowledgment of his work.

[Signed]

A. VALENCIENNES,
GUERIN MENEVILLE,
MILNE EDWARDS,

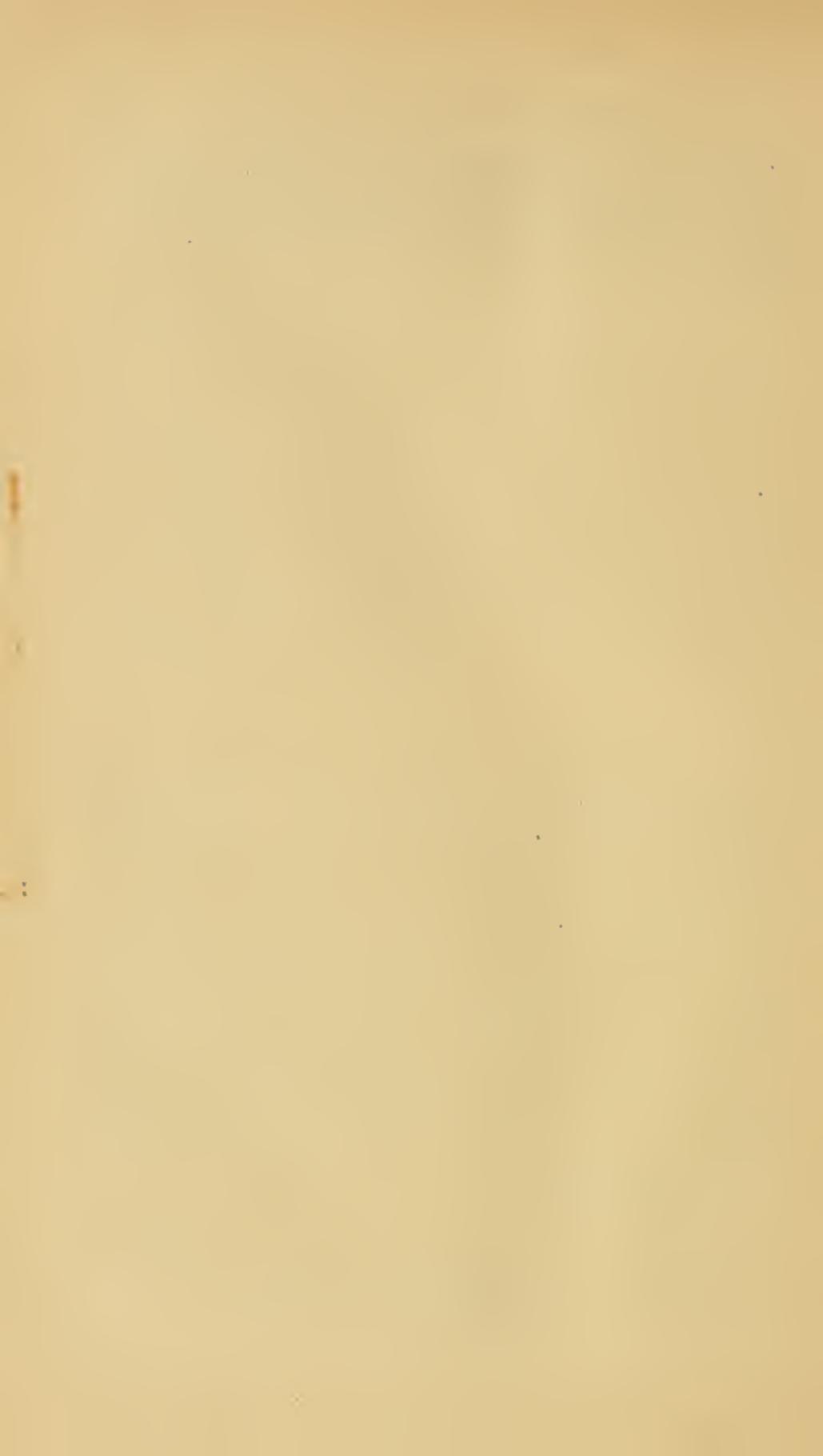
Committee.

The resolution proposed was adopted at the meeting of April 14, 1858. A true copy.

Signed: For the Permanent Secretary:

The Recording Secretary, F. DE LAGARDE.]

The labors of Dr. Fitch will long be held in grateful remembrance, and the New York State Agricultural Society may justly lay claim to having, by its action in connection therewith, done very much toward the promotion of Entomological research, not only within the immediate sphere of its labors, but throughout the Union, and to science at large — coextensive with the civilized world.



(B.)

INSECT DEPREDATORS UPON THE APPLE-TREE.

The following are all the United States species (one hundred and seventy-six in number) that are known to me, or have been reported upon accepted authority, as depredating upon the Apple-tree. The list will, without doubt, be largely extended ; it is published at this time to serve as the 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.

It is hardly necessary to state that not all the species here recorded are to be included among those injurious to the apple-tree, 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 seriously injurious.

The authority for including the species in the list is given in each instance. For the convenience of those who may be willing to scrutinize the list with a view of supplying omissions, the species have been grouped under their several orders, and for the most part, in their latest systematic arrangement.

Lepidoptera.

Diurnals.

Papilio Turnus LINN. <i>Turnus swallow-tail</i>	Harris, Ins. Inj. Veg., 268.
Limenitis disippus GODT. <i>Disippus butterfly</i>	Scudd., Bul. Buff. Soc., ii, 250.
Limenitis ursula (FABR.). <i>Ursula butterfly</i>	Riley, Amer. Ent., ii, 276.
Thecla strigosa HARRIS. <i>Streaked Thecla</i>	Scudd., Bul. Buff. Soc., iii, 111.

Sphingidæ.

Deilephila lineata (FABR.). <i>White-lined Sphinx</i>	Riley, Amer. Ent., i, 206.
Smerinthus excæcatus (SM.-ABB.). <i>Blind-eyed Sphinx</i> ...	Harris, Ins. Inj. Veg., 327.
Sphinx drupiferarum (SM.-ABB.). <i>Plum Sphinx</i>	Liutner, Proc. E. S. Ph., iii, 658.
Sphinx Gordius CRAM. <i>Apple Sphinx</i>	Harris, Ins. Inj. Veg., 328.

*Mr. R. Thaxter has found that nearly all of the *Scopelosoma* larvæ, and many others of Noctuid genera, will eat the leaves.

Bombycidae.

Spilosoma Virginica (FABR.).	<i>Virginia ermine-moth</i>	Walsh, Pract. Ent., ii, 103.
Hyphantria textor HARRIS.	<i>The Weaver</i>	Fitch, N. Y. Rept., iii, 19.
Halisidota caryæ (HARRIS).	<i>Hickory tussock-moth</i>	Id., ib., 19.
Halisidota maculata (HARRIS).	<i>Spotted tussock-moth</i>	Thaxter, <i>in lit.</i>
Orygia leucostigma (SM.-AAR.).	<i>White-marked tussock-moth</i> .	Harris, Ins. Inj. Veg., 366.
Parorgyia parallela GR.-ROB.	.....	Coquillet, Ill. Rept., x, 166.
Lagoa opercularis (SM.-ABB.).	.....	Walsh, Amer. Ent., ii, 29.
Euclea querceti HER.-SCH.	.....	Thaxter, <i>in lit.</i>
Parasa chloris (HER.-SCH.).	<i>Green hag-moth</i>	Riley, Amer. Ent., ii, 307.
Empretia stimulea CLEM.	<i>Saddle-back caterpillar</i>	Id., ib., i, 40.
Phobetron pithecium (SM.-ABB.).	<i>Hag-moth</i>	Id., ib., ii, 340.
Limacodes scapha HARRIS.	<i>Skiff Limacodes</i>	Thaxter, <i>in lit.</i>
Lithacodes fasciola HER.-SCH.	<i>Banded Lithacodes</i>	Id. ib.
Thyridopteryx ephemeraformis (HAW.).	<i>Bay-worm</i>	Riley, Amer. Ent., ii, 38.
Datana ministra (DAUBY).	<i>Yellow-necked apple-tree worm</i> .	Fitch, N. Y. Repts., i-ii, 235.
Datana integerrima GR.-ROB.	.....	Gr.-Rob., Proc. E. S. Ph., vi, 12.
Edemasia concinna (S.-A.).	<i>Red-humped ap-tr. caterpillar</i>	Harris, Ins. Inj. Veg., 425.
Edemasia eximia GROTE.	.....	Thaxter, <i>in lit.</i>
Cœlodosys unicornis (SM.-ABB.).	<i>Unicorn prominent</i> ...	Harris, Ins. Inj. Veg., 424.
Callosamia Promethea (LINN.).	<i>Promethea moth</i>	Minot, Canad. Ent., ii, 100.
Samia Cecropia (LINN.).	<i>Cecropia Emperor moth</i>	Harris, Ins. Inj. Veg., 388.
Hemileuca Maia (DAUBY).	<i>Maia moth</i>	Marten, Ill. Rept. x, 123.
Hyperchiria Io (FABR.).	<i>Io Emperor moth</i>	Saunders, Ins. Inj. Fr., 139.
Clisiocampa Americana HARR.	<i>Apple-tree tent-caterpillar</i> .	Harris, Ins. Inj. Veg., 373.
Clisiocampa sylvatica HARR.	<i>Forest tent-caterpillar</i>	Id., ib., 375.
Clisiocampa sp.? (An Oregon apple-tree caterpillar).....		Stretch, Papilio, iii, 19.
Clisiocampa sp.? (Associated with prec.).....		Id., ib., 20.
Gastropacha Americana HARR.	<i>American lappet-moth</i> ...	Harris, Ins. Inj. Veg., 377.
Tolype vellea (STOLL).	<i>Vellea lappet-moth</i>	Id., ib., 379.

Noctuidæ.

Acronycta occidentalis GR.-ROB.	.....	Lintner, Ent. Contrib., i, 62.
Acronycta morula GR.-ROB.	.....	Id., ib., ii, 137.
Acronycta luteicoma GR.-ROB.	.....	Thaxter, Papilio, iii, 17.
Acronycta Radcliffei HARVEY.	.....	Id., ib.
Acronycta clarescens GUEN.	.....	Id., ib.
Agrotis clandestina HARR.	<i>W-marked cut-worm</i>	Riley, Mo. Rept., i, 79.
Agrotis messoria HARR.	<i>Dark-sided cut-worm</i>	Id., ib., 74.
Agrotis Cochranii RILEY.*	<i>Cochran's cut-worm</i> ..	Id., ib., 74.
Agrotis scandens RILEY.	<i>Climbing cut-worm</i>	Id., ib., 76.
Agrotis saucia (HUEN.).	<i>Variogated cut-worm</i>	Id., ib., 72.
Mamestra assimilis MOHR.	.....	Thaxter, <i>in lit.</i>
Lapbygma frugiperda GUEN.	<i>Fall army-worm</i>	Riley, Amer. Ent., ii, 364.
Amphipyra pyramidoides GUEN.	<i>Pyramidal grape-vine cat</i> .	Guenée, Noct., iii, 398.
Orthosia instabilis SCHIFF.	<i>Unstable drab-moth</i>	Fitch, N. Y. Rept., iii, 25.
Xylina Bethunei GR.-Rob.	<i>Bethune's Xylina</i>	Thaxter, <i>in lit.</i>
Xylina antennata WALK.	<i>Ash-grey pinion</i>	Riley, Mo. Rept., iii, 135.
Nolophana malana (FITCH).	<i>Shoulder-striped Tortrix</i> ...	Fitch, N. Y. Repts., i-ii, 241.
Aletia argillacea HUBN.	<i>Cotton-moth</i>	Amer. Entomol., iii, 68.
Catocala grynea CRAMER.	.....	Coquillet, Ill. Rept., x, 184.

*Now regarded by Riley, as identical with *A. messoria*.

Geometridæ.

<i>Ennomos subsignaria</i> HUBN. <i>Snow-white linden-moth*</i> ..	Dodge, <i>Canad. Ent.</i> , xiv, 80.
<i>Eurymene Keutzingeria</i> GAOTE.....	Thaxter, <i>in lit.</i>
<i>Corycia vestaliata</i> GUEN. <i>Vestal Corycia</i>	Perkins, Prof. G. H., <i>in lit.</i>
<i>Hybernia tiliaria</i> HARR. <i>Lime-trees winter-moth</i>	Harris, <i>Ins. Inj. Veg.</i> , 472.
<i>Phigalia? cinctaria</i> FRENCH. <i>Banded Phigalia</i>	French, <i>Ill. Rept.</i> , vii, 241.
<i>Anisopteryx vernata</i> PECK. <i>Spring canker-worm</i>	Harris, <i>Ins. Inj. Veg.</i> , 463.
<i>Anisopteryx pomataria</i> HARR. <i>Autumn canker-worm</i>	Id., ib., 463.

Tortricidæ.

<i>Teras Cinderella</i> (RILEY). <i>Green apple-leaf-tyer</i>	Riley, <i>Mo. Rept.</i> , iv, 46.
<i>Teras malivorana</i> (LE BARON). <i>Lesser apple-leaf folder</i> ..	Le Baron, <i>Ill. Rept.</i> , i, 20.
<i>Cacœcia rosaceana</i> (HARR.). <i>Oblique-banded leaf-roller</i> ..	Harris, <i>Ins. Inj. Veg.</i> , 480.
<i>Cacœcia argyrospila</i> (WALK.).....	Riley, <i>Trans. Am. E. S.</i> , x, 12.
<i>Lophoderus triferana</i> (WALK.).....	Murtfeldt, ib., 15.
<i>Eccopsis malana</i> FERNALD. <i>Apple-bud worm</i>	Cœquillet, ib., 72.
<i>Eccopsis permundana</i> (CLEM.). <i>Neat strawberry-leaf roller</i>	Id., <i>Papilio</i> , iii, 102.
<i>Tmetocera ocellana</i> (SCHIFF.). <i>Eye-spotted bud-moth</i>	Harris, <i>Ins. Inj. Veg.</i> , 482.
<i>Grapholitha prunivora</i> (WALSH). <i>Plum moth</i>	Riley, <i>Mo. Rept.</i> , iii, 6.
<i>Phoxoptera nubeculana</i> (CLEM.). <i>Apple-leaf folder</i>	Riley, <i>Agr. Rept.</i> for 1878, 239.
<i>Carpocapsa pomonella</i> (LINN.). <i>Codling-moth</i>	Linnaeus, <i>Syst. Nat.</i> , x, 538.

Pyralidæ.

<i>Eurycreon rantis</i> GUEN. <i>Pyralid web-caterpillar</i>	Popenoe, <i>Kan. R. B. A.</i> , 1880, 100.
<i>Peopelia Hammondi</i> RILEY. <i>Apple-leaf skeletonizer</i>	Riley, <i>Mo. Rept.</i> , iv, 44.
<i>Phycis indigenella</i> (ZELLER). <i>Leaf-crumpler</i> ..	Id., ib., 38; as <i>Phycita nebulo</i> Walsh.*

Tineidæ.

<i>Ypselophus pomotellus</i> (HARRIS). <i>Pulmer-worm</i>	Fitch, <i>N. Y. Repts.</i> , i-ii, 221.
<i>Ypselophus centuberoalallus</i> (FITCH). <i>Comrade palmer-worm</i>	Id., ib., 233.
<i>Ypselophus malifoliellus</i> (FITCH). <i>Many-striped palmer-worm</i>	Id., ib., 231.
<i>Cleophora malivorella</i> RILEY. <i>Apple-tree case-bearer</i>	Riley, <i>Agr. Rept.</i> for 1878, 258.

*This name is proposed in consideration of the preference which the caterpillar shows for the Linden (even above the Elm), as was seen in its devastations of the Lindens in New York city and Brooklyn during at least twenty-five years preceding 1861, when as a means of arresting the nuisance the following resolution was presented to the Common Council of Brooklyn:—

“Resolved, That the owners of property having Linden trees on the streets are hereby ordered to remove them within ten days after the passage of this ordinance, and failing to do so, shall be liable to a fine of five dollars for each tree left on the streets, after that date. The street commissioner is hereby directed to remove all trees of that species that may be left on the streets after that date.”

The resolution was referred to the Health Committee and Health Officer of the Common Council, who presented a report (of which 1,000 copies were printed), entitled, Report | on the | Measure Worm, | or the | *Geometra niveosericearia* [JONES], | which | infest the trees of Brooklyn; | suggesting | remedies for their extermination. | By Joseph B. Jones; M. D., | Health Officer. | Health Department, June 1, 1861. | [Seal of City] | Brooklyn: | 1861. | 8 vo., pp. 19.

As the caterpillars were found by the investigations of the above Committee, aided by a Committee of the Brooklyn Sanitary Association, and a Committee appointed at a public meeting of the citizens, to feed upon other shade-trees, several remedies for the nuisance were recommended, in lieu of the measure proposed in the above resolution.

Lithocolletis pomifoliella ZELL.*	Thorn-apple leaf-miner.	Clem., P. A. N. S. Ph., 1860, 208.
Tischeria malifoliella CLEM.	Apple-leaf miner.....	Id., ib., 208.
Aspidisca splendoriferella CLEM.	Resplendent shield-bearer.	Comstock, Agr. R. for 1879, 210.
Ornix prunivorella CHAMB.	Wild-cherry leaf miner.....	Chambers, Can. Ent., v, 50.
Bucculatrix pomifoliella CLEM.	Apple-leaf Bucculatrix..	Clem., P. A. N. S. Ph., 1860, 211.
Micropteryx pomivorella PACK.	Apple Micropteryx.....	Packard, Inj. Ins., etc., 1870, 6.

Hymenoptera.

Formica Noveboracensis FITCH.	New York ant.....	Fitch, N. Y. Reports, i-ii, 63.
Vespa maculata LINN.	White-faced hornet.....	Authors.
Vespa vulgaris LINN.	Yellow jacket.....	Id.
Polistes fuscata FABR.	The common wasp.....	Id.
Tremex columba LINN.	Pigeon Tremex.....	Amer. Entom., ii, 128.

Diptera.

Sciara mali (FITCH).	The Apple midge.....	Fitch, N. Y. Reports, i-ii, 252.
Trypeta (Rbagolites) pomonella WALSH.	Apple maggot..	Walsh, Rept. Act. S. E., p. 29.
Drasophila ampelophila LOEW.	Pickled-fruit fly.....	Comstock, A. Rep. for 1881, 199.
Drasophila amœna LOEW.	Pretty pomace fly.....	Id., ib., 201.

Coleoptera.

Silvanus Surinamensis (LINN.).	Grain Silvanus.....	Glover, Agr. Rept. for 1870, 66.
Trogosita nana (MELSH.).	Dwarf Trogosita.....	Riley, Mo. Rept., iii, 6.
Ips fasciatus OLIV.	Banded Ips.....	Thomas, Ill. Rept., vi, 91.
Lucanus dama THUNB.	Stag beetle.....	Harris, Ins. Inj. Veg., 45.
Serica iricolor (SAY).	Iridescent Serica.....	Glover, Agr. Rept. for 1868, 87.
Macrodactylus subspinosus (FABR.).	Rose beetle.....	Harris, Ins. Inj. Veg., 36.
Lachnosterna fusca (FROHL.).	May beetle.....	Glover, Agr. Rept. for 1868, 104.
Lachnosterna sororia LEC. = (L. micans.).....*		Id., ib.
Lachnosterna fraterna (HARRIS).	June beetle.....	Harris, Ins. Inj. Veg., 32.
Lachnosterna hirticula (KNOCH).	Hairy May beetle.....	Glover, Agr. Rept. for 1868, 88.
Lachnosterna crenulata (FROHL.).....		Id., ib.
Lachnosterna tristis (FABR.) = (L. pilosicollis Knoch)....		Harris, Ins. Inj. Veg., 33.
Macronoxia variolosa (HENTZ).	Scarred Melolontha.....	Id., ib., 33.
Euphoria melancholica (G.-P.).	Melancholy chafer.....	Amer. Entomol., ii, 61.
Euphoria Inda (LINN.).	Indian Cetonia.....	Riley, Mo. Rept., iii, 6.
Osmoderma eremicola (KNOCH).	Hermit Osmoderma.....	Harris, Ins. Inj. Veg., 42.
Osmoderma scabra (BEAUV.).	Rough Osmoderma.....	Glover, Agr. Rept. for 1868, 90.
Dicerca divaricata (SAY).	Divaricated Buprestis.....	Id., ib., 91.
Chrysobothris femorata (FABR.).	Flat-header ap.-tr. borer	Fitch, N. Y. Rept., i, 25.
Alaus oculatus (LINN.).	Eyed Alaus.....	Id., ib., iii, 11.
Alaus myops (FABR.).	Blind Alaus.....	Id., ib., iii, 12.
Melanotus incertus (LEC.).	Uncertain snapping-beetle....	Riley, Mo. Rept., iii, 6.
Melanotus communis (GYLL.).	Common snapping-beetle.	Id., ib., 6.
Sinoxylon basilare (SAY).	Red-shouldered Sinoxylon....	Id., ib., iv, 54.
Amphicerus bicaudatus (SAY).	Apple-twig borer.....	Fitch, N. Y. Rept., iii, 12.
Polycaon confertus LEC.....		Riley, Amer. Nat., xvi, 747.
Prionus laticollis (DRURY).	Broad-necked Prionus.....	Amer. Entomol., i, 233.
Prionus imbricornis (LINN.).	Tile-horned Prionus.....	Riley, Mo. Rept., iii, 6.
Chion garganicus (FABR.).....		Fitch, N. Y. Rept., iii, 8.†
Chion cinctus (DRURY).	Banded Chion.....	Id., ib.
Elaphidion villosum (FABR.).	Apple-tree pruner.....	Riley, Amer. Ent., iii, 239.
Elaphidion parallelum NEWM.	Parallel Elaphidion.....	Id., ib.

**Lithocolletis crategella* Clem., is, according to Lord Walsingham (*Trans. Amer. Entomolog. Soc.*, ix, 1882, p. 202), identical with this well-known European species.

† As *Cerasphorus balteatus* De Geer.

<i>Psenocerus supernotatus</i> (SAY).....	Packard, Guide St. Ins., 500.
<i>Leptostylus aculifer</i> (SAY). <i>Prickly Leptostylus</i>	Fitch, N. Y. Rept., iii, 8.
<i>Sternidius alpha</i> (SAY).....	Riley, Amer. Ent., iii, 270.
<i>Liopus facetus</i> SAY. <i>Facetious Liopus</i>	Fitch, N. Y. Rept., iv, 65.
<i>Hyperplatys maculatus</i> HALD.....	Riley, Amer. Ent., iii, 271.
<i>Oncideres cingulatus</i> (SAY). <i>Twig-girdler</i>	Id., ib.
<i>Saperda candida</i> FABR. <i>Round-headed ap.-tr. borer</i>	Harris, Ins. Inj. Veg., 107.
<i>Saperda cretata</i> NEWM.....	Osborn, Amer. Nat., xv, 244.
<i>Glyptoscelis crypticus</i> (SAY). <i>Cloaked Chrysomela</i>	Fitch, N. Y. Rept., iii, 18.
<i>Diabrotica vittata</i> (FABR.). <i>Striped cucumber-beetle</i>	Riley, Mo. Rept., iii, 6.
<i>Odontota rosea</i> (WEBER). <i>Rosy Hispa</i>	Harris, Ins. Inj. Veg., 120.
<i>Hymenorus obscurus</i> (SAY).....	Lintner, Count.-Gent., 1862, 605.
<i>Macrobasis unicolor</i> (KIRBY). <i>Ash-grey blister-beetle</i>	Glover, Ag. Rept. for 1868, 105.*
<i>Pomphopœa aenea</i> (SAY). <i>Pear-tree blister beetle</i>	Riley, Mo. Rept., iii, 6.
<i>Epicærus imbricatus</i> (SAY). <i>Imbricated snout-beetle</i>	Glover, Ag. Rept. for 1870, 71.
<i>Ithycerus Novboracensis</i> (FORST.). <i>New York weevil</i> ...	Fitch, N. Y. Rept., iii, 18.
<i>Anthrenomus cratægi</i> WALSH. <i>Thorn curculio</i>	Riley, Amer. Ent., ii, 308.
<i>Anthrenomus quadrigibbus</i> SAY. <i>Apple curculio</i>	Walsh, Amer. Ent., i, 36.
<i>Conotrachelus nenuphar</i> (HERBST). <i>Plum curculio</i>	Harris, Ins. Inj. Veg., 76.
<i>Monartbrum mali</i> (FITCH). <i>Apple bark beetle</i>	Fitch, N. Y. Rept., iii, 8.
<i>Xyleborus pyri</i> (PICK). <i>Pear-blight beetle</i>	Harris, Ins. Inj. Veg., 90.

Hemiptera.

Heteroptera. †

<i>Nysius destructor</i> RILEY. <i>False chinch-bug</i>	Riley, Mo. Rept., v, 112.
<i>Lygus lineolaris</i> (BEAUV.). <i>Little-lined plant-bug</i>	Id., ib., ii, 114. ‡

Homoptera.

○ <i>Cicada tibicen</i> LINN. <i>Dog-day Cicada</i>	Uhler, <i>in lit.</i>
○ <i>Cicada septendecim</i> LINN. <i>Seventeen-year locust</i>	Fitch, N. Y. Rept., i, 45.
○ <i>Cicada tredecim</i> RILEY. <i>Thirteen-year locust</i>	Riley, Mo. Rept., iii, 6.
○ <i>Cercsa bubalus</i> (FABR.). <i>Buffalo tree-hopper</i>	Id., ib., v, 122.
○ <i>Ceresa taurina</i> FITCH. <i>Calf tree-hopper</i>	Fitch, N. Y. Rept., iii, 17.
○ <i>Jassus irroratus</i> SAY.....	Uhler, <i>in lit.</i>
○ <i>Psylla pyrisuga</i> FORST. <i>Pear-tree Psylla</i>	Glover, Agr. Rept. for 1876, 33.
○ <i>Aphis mali</i> FABR. <i>Apple-tree Aphis</i>	Fitch, N. Y. Rept., i, 49.
○ <i>Aphis malifoliae</i> FITCH. <i>Apple-leaf Aphis</i>	Id., ib., i, 56.
○ <i>Schizoneura lanigera</i> HAUS. § <i>Apple-root plant-louse</i>	Id., ib., i, 5.
○ <i>Callipterus mucidus</i> FITCH. <i>Mouldy Aphis</i>	Id., ib., iii, 16.
○ <i>Aleurodes</i> sp.....	Walsh, Pract. Ent., ii, 58.
○ <i>Chionaspis furfurus</i> (FITCH). † <i>Scurfy bark-louse</i>	Id., ib., 31.
○ <i>Diaspis ostreaformis</i> (CURTIS). † <i>Circular bark-louse</i> (Fitch)	Comstock, A. R. for 1880, 312.
○ <i>Mytilaspis pomicorticis</i> RILEY. ** <i>Apple bark-louse</i>	Harris, Ins. Inj. Veg., 252.

*As *Macrobasis Fabricii*.

†Dr. Fitch, in his Third-Fifth Reports, pp. 17 and 18, nos. 24 and 26, includes among insects affecting the leaves of apple-trees *Arma grandis* [now *Podisus cynicus* (Say)], and *Arma spinosa* [*Podisus spinosus*], but these are now regarded as cannibals and not vegetable feeders. *Sinea diadema* (Fabr.) and *Milyas cinctus* (Fabr.), which have also been recorded among apple-tree insects, also subsist on the juices of other insects.

‡As *Capsus oblineatus* Say.

§As *Pemphigus pyri* Fitch.

|| *Aspidiotus Harrisii* Walsh.

¶ *Aspidiotus circularis* Fitch.

** *Aspidiotus conchiformis*, of Authors.

- Aspidiotus perniciosus COMSTOCK. *The pernicious scale..* Comstock, *sup. cit.*, 304.
 Lecanium oleæ BERNARD. *Black scale of California.....* Id., ib., 336.
 Thrips sp?..... Osborn, Psyche, iii, 369.
 Phlaeothrips mali FITCH. *Apple thrips.....* Fitch, N. Y. Rept., i, 102.
 Heliothrips hæmorrhoidalis BOUCHE..... Pergande, Psyche, iii, 381.

Orthoptera.

- Ecanthus niveus HARRIS. *White flower-cricket* Riley, Mo. Rept., v, 120.
 Caloptenus femur-rubrum HARRIS. *Red-legged grasshopper* U. S. Ent. Com. Rept., i, 445.
 Caloptenus spretus UHLER. *Rocky Mountain locust.....* Id., ib., 253.
 Caloptenus atlantis RILEY. *Atlantis grasshopper.....* Id., ib., 445.
 Camnula pellucida SCUDD..... Id., ib.

(C.)

DESCRIPTIONS AND NOTES OF LEPIDOPTERA.

The following papers upon Lepidoptera have already been published in Scientific Journals. They are republished here for convenience of reference, and as being a portion of the work of the Entomologist during the period for which his Report is made.

[From *Pupilio*, May, 1881, i, pp. 69-74.]

ON SOME SPECIES OF NISONIADES.

Mr. Wm. H. Edwards has submitted to me for examination some examples of *Nisoniades*, which prove to be undescribed species. They are the following:—

NISONIADES NÆVIUS n. sp.

Size somewhat less than *N. Juvenalis* and *N. funeralis*. Wings fuscous, almost black, with a purple reflection.

Primaries with four minute, subquadrangular, white, costo-apical, hyaline spots, of which the fourth (from costa) may be obsolete; a similar spot in cell 3, and none in the discal cell. An irregular umber-brown spot centers on the discal cross-vein, and at about the middle of cell 1 b (the submedian interspace) is another, showing more distinctly in the ♀. The subterminal row of obscure, rounded, intranervular fuscous spots rest on a dark umber-brown ground. All the markings are nearly lost in the dark ground; those best defined are two confluent trapezoidal spots in cell 1 b, forming the inner termination of the transverse row of spots, and defined without and within by a W in umber-brown. The spots of the transverse row are not of the ordinary sagittate form.

Secondaries dark brown, showing faintly the two rows of intranervular paler brown spots, more distinct in the ♀. Cilia dark brown, lighter upon their outer half in one ♂, and quite pale, approaching whitish in the ♀.

Beneath, paler brown, and showing more or less distinctly the two ordinary lines toward the margin of pale brown spots, and in one ♂ example, a white spot in the discal cell, not seen on the upper surface. Head and palpi concolorous with the thorax, abdomen, and legs.

Expanse of wings: ♂ 1.45 to 1.65 in.; ♀ 1.65 to 1.70 in.

Described from 3 ♂'s, collected at Indian River, Florida.

This species is allied to *N. funeralis* Scudd.-Burg. Its markings are similar in form and arrangement and nearly as inconspicuous, and the pale fringe of the secondaries in one example shows a tendency toward the white fringe of that species. Its wings are not quite so pointed. The examples before me show

none of the bluish hairs which sprinkle the primaries of *N. funeralis* and are still more numerous in *N. Juvenalis* Fabr. and *N. Propertius* Scudd.-Burg.

This may possibly be the *N. Terentius* of Scudd.-Burg., based upon the genital armature; but as the differences presented between the genitalia of this species, which have been carefully observed, and those of *N. Terentius* as described and illustrated, are greater than those which have served to separate other of the genitalic species, it would not be proper to accept the two as identical.

NISONIADES PETRONIUS n. sp.

In ornamentation and general character, allied to *N. Propertius* Scudd.-Burg., resembling it in the quite oblique line of subsagittate black spots crossing the nervules. The black markings of the wings are more strongly contrasted with the dark brown ground than in *N. funeralis* or *N. Navius*, but less so than in *N. Propertius* and *N. Juvenalis* — about equal to *N. Persius*. The white hyaline spots of the primaries are of medium size — smaller than in the average of *N. Juvenalis*; that in the discal cell is small; that in cell 3 on the transverse line of sagittate spots is crescentic, concave toward the base; below the latter, in cell 2, a smaller white spot, wanting in one example.

Beneath, reddish-brown, especially the secondaries, which show two rows of pale-brown submarginal spots which become obsolete before reaching the front margin of the wing, and wholly want the white spots in cells 6 and 7 which characterize *N. Juvenalis** and *N. Propertius*. The white spots of the primaries are larger than above.

Head: above the eyes and just behind the "locklet" are a few white scales; behind and beneath the eyes are some pale yellow-brown scales, and similar colored hairs compose most of the palpal covering, quite in contrast with the dark-brown color of the legs, thorax and abdomen.

A single ♀, accompanying the examples submitted to me, I refer, somewhat doubtfully to this species, from general markings and the pale-colored palpi. The transverse row of ellipsoidal black spots, and those of the medial and basal regions, are conspicuously outlined on a somewhat pale amber-brown ground — the contrast about that presented in *N. Martialis* ♀. An oval white spot in cell 2 accompanies the round one in cell 3. The costo-apical white spot in cell 9 is wanting.

Expanse of wings: ♂, 1.90 to 2 in.; ? ♀, 1.80 in.

Described from 4 ♂'s and 1 ♀, from Indian River, Florida.

This is the largest species known to us in the genus. It is separable from *N. Juvenalis* and *N. Propertius* by its darker color, less distinct ornamentation, less rounded wings, and absence of the white spots of secondaries in cells 6 and 7. From *N. Navius* with which it is associated, it is distinguished by its large size, more distinct markings, and the contrasting lighter shade of the palpi.

The genitalia of this species resemble those given for *N. Horatius* and *N. Virgilius*, named from their genital armature, by Scudder and Burgess, but I am unable to refer it to either. Examples from Florida, which Mr. Scudder has kindly permitted me to examine, and labeled by him as *N. Horatius*, have the white hyaline spots of the primaries larger than in the above species, and, ac-

* In 45 examples of *N. Juvenalis* before me, these white spots are a prominent feature. In one example the spots each occupy the entire breadth of the cell.

ording to notes made at the time of their examination, "larger than in any of the *N. Juvenalis* in my collection, except in a single example taken at Center, in which they are about the same in size and similar in form."

NISONIADES PROPERTIUS Scudd.-Burg.

Several years ago, through the kindness of Mr. Scudder, I was permitted to examine the species of the *Nisoniades* in his collection, including several of his types. Among them were eight examples, bearing his label of *Propertius*, from the following localities: two from Mokiah Pass, Palmer collection; one from Sierra Nevada; four from California; one from Juniper Mountains.

The following notes upon this species were made by me at the time, upon comparison of the material with the examples of *N. Juvenalis* in my own collection.

Size of *N. Juvenalis*; the primaries more pointed; the submarginal row of sagittate and black spots is more oblique, being more drawn inwardly toward the base as it approaches the internal margin, whence it follows that, while in *Juvenalis*, of the two subelliptical whitish spots in cell 1 b, the lower one is as near to the outer margin as that in cell 3, in this species it is always further removed. The hyaline spot in the discal cell is smaller than in *N. Juvenalis* and is much less conspicuous underneath. Of the four costo-apical hyaline spots, 1, 3 and 4 are in line, or 3 is somewhat nearer to the base of the wing; 2 is nearer the apex and is elongated. The thorax and abdomen are fuscous, instead of umber-brown. In general color it is darker, more approaching *N. Persius* — the black spots not offering so strong a contrast with the ground as in *N. Juvenalis*; the primaries are nearly covered with bluish hairs, which is perhaps the best characteristic feature of the species.

It is very doubtful if the genitalic form, *N. Tibullus* of Scudd.-Burg., can be separated from *N. Propertius*.

This species has also been received from Utah and Arizona. I have also in my collection, examples received from Mr. Henry Edwards (No. 76), from Havilah, California, and Vancouver Island.

NISONIADES ICELUS Lintn.

Mr. W. H. Edwards has allowed me to examine two examples of this species, which he had obtained from the Western collections of Mr. Morrison in 1880, taken in Washington Territory. This extreme western locality for this insect is an interesting addition to our knowledge of its distribution. Mr. Scudder in his *Systematic Revision of American Butterflies* (1872), gives as its distribution, Canada to West Virginia; Atlantic Coast to Michigan. In the Edwards' *Catalogue of the Diurnals of North America* (1877), its habitat is given as New England, Middle States and Illinois. Subsequently (my *Entomolog. Contrib.*, No. IV, 1878), I identified it among some Colorado collections of Mr. Morrison. These western examples do not differ in size or in any particular feature from our eastern forms. The examples before me are without date of collection. They are in fresh condition, and are rather more strongly marked with white scales toward the costal and outer margins of the primaries than those ordinarily met with in the Middle and Eastern States.

An interesting feature of this species, observed by Dr. Speyer, is noticed in his valuable paper on the *Genera of the Hesperidæ of the European Faunal-Region*

(Canad. Entomol., x, p. 169). It is the presence of a long and thick tuft of hairs on the posterior tibiæ. This is not found in *N. Brizo* Boisd.-Lee.—a species so closely allied to *N. Icelus* that some writers have questioned their specific difference. It has been observed in but one other species of *Nisoniades*, viz., *N. Persius* Scudd. It also characterizes the Hesperidean genus *Daimia* of Murray, of which the European *D. Tethys* Men. is the type and sole species, and *Scelothrix* of Ramb.—united with *Pyrgus* H. by Dr. Speyer in his last Revision of the European Hesperidæ (1878), as Group II, having *maculatus* Brem, as the type of the group. This tuft or hair-pencil differs in the several species. In *N. Icelus* it is produced from the femoral joint of the tibia, and is widely spread apart in the examples before me. In length it exceeds the tibia by nearly one-half. Like the costal-fold, it is probably confined to the ♂ sex.

A revision of the proof of this paper has enabled me to add the following : Since the above was written, an examination of the *Nisoniades* in my collection has shown the presence of the tibial hair-pencil also in the males of *N. funeralis* Boisd., *N. Nævius* Lintn., and *N. Lucilius* Lintn. I cannot detect it in any other than the above-mentioned five species. In the genus *Pyrgus*, I find it in *P. centaureæ* Ramb., *P. scriptura* Boisd., *P. Xanthus* Edw., *P. Petreius* Edw., and *P. ericetorum* Boisd. It is not present in *P. tessellata* Scudd. Of *P. Oceanus* Edw., *P. Ricara* Edw., *P. Philetas* Edw., and *P. cæspitalis** Boisd., I possess no examples for examination. It exists also in *Achlyodes Thraso* Hübn.

NISONIADES SOMNUS n. sp.

Belongs to the *N. Icelus* and *N. Brizo* group; size of the former—its wings somewhat narrower and more extended apically.

Male, dark brown in color, approaching *N. Persius*. Primaries, without the ante-apical white spot above, and the large patch of bluish-white scales resting on the discal cross-vein of *N. Icelus*. The black transverse bands are of the position and character of those of *N. Icelus*, but are almost lost in the ground color. Secondaries, nearly as dark as the primaries, showing indistinctly the two rows of pale brown spots.

Beneath, wings bronze by reflection. The primaries have a short costo-apical white streak in cell 8, and a minute white dot in cell 9 (*N. Icelus* has usually a subquadrangular white spot in cells 6, 7 and 8 each, and occasionally the spots form a continuous line nearly across the wing, from 2 to 8 inclusive); an intranervular series of pale streaks, and on the secondaries, the two rows of yellow-brown spots are distinct.

Female, paler brown than the male. The two transverse bands of primaries are quite distinct, and between them, on the discal cross-vein, is a conspicuous patch of whitish scales; no white ante-apical spots; upon the margin, a row of rounded brown spots, separated from the contiguous band, by whitish scales. The bands are broader than in *N. Icelus*, and are almost drawn together on vein 2; the connected series of spots composing each, are shaped much as in *N. Icelus*, are heavily bordered with black, and bear bluish scales. Secondaries, with a geminate discal mark, a submarginal row of yellowish spots much bent inwardly opposite the cell, and a marginal row of small, linear, whitish spots.

Beneath, wings with a strong bronze reflection. The secondaries have the two rows of spots of the upper surface repeated; the primaries have a marginal

* Erroneously given as *Cæspitalis* in Edwards' Catalogue.

row of linear whitish spots, a regularly curved submarginal row of eight oblong yellowish spots, and a single white ante-apical spot in cell 8.

The antennæ, in this species, are delicately annulated with white. The palpi are shorter than in *N. Icelus*, shaggy, some of the hairs of the second joint extending to the tip of the third. The tibiæ of the posterior pair of legs are without the pencil of hairs characterizing *N. Icelus*.

The last-mentioned feature separates, beyond question, this species from *N. Icelus*. It may also be distinguished by the darker and more uniform color of the male, the transverse bands hardly separable from the ground color, the absence of an ante-apical white spot and of the discal patch of bluish scales. The female resembles *N. Brizo*, but the inner margin of the outer band is much more irregular than in that species, and the submarginal row of spots on the primaries beneath, takes the place in prominence, of a different series seen in *N. Brizo*, of which only the costal one is here represented.

Expanse of wings: ♂, 1.30 inch; ♀, 1.45 inch.

Described from 1 ♂ and 1 ♀, in the collection of Mr. W. H. Edwards, received from Indian River, Florida.

The relationship of this species suggests the mythological name given it. BRIZO was worshiped as the goddess of sleep. ICELUS was regarded as the inspirer of dreams in mortals, and was the son of SOMNUS, the god of sleep (see 23 *Rept. N. Y. St. Mus. Nat. Hist.*, 1873 p. 163-4).

EUDAMUS PROTEUS (Linn.).

Quite an interesting addition to the list of Hesperidæ occurring in the State of New York, is the above species.

Two examples of it, one of which I have been permitted to see, were captured by Mr. S. Lowell Elliot, of New York city, about the middle of August of last year, in the Central Park Gardens, east of the Mt. St. Vincent Art Gallery, upon the flowers of *Salvia splendens*. Other examples of it, as Mr. Elliot informs me, were seen by him, which he was unable to capture, for as soon as they alighted they were attacked by *Eudamus Tityrus*, which swarmed around these flowers and seemed to recognize the *Proteus* as strangers and intruders.

The species was not observed about other flowers, but were seen hovering around the *Salvia* for three consecutive days, when a cold rain storm ensuing and continuing for several days, terminated their visits.

Mr. Scudder reports the species from "Eastern N. America, as far north as Connecticut," but we have not been able to verify its collection in that State. We believe that these are its first captures within the State of New York.

EUDAMUS NEVADA Scudd.

From an example received from Mr. Henry Edwards (No. 2509, Summit Sier. Nev., Cal.), and from an additional example collected by Mr. Nash, of Ithaca, N. Y., in Colorado, I find that the above form is a valid species, quite easily to be separated from *E. Pylades*, of which, at the time of the publication of the Edwards' *Catalogue of the Lepidoptera of America: Diurnals*, it was believed to be a dwarfed variety.

[From the *Canadian Entomologist*, April, 1881, xiii, pp. 63-65.]

DESCRIPTION OF A NEW SPECIES OF EUDAMUS.

EUDAMUS ELECTRA, n. sp.

Size of small *Nisoniades Juvenalis*. Primaries narrower than in *Eudamus Pylades* Scudder ♀, more rounded on the costa, and more oblique on the hind margin. Secondaries rounded, not prolonged at the anal angle as in *E. Pylades*, nor excavated opposite the cell as in most of the *Nisoniades*.

General color dark brown, approaching that of *E. Pylades*; the fringe concolorous with the terminal portion of the wings, a little paler at their tips.

Primaries with eleven transparent white spots, upon which an ordinary lens shows regular rows of small black scales — the spots, as follows: Near the end of the cell (apparently open) are two spots, separated by the cellular fold and extending to the enclosing veins (subdorsal and median) — the upper one twice as large as the lower and prolonged backward superiorly in one or two teeth — the lower one subtriangular in shape; above and in line with these two, in cell 10, is a small elongated spot — the smallest on the wing, while beneath them and in range, in cell 2, extending from vein 2 to vein 3, is the largest spot on the wing, enlarged superiorly and excavated inwardly. Outside of this discal band of four spots, are seven others, bordered by dark brown, and arranged in an irregular curve, as follows: in cells 9, 8 and 7, three costo-apical spots, oblique to the costa; outside of these, in cell 6, a spot; in cell 5, still nearer the margin, another; in cell 4, a little farther removed from the margin, another — these last three subtriangular in shape; in cell 3, extending from vein to vein, a subquadrate spot, placed farther from the margin, about equidistant with the lower costo-apical spot; these seven spots, commencing at the costa and omitting the fifth, show a regular increase in size. Outside of these transparent spots, is a series of obscure dark brown intranervular subterminal spots which merge into the dark brown shade of the margin. Inside of these spots, the wing shows by oblique light a purplish reflection approaching a grape bloom but more vivid, with the exception of the internal margin and two brown bands of the color of the outer margin and posterior wings; the bands extend from the subcostal to the internal vein; the outer and broader embraces the discal band of transparent spots in its outer margin, and the other crosses the median vein at its intersection by vein 2; a brown shade rests also on the base of the wing.

Secondaries traversed at about their outer third by a narrow obscure brown band, inside of which the wing is dark brown; outside of this band, the subterminal series of brown spots of the primaries is continued.

Beneath, the purplish reflection of the upper surface appears only at the tip of the wing — the median and basal portions being dark brown, concolorous with the secondaries inside of the paler brown band; the obscure intranervular brown spots of the upper surface are repeated, and continued on the secondaries; the transparent spots are without the lines of brown scales.

The costal vein of the primaries intersects the costa nearly opposite the end of the cell; vein 8 reaches the margin at the extreme apex — not below it.

Antennæ about one-half the length of the anterior wings, dark reddish-brown, marked inwardly with white at the joints, expanding rapidly into the club (the terminal half of the club lost).

Palpi in length about equal to the diameter of the eyes, clothed with thick, bristly, dark brown hairs, some of which are white tipped; apical joint short, conical, projecting a little beyond the hairs.

Locklet black, curving about half-way over the eyes. Front of head dark brown.

Thorax above and beneath clothed with long brown hairs, concolorous with the posterior wings.

Abdomen darker brown, reaching only to the pale band of the hind wings.

Legs dark brown; the posterior pair have the femur and tibia of the same length, bearing brown hairs which nearly equal them in length, tibiae armed with two pairs of spurs; tarsi twice as long as the tibiae, moderately spinose.

Expanse of wings, 1.65 in.; length of body 0.55 in.

Described from a single female received from Mr. W. H. Edwards. The specimen was captured in Hamilton, Ontario, by Mr. J. Alston Moffat, in 1877, in company with another like it, which escaped capture.

In the *Hesperida* the anteanal club affords excellent generic features. It is unfortunate that in this unique specimen, the half of one antenna and the terminal half of the club of the other, have been lost. It being also of the female sex, we are without knowledge of the presence of a costal fold in this species. In the absence of these characters, it is referred, with some doubt, to the genus *Eudamus*, in which Dr. Herrich-Schäffer, Dr. Speyer and others arrange species with rounded hind wings and those in which they are greatly prolonged. Of the three groups in which Dr. Speyer has divided the genus, viz., *Hind wings on submedian nervure little or not at all produced,— **Prolonged in a lobe,— ***Caudated,— *E. Electra* falls in the first group.

The detection of the above species is a very interesting discovery for this portion of the United States.

[From the *Canadian Entomologist*, November, 1881, xiii, pp. 218-220.]

ON THE LIFE DURATION OF THE HETEROCERA (MOTHS).

Read before the American Association for the Advancement of Science, at its Cincinnati Meeting, August, 1881.

I have been requested by Mr. Edwards, who has presented to the Association an interesting and valuable paper, "On the Length of Life of Butterflies," to supplement it with some remarks on the *Life Duration of the Heterocera*.

The period of time passed by insects in their perfect stage is an item in their history to which, so far as I know, very little attention has been paid. It has not hitherto been made a special subject of inquiry. When we seek to answer the question, we find that very few of our published observations bear upon it. The little that is known upon this point, in the Heterocera, would not authorize the presentation of these notes before this body, were it not that a confession of our ignorance should, and I hope may, serve as an incentive to the examination of the interesting question.

It must prove a difficult field of investigation. Observations made upon species in confinement, deprived of food and subjected to other unnatural conditions,

would give only approximate results. Even here we find our knowledge extremely limited. Outside of the *Sphingidæ* and the *Bombycidæ*, scarcely any thing has been done by our Lepidopterists in rearing entire broods of species. In these two families the eggs can be easily obtained, either by the "sembling" method (attraction of the male by a newly-emerged female) or by simply pinning out of doors a captured female. Several species of the *Phalænidæ* are quite prompt in extruding their eggs upon being pinned, even after having been temporarily subjected to anæsthetic influence. But in the extensive family of *Noctuidæ*—with the winged forms of which we are so familiar, and of which our knowledge, therefore, should be the more complete—it is difficult to obtain the eggs under the restraint of confinement. I have never carried an oviposition of a single Noctuid to the perfect stage, nor can I recall a published record of its having been done. Further, in illustration of the veil that still hides portions of the life-histories of these forms which rarely obtrude themselves upon our sight except under cover of the night, it may be mentioned that during the thirty years in which my studies have engaged me to a greater or less extent in the rearing of Lepidoptera, I do not recall an instance where I have observed the *Noctuidæ* in *coitu*, and therefore have no personal knowledge of the time, place, manner or duration of the initiative of Noctuid life.

It is known that in the *Attacineæ*, among the *Bombycidæ*, in confinement, the lives of the moths are very brief. The sexes mate a few hours after emerging from the pupæ, and continue in copulation for twenty-four hours or more. Oviposition may be commenced the following day, and completed within four or five days thereafter. Perhaps a week longer will complete the life-period of the female—extending in all to about fifteen days. The male usually dies a few days after copulation—several days before the female.

In the *Sphingidæ*, the lives as observed, in confinement, are longer than in the *Attacineæ*, but I have no records from which to give comparative duration. Our observations upon the *Phalænidæ* lead us to believe that, as a general rule, their lives are shorter than are those of the *Noctuidæ*.

An approximation to the life-period of the *Noctuidæ* may be obtained from the dates when the several species are observed abroad. The published records of the collections made by "sugaring" will furnish convenient data for this. I regret that at my present writing, away from books of reference, I am unable to refer to the papers of Messrs. Thaxter, Norman, Westcott* and others. From a paper published by myself in *Entomolog. Contrib.*, iv, pp.43-51, it appears that the period of collection (embracing probably nearly the entire life-period, as the examples when first taken at sugar were apparently just from pupæ, and those last taken so worn as to be hardly capable of flight) of quite a number of species was about one month. Among these may be mentioned *Habrosyne scripta*, *Agrotis baja*, *A. subgothica*, *A. bicarnea*, *A. repentis*,† *Hadenæ verbascoïdes*, *Gortyna sera*, *G. nictitans*, *Leucania pallens*, *L. phragmitidicola*, *L. lapidaria*, *L. pseudargyria*, *Orthodes infirma*, *Orthosia helva*, *Scoliopteryx libatrix* and *Pseudoglossa lubricalis*.

If, in consideration of the condition of the moths when captured, the probable different time of oviposition and more or less favorable exposure of eggs, we as-

* *Psyche*, ii, pp. 84-88, 80; *Canad. Entomol.*, vii, pp. 3, 21; *Id.*, viii, p. 12.

† Now regarded as distinct from *A. messoria* Harris.

sume that the individuals of a species continue to emerge from the pupa during one-third of the above period, there will remain, as the approximate life duration of these *Noctuidæ*, a period of three weeks.

Mr. Wm. L. Devereaux, of Clyde, N. Y., in giving the results of his collections of *Noctuidæ* at sugar for two years,* states that "most of the species remain for about a month." From other data which I have consulted, I think that we shall not be far from the truth if we adopt as the life-period of the larger portion of the *Noctuidæ* a term of three weeks.

As might be expected in so heterogeneous a family as the *Noctuidæ* — differing so greatly in general character, coming forth at such different seasons of the year, and varying in the number of the broods, — the life-histories of the several groups vary to the extent of preventing generalization and necessitating specific observations. For example, we find that the genera *Xylina*, *Homoptera*, and *Catocala* have their periods of apparition much extended beyond the species above noticed. In the paper by myself, above referred to (p. 51), we find that *Xylina petulca*, *X. disposita* and *X. Bethunei* were observed for a period extending over forty-one, forty-seven and fifty-one days respectively, with a possible prolongation of the lives of some of their later individuals through hibernation and reappearance in the following spring, of six additional months. Seven species of *Catocala* give an average duration of forty-five days; and from Mr. Devereaux's observations, nine species of *Catocala* give an average period of fifty-seven days. These last may have shown a prolonged period from their record extending over two years — one of which years, from a more favorable season, may have included earlier dates of first appearance. It is proper to state that the above species were selected from the lists, as having been observed for the greatest length of time; the larger number gave considerably shorter terms of apparition.

In concluding these brief notes, which are quite unsatisfactory to the writer, and offered only in compliance with request, I would beg leave to suggest that good service may be rendered to Entomology by the collation from published records, and incorporation in our published lists of insects hereafter, of the several dates of their collection or observation throughout the entire time of their appearance. The want of such data has been felt in the attempt to answer the question of Dr. Weismann, [†] as to the duration of life of some of our insects in their perfect state. It would also be of service in the determination of the number of annual broods; it would afford a knowledge of the time for guarding against the initiative of insect attack; it would enable us in many cases to decide upon the best time for putting in our crops; it would enable collectors to seek for specimens for their cabinets when they are to be found: in short, it would furnish an essential part of the life-histories of our species. I commend it to the attention of Entomologists.

**Canadian Entomologist*, vol. xi, 1879, pp. 105-109.

[†Dr. August Weismann, of Freiburg in Baden, Germany, had applied to Mr. W. H. Edwards for this information.]

(D.)

ADDENDA.

INCREASED PRODUCTION OF PYRETHRUM INSECT-POWDER; page 37.—That the promise of Mr. Milco of a great reduction in price of the “Buhach” is about to be fulfilled, may be inferred from the following statement recently made:

Mr. G. N. Milco, superintendent of the Buhach Producing and Manufacturing Co., Stockton, Cal., estimates this year's Pyrethrum crop of the company's farm in Mercer county, to be at least forty tons. (*American Naturalist*, June, 1883, xvii, p. 666.)

PARAFFINE AS AN INSECTICIDE; page 46.—An English horticulturist gives the following directions for the use of paraffine, which he says he finds the best of all insecticides for the greenhouse: “I mix it thus: to half a pound of soft-soap, I add one pint of hot water, stir until the soap is thoroughly dissolved, then add half a pint of paraffine and stir well; to this I add two quarts more of hot water, and put the whole into a stone bottle and shake it well before using. This I always have in readiness, and for syringing or sponging we dilute it as may be necessary. It mixes readily with cold water, and thus mixed may be safely applied to any plant.”

LUCILIA SP.; page 62, foot-note.—The parent of the “screw-worm” long known as a serious pest to horses and cattle in Central America, has recently been ascertained to be *Lucilia (Campsomyia) marcellaria*, Fabr. For an interesting account of its attack upon man—in several instances proving fatal—see a paper by Prof. F. H. Snow, in *Psyche*, 1883, iv, pp. 27-30.

REMEDY FOR THE COCKROACH; page 65.—Powdered borax has inadvertently been given as a *repellant* of the cockroach and the croton-bug. It should have been included among the remedies, as it is perhaps the most simple and effectual means for killing them that can be employed. In a house badly infested with them, a pound of the powder was strewn over the floors of two basement rooms, and along the wainscoting of others. When the house was opened after having been closed for a fortnight, thousands of the dead bodies of the two species were scattered over the floors, and a few were still giving evidence of life. What seemed dust upon a portion of a pantry, was found to be

myriads of the dead bodies of young individuals, apparently a few days from the egg.

HELIOTHIS ARMIGER *Hübner*; page 116.—Add to the bibliography, WALSH: in *Pract. Entomol.*, ii, 1866, pp. 21, 22 (larval habits and description); *Ib.*, pp. 34, 112 (brief notices).

BUCCULATRIX POMIFOLIELLA *Clem.*; page 157.—In the *Canadian Entomologist*, vol. xiv, 1882, pp. 153-160, Mr. V. T. Chambers, in a paper entitled "Notes on the Larva of *Bucculatrix ambrosiæfoliella*," presents valuable information upon the natural history of the species, the larval structure, and a very interesting account of the manner in which it builds its peculiar ribbed cocoon. The details given will probably apply, in the greater part, to its congener, *B. pomifoliella*, to which references are made in the paper.

PUPA OF MEROMYZA AMERICANA, page 222.—When the examples of the transformed larvæ referred to came under my observation, the external features of the pupa were so well-defined, that, not being reminded at the time of its necessarily coarctate form, the puparium was not noticed. My attention having recently been called to this feature of the insect, by an inquiry of Professor Forbes, I am led to believe, from my recollection of the specimens, that the pupæ were enveloped in a thin, transparent and closely adhering puparium. Such puparia are recorded of species of *Chlorops*—nearly allied forms, and occurring under almost identical conditions.

A Western locality for this Fly, showing for it quite an extensive distribution throughout the United States, is that given by P. R. Uhler, in *Bull. U. S. Geolog.-Geograph. Surv. Terr.*, iii, 1877, p. 783, where it is stated to be "a very common species upon weeds in damp places near Denver [Colorado], Aug. 5-18," as observed in the explorations of 1875.

According to Prof. Forbes, the insect has the present season (spring of 1883) been very destructive to winter wheat in Central and Southern Illinois, destroying entire fields so that they were plowed up for other crops.*

PROTECTION OF GRAPE-VINES FROM THE ROSE-BEETLE; page 232.—A writer in the *Cultivator* for May, 1851 (p. 174), states, that if the vines are laid upon the ground before they put forth their leaves, and are allowed to remain until the beetles have disappeared, or until the grapes begin to have a sour taste, which they generally acquire when they attain the size of large shot, they will entirely escape the attack of the beetle. After this, the vines should be raised and attached to their proper support. The writer gives minute directions for handling the vines.

* *A New Wheat Insect. Wheat-bulb-worm.* By S. A. Forbes, State Entomologist. *Normal*, III., April 12, 1863.

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ERRATA.

- Page 15, line 18, for these read those.
Page 18, line 4, for *and* read and.
Page 20, line 19, for Ratz- read Ratze-.
Page 25, line 5, *dele* 5.
Page 43, line 28, for wooly-apple louse read wooly apple-louse.
Page 45, line 7, for *curculionidæ* read *Curculionidæ*.
Page 58, line 6, for *Chrisobothris* read *Chrysobothris*.
Page 87, line 38, for ii read iii.
Page 99, line 9, for Guenee read Guenée.
Page 108, line 40, and page 229, line 23, for omniverous read omnivorous.
Page 115, line 2, for *Gortyra* read *Gortyna*.
Page 126, line 4, after page insert 148.
Page 127, line 14, for Ogs. read Ogd.
Page 171, line 35, for *alcathoe* read *Alcathoe*.
Page 172, and page 206, last lines, for † read ‡.
Page 191, line 9, for WEIDEMANN read WIEDEMANN.
Page 199, line 37, for ANTHOMYIDÆ read ANTHOMYIIDÆ.
Page 204, beneath left-hand figure insert *a*, and beneath the other, *b*.
Page 248, line 10, for Popence read Popenoe.
Page 253, line 5, for Sturtevent read Sturtevant.
Page 272, line 2 from bottom, for decidely read decidedly.
Page 285, line 10, for *parcllela* read *parallela*.
Page 301, line 24, for *auriantica* read *aurantiaca*.
Page 329, line 28, for contubernalallus read contubernaellus.
Page 330, line 31, for Macronoxia read Polyphylla.
Page 330, line 37, for *Flat-header* read *Flat-headed*.
Page 331, line 3, for Sternidius read Liopus.
Page 331, line 4, change to *Lepturgus facetus* SAY. *Graceful Lepturgus*.





