FIRST ANNUAL REPORT

ON

THE NOXIOUS INSECTS

OF THE

STATE OF ILLINOIS.

By BENJ. D. WALSH, M. A.,

ACTING STATE ENTOMOLOGIST.

FROM THE APPENDIX TO THE TRANSACTIONS OF THE ILLINOIS STATE HORTICULTURAL SOCIETY. 1868

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TABLE OF CONTENTS.

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INTRODUCTORY.

To Executive Committee of the Illinois State Horticultural Society:

GENTLEMEN: — I present herewith, for publication in your Transactions, my first Annual Report as Acting State Entomologist.

What business I have to assume that title, I may be allowed briefly to explain to the people of Illinois, before I proceed to the discussion of subjects more immediately connected with the Report itself.

The Legislature of Illinois, as you are aware, at the close of the Regular Session in the winter of 1866--7, passed a law which enacts that a State Entomologist shall, by and with the consent of the Senate, be appointed by the Governor, with a salary of $2,000 per annum, and for a period of two years and until his successor is appointed and qualified. Owing probably to the late day at which this Act was passed by the Legislature, (Feb. 27th, 1867,) the Governor made no appointment at this Session.

On May 21st, 1867 — having in a previous Resolution requested the Governor to appoint me State Entomologist, in order that I might immediately enter upon the duties of that office — you passed the following Resolution:

"That the President of the Society be authorized to engage Benj. D. Walsh to immediately commence entomological investigations in relation to horticulture; and be empowered to pay out for that purpose a sum not exceeding $500 from the Legislative appropriation. This action is taken in case of a failure to appoint."

Having been duly notified on May 23d, by the President of your Society, of this most gratifying action on your part, and tendered the full amount of $500 in case I performed the duties specified in

the Resolution, I accepted with thanks the offer so liberally made me, in a letter addressed to your President and bearing date May 25th, 1867.

In the meantime the Governor had called a Special Session of the Legislature to meet June 11th, 1867. During this Session he presented my name to the Senate as his appointee for State Entomologist, along with the names of several gentlemen as his appointees on certain political Commissions. In all these cases the Senate took the ground, that they had no constitutional right to act upon such appointments at a Special Session, called for certain specified objects of which such appointments formed no part; and they therefore postponed all further consideration of all these appointments till the next Regular Biennial Session to be held in the winter of 1868–9.

Both you and myself were now manifestly placed in a false position. When the five hundred dollars was voted by you on May 21st, it was known that a Special Session would have to be called some time that year, and it was confidently anticipated by every one, that either myself or some one else would be duly appointed, and confirmed by the Senate as State Entomologist at that Special Session, whenever it met. As the matter actually stood at the close of that Session, neither myself nor any body else had any legal claim either to the title or to the emoluments of State Entomologist; and in the ordinary course of events no one could have such claim for a year and a half thereafter. It was manifestly absurd to suppose, that I could for the sum of $500 perform for two whole years duties, for which the Legislature had thought $4,000 to be a suitable compensation; and the impression on my mind was strong, that the whole movement in this direction had proved a failure and fallen to the ground. All men saw and felt that the Political Commissioners, who had been in the same boat as myself, were politically killed. I supposed therefore that the State Entomologist was entomologically killed.

Feeling as I have stated above, I wrote on June 19th, 1867, to your President, offering to release the Society entirely from any pecuniary claim that I might have on them, and, if they declined such offer, proposing to continue my researches and investigations in the matter of those insects that are peculiarly injurious to fruit,

not for the entire period of two years, but for a fair and reasonable time. Your President in his reply, dated July 3d, 1867, declined the former alternative and accepted the latter, generously leaving the amount of labor to be done by me on account of the $500 entirely to my discretion. And here the matter rested for the present; and I went ahead with those investigations, which I had commenced at the end of May and continued up to the receipt of President Baldwin's last letter.

It was my earnest wish to have attended the Meeting of your Society held at South Pass, Sept. 3—5, 1867; but, as will be seen from the following report, several insects—and in particular a very delicate small moth preying on the plum, which was an entirely new discovery of mine, and which will be found figured and described in the Report as "the Plum Moth"—would persist in coming out at that very period; and if I had then left home, almost all my specimens of this moth would have been ruined for want of immediate attention, and the discovery thrown over to be completed in some subsequent year. I had also other investigations in progress which required daily care; and I ventured to flatter myself, that I could do the fruit-growers of Illinois more service by staying at home and minding my business, than by laying before them in person discoveries only half finished and theories based upon too slender a foundation of facts.

A month later, when the entomological season was nearly closed, I attended the Fair of the State Agricultural Society; and on conversing there with many of our leading Agriculturists and Horticulturists, I found—much to my surprise—that it was the universal opinion among them, that if I went on, fairly and honestly and to the best of my ability discharging the duties of State Entomologist till the next Biennial Session of the Legislature, the Senate would then undoubtedly confirm my appointment by the Governor; and I was strongly urged and advised to take this course by all these gentlemen. I may add that officers of the State Agricultural Society proposed to me in private, to have the same sum appropriated in my behalf on the part of their Society, which your Society had already appropriated for a similar object This offer, however, I respectfully but thankfully declined; for I had already made up my mind to go on and discharge the duties of

State Entomologist for the whole period of two years for which the appointment was tenable, and to trust to the future liberality of the Legislature to reimburse me for my work.

I therefore, shortly after returning home from the State Fair, took care that the people of Illinois should be informed unofficially through the Public Press of the course that I had determined on; and I further, by the advice of friends, notified the Governor officially of what I proposed to do. I also informed your President, both by letter and personally, that I did not ask any pecuniary assistance whatever for the present from your Society; but that, if the Senate failed to confirm my appointment in the Regular Session of 1868–9, then, and then only, I purposed to call upon your Society for the payment of the sum, which had been so liberally appropriated in the first instance to meet a temporary necessity.

This whole matter is so complicated, and the misunderstandings respecting it have been so general, that I hope that I shall be excused for the publication of all these egotistical details. In justice to the Society, and in justice to myself, I could not well say less; and I have felt throughout, and still feel, a repugnance to thrusting myself forwards — without explanation or apology — to undertake functions, to the performance of which I am not legally and officially called. Time will show whether the people of this great State will endorse and approve what I am doing; or whether I am to be treated as an impudent pretender, who has been assuming a title to which he has no legitimate claim whatever.

The law authorizing the appointment of a State Entomologist makes it one of his duties to prepare an Annual Report of his researches and discoveries, for publication by the State. Under existing circumstances, I have thought that the most appropriate mode of carrying out the spirit, though not the letter, of the law upon this point was to offer this my First Annual Report for publication in the Transactions of your Society.

In preparing this document, I have aimed to use only such language, as will be intelligible to any one who has had a good Common School education, with one single exception. I have throughout, after giving the English names of insects, added the scientific names, printed in *italics* and enclosed in a parenthesis ( ). The general reader will find the sense always complete with-

out the parenthesis in *italics;* and therefore all that he has to do, in order to avoid those technical names which are so distasteful to many, is to skip over entirely, as he reads on, every parenthesis (printed *in italics*). To the scientific reader the scientific names are absolutely essential, because they are part and parcel of the peculiar language in which he writes and speaks and thinks; and because, while the scientific names are intelligible to every man of science, no matter whether he resides in America, in England, in France, or in Germany, and are the same everywhere throughout the whole civilized world, the English names of insects are often local, and differently employed by different writers and different States. For example: — a minute, two-winged Fly, the orange-colored larva of which infests the ears of wheat in the field a little before harvest, and which is called in English throughout New York and New England "the Wheat Midge" (*Cecidomyia tritici*, Kirby), is called pretty generally out West "the Red Weevil" and often simply "the Weevil," and in Pennsylvania and Maryland is popularly known as "the Milk Weevil." Now, if I have occasion to talk of this insect, and call it, after the fashion of most of our Illinois farmers, "the Red Weevil" or simply "the Weevil," every foreign entomologist, being entirely unacquainted with our local terms, will suppose that I am speaking of some kind of Snout beetle, and probably of that particular little black species (*Sitophilus granarius*, Linnæus), which infests such wheat as is stored in granaries both in this country and in Europe, and is popularly know in England as "the Weevil." But if, on the other hand, I give our popular Illinois name, or the English name used in Pennsylvania, or that used in New York and New England, and add in an innocent little parenthesis — ☞ (printed *in italics*) — the three words that form its complete scientific designation, then every entomologist, from one end of the world to the other, knows at a glance exactly what particular species I am speaking of, without the possibility of doubt, misconception, or confusion. Another instance: — I find that an insect, which will be fully treated of hereafter as the "Apple-root Plant-louse" (*Pemphigus pyri*, Fitch,) and which, as I have ascertained, is doing an enormous amount of damage thoughout our State, destroying apple-trees by what is popularly known as "rotten-roots," is commonly called almost every-

where in Illinois "the Wooly Aphis." Now, if I speak of this insect solely under this name, without adding its scientific name, every foreign entomologist, and a good many American ones besides, will suppose that I am referring to an entirely different kind of Plant-louse, which is properly called, both in America and in Europe, "the Wooly Aphis" (*Eriosoma lanigera*, Hausmann), and which is as different from the species misnamed "Wooly Aphis" in Illinois, as a sheep is from a goat. Whereas, if I give the scientific name, as well as the English name, every entomologist from San Francisco, in California, to Vienna, in Germany, will know exactly what insect I refer to. Moreover, there are already many purely scientific names, which pass current in the mouths of every fruit-grower and even of every farmer. The very name "Aphis," which I have just been referring to as current everywhere in Illinois, is a purely scientific name, and for that reason I have preferred to avoid it throughout in the body of my Report, and to use instead the good old homely Anglo-Saxon word "plant-louse." "Curculio" — which is upon everybody's tonguein Illinois, and alas! also upon everybody's plums and peaches and apples — is another purely scientific word, which has been popularized throughout the length and breadth of the United States, though in scientific language it has a much wider signification than in popular parlance, and is equivalent to the pure old English term "Snout-beetle." A third scientific name which has been engrafted into our tongue is "Cantharides," and it is always applied exclusively to a foreign species of the same genus of Blister-beetles, to which belong the old-fashioned Potato-bugs found for time immemorial in Illinois — not the new-fashioned Colorado Potato-bug (*Doryphora* 10-*lineata*, Say), which only invaded our State a few years ago, for that belongs to an entirely different group. Now, if the general reader can, without the least difficulty, open his mouth wide enough almost every day of his life to say "Aphis" and "Curculio" and "Cantharides," why should he be scandalized, offended and annoyed by *other* scientific names? always provided that they are printed in *italics* by way of finger-post to warn him off, as we stick up a board with "DANGEROUS" on it, where the ice is likely to break through in a skating-park; and provided further that these vicious scientific names are properly fenced in by a parenthesis ( ), so

that the incautious traveller may not stumble in upon them unawares, and get his brains kicked out by them before he knows what he is about.

I am well aware that it is impossible to please everybody, and that many men are of a very different opinion from those who take fright at every scientific term, actually holding that nothing can be worth reading, which, as a general rule, is written in such plain and popular language that it can be easily understood. But, because one author writes in a clear and intelligible style, it does not follow that he lacks depth of research and profundity of conception. Because another author indulges in muddy and obscure phraseology, it does not follow that he is a learned man and an original thinker. A puddle is not necessarily deep, because one is unable to see the bottom of it; neither is a lake necessarily shallow, because the eye can catch at a single glance every object that exists beneath its pellucid waters. In printed books, we often see ignorant blockheads cover up their lack of knowledge by a string of misapplied long words, as uncalled for as they are distasteful and unintelligible; while the really learned man, instead of going out of his way to lug in technicalities head-and-shoulders, uses them only when they are absolutely necessary to give precision and accuracy to his statements. As a general rule, when an author thinks clearly, he writes clearly; and when an author's ideas are confused, his expressions partake of the disorder of his mental faculties.

In a Memoir intended for publication in the Proceedings of some grave Scientific Society, it would, of course, be highly indecorous to break the dreary monotony of scientific hair-splitting by a single remark, which had the slightest tendency towards exciting that convulsive movement of the midriff, which the vulgar herd of mankind call "laughter." But as this Report is intended chiefly for the use of common folks, who do not think it beneath their dignity to indulge occasionally in a hearty laugh, I hope that I shall be pardoned, if I inadvertently here and there should drop a word, which may cause the cheek of the reader to mantle with a smile. Four hundred years ago Martin Luther said, that "he could see no reason why the Devil should run away with all the good tunes." I can see no reason, in the year 1867, why the

pestilent yellow-covered literature of the day should monopolize all the wit and humor. If there is one thing which I have at heart more than another, it is to popularize Science — to bring her down from the awkward high stilts on which she is ordinarily paraded before the world — to show how sweet and attractive she is when the frozen crust, in which she is usually enveloped, is thawed away by the warm breath of Nature — and more especially to demonstrate how delightful that particular branch of science, to which I have devoted half a life-time, may be made to any one, who will keep his eyes wide open as he walks through his garden or his orchard. If I merely succeed in enticing away a single young woman from her mawkish novelettes and romances into the flowery paths of Entomology, or if I can only induce a single young man, instead of haunting saloons and lounging away his time at street-corners, to devote his leisure to studying the wonderful works of the Creator, as exemplified in these tiny miracles of perfection which the people of the United States call "bugs," I shall think that I have not written altogether in vain.

I have felt, of course, that the main object of this Report is, and ought to be, the investigation of the history and habits of such Noxious Insects, as are peculiarly troublesome in the Garden and in the Orchard, and the suggestion of such modes of fighting these foes as will be found to be practically most successful. I know that my principal duty is to add in this manner to the profits of the Gardener and the Fruit-grower, and thereby incidentally to add to the sum total of the wealth of this great and growing State. But "man does not live by bread alone;" and there are other pursuits, besides dollars and cents, which are worthy the notice of every one. It is an excellent thing to have plenty to eat and to drink and to wear, and to have a good warm house over one's head — especially in the winter-time in Northern Illinois. These wants of the body are of primary importance, and must be, and ought to be, attended to by every man — whether he be a day-laborer, or whether he be a philosopher. But, besides the body, every man has a mind, which requires food, just as much as does the body; and if we starve the mind and feed the body fat, we are simply dwarfing and stunting that intellectual part of us, by which alone we are distinguished from the beasts of the field. I hope I shall be

pardoned, therefore, if I occasionally indulge in short digressions, which, though of no immediate bearing upon the main subject of the Report, seem to be calculated to arouse an inquiring spirit in the mind of the reader, and gradually to introduce him to the higher and more attractive and more intellectual departments of Natural History.

Several discoveries in Economic Entomology, made by myself since I became connected with your Society through the action taken by its Executive Board on the 21st of May last, were published at the time in the columns of the now defunct *Practical Entomologist*, of which I was for the first year of its existence Associate Editor, and for the second year sole Editor. These I have not thought it necessary or advisable to reproduce in the following pages, because I have aimed as far as possible to insert nothing here but what is original and hitherto unpublished. On the other hand, certain other subjects have been entirely omitted, because my investigations on those subjects are as yet uncompleted; and others again, because they have reference to insects which are injurious, not to the Gardener and the Fruit-grower, but solely, or almost entirely, to the Farmer.

At some future day — and, if it be possible, by the time that the next Biennial Session of the Legislature takes place — I hope to prepare a General Manual of the chief Noxious Insects of Illinois, comprising all the known facts respecting them that ought to become familiar to the intelligent Farmers and Gardeners and Fruit-growers of this State, no matter whether those facts be already published, or whether they be original. Such a Manual, to be of the greatest practical utility, would require to be very copiously illustrated; but a State, that is wealthy enough to spend three million dollars on a new State-house, ought to be able to afford a few thousand dollars for the publication of a work of primary necessity for nearly nine-tenths of its population.

A few purely scientific descriptions, which it has been requisite to insert in this Report, are printed in smaller type, because they are intended chiefly for the use of the few persons, who may desire to identify scientifically the species therein described. But even these, I have couched, so far as possible, in popular language, oc-

casionally adding the corresponding scientific terms in a parenthe sis, where perspicuity and precision required it. For instance, i we talk simply of the "jaws" of an insect, an entomologist may b uncertain as to our meaning; for in the typical insect there ar *two* pairs of jaws, placed one above the other and called respectivel in technical language "the mandibles" and "the maxils." But i we write "jaws (mandibles)," then everybody will know what w refer to, with just as much accuracy as his peculiar wants ma require.

The illustrations furnished herewith have been drawn by myse and engraved by Mr. Wm. Mackwitz, of St. Louis. Whateve defects there may be in them must be laid to my door; for, lik everything else which that artist has hitherto executed for m they are exact and faithful reproductions on wood of the origin sketches on paper.

All which is respectfully submitted by

BENJ. D. WALSH, M. A.,
Acting State Entomologist.

ROCK ISLAND, ILLINOIS, Dec. 18, 1867.

INSECTS INJURIOUS TO THE GARDENER AND THE FRUIT-GROWER.

INSECTS INFESTING THE GRAPE. — ON THE FRUIT.

CHAPTER I. — The Grape Curculio. (*Cœliodes inæqualis*, Say.) See plate, fig. 1.

This species of Snout beetle was described in the perfect beetle state 36 years ago by the great American entomologist, Thomas Say; but up to this date it has never been recognized scientifically in the larva state, and consequently its habits in that state have remained a sealed book to the great world of science. Yet the destructive operations of the larva upon the cultivated grape have been known to vineyardists for several years back, and the insect appears to be very generally distributed through the valley of the Mississippi; as may be seen at once from the following statements: —

So long ago as 1853, Dr. Warder, the distinguished pomologist, said that "at Cincinnati they have insects that work on the grape — a species of Curculio." (*Transactions Illinois State Agricultural Society*, I. p. 340.) Mr. Spaulding, of Cobden, South Illinois, tells me that he has noticed it on his grapes for 4 years; and that one particular vine has been nearly ruined by it for 3 consecutive years. Mr. T. J. Prickett, of the same neighborhood, says that it has infested his grapes for the last 3 years. One of these years it took, as he informs me, three-fifths of the fruit upon one Isabella and one Concord vine, so as to render the crop almost entirely worthless. Col. H. C. Forbes, of Cobden, finds the Grape Curculio worse than the Rot upon his grapes. Mr. S. W. Beck, with, who resides not far from Cobden, discovered 5 or 6 individuals of the perfect beetle, which he identified from specimens shown to him by me, upon his grapes in the forepart of August, 1867. Prof. Turner, of Jacksonville, Central Illinois, and Mr. McPike of Alton, South Illinois, both of them told me that their grapes were badly stung in 1867 by what, from their description, must be the same insect. Mr. J. R. Switzer, of Carroll Co. and Mr. W. Olds, of Whitesides Co., both in North Illinois, inform me that they have each of them noticed in their grapes, though only in small numbers, borings which in all probability are nothing else but those of this Curculio. Mr. C. H. Murray, of Clay City, South Illinois, writes in the *New York Tribune* of Oct., 29, 1867, that "last year nearly all of the wild grapes of that region were stung by some kind of a fly, and at the time of ripening contained a small worm." "This year," he adds, "there are no wild grapes, but the tame grapes have been stung. Some fell off, others remained until the time of ripening, and contained a bluish white worm, about one-fourth of an inch

long. Whole bunches of the grapes were thus destroyed, and often every bunch on a vine." Mr. Christ. S. Jackson, of Danville, Kentucky, sent me on July 31st, 1867, a large bottle of grapes, punctured by this same larva, and some of them still containing the defunct body of the offender. As, however, these grapes were preserved in alcohol, they only enabled me to identify the species, and were useless for the purpose of rearing the perfect beetle. The grapes forwarded by this gentleman were Catawbas, obtained from vineyards at Big Hill, Kentucky, "where," as he adds, "THERE ARE SIXTEEN ACRES IN ONE PLACE ENTIRELY RUINED BY THIS INSECT." Mr. M. C. Read, of Hudson, Ohio, has manifestly, as is proved by a letter of his to me, had his grapes infested for the last 3 years by this very same larva, though, in endeavoring to trace out its Natural History, he has apparently — by a very pardonable oversight in one who is not a professional entomologist — confounded it with one of the leaf-rolling caterpillars of the grape-vine; which last produce, in the perfect state, not a Beetle, but a Moth or "Miller," as it is popularly called. "When my grapes are ripe," so he tells me, "I am compelled to carefully look over every bunch, and pick out the infested berries, before sending them to the table; and out of the 18 or 20 insects that I have found on the grape, this one gives me the most anxiety. For a slight increase in its numbers would render our grape crop worthless." Finally, my esteemed correspondent, Mr. Joseph Wood, of Marietta, Ohio, informed me last summer that he had "every year hundreds or thousands of grapes punctured by some insect, and afterwards found the larva eating the grape." He subsequently sent me on July 27th, 1867, a box containing a few punctured grapes, two of which had respectively a living and a dead larva in them. Upon examining these larvæ, I was satisfied that they were those of some species or other Snout-beetle, but that they were decidedly distinct from those of either of the two species — the Plum Curculio and the Plum gouger* — known to infest the plum, with which Mr. Wood had in the first instance confounded them. I therefore wrote at once to him, stating the above facts, and requesting a copious supply of infested grapes. These he obligingly forwarded to me in excellent order, and by this means I have been enabled to trace the progress of our newly-discovered Grape Curculio from the larva to the perfect beetle state. In the following paragraph I have, partly from my own observations, partly from the statements of the above-named gentlemen, and partly from certain general laws known to apply to the whole of this pernicious group of insects — the Snout-beetles — drawn up as full a history as possible of this seemingly insignificant, but really very important foe of the grape-grower.

Late in June, or early in July, or a little earlier or later, according to the latitude, berries may be observed coloring very slightly upon one side, as if prematurely ripening. Not long afterwards a dark circular dot may be noticed in the middle of the colored spot, as if a common pin had been thrust red-hot into the berry. The infested berry *does not rot or decay*, but, with the exception of the puncture and the slight discoloration, remains to the last perfectly sound and plump, so far as external appearance goes. Hence the work of the Grape Curculio may be always readily distinguished from the so-called and very appropriately named "Rot," which is caused, not by any insect, but by a microscopically minute fungus. Towards the end of July, if one of these infested berries is cut into, the larva may be generally found burrowing in the flesh and surrounded — as is always the case with the larvæ of Snout-beetles and of Moths — by what is technically termed "frass;" that is to say, solid, hard pellets of excrement

* Respecting these two, see below, Chapters XI. and XII.

a round, oval, or short-cylindrical shape, and looking at first sight, like so many grains of gunpowder, their size varying, according to the size of the insect, from that of the finest Sporting Powder to that of the coarsest Cannon Powder. Usually, but not always, the larva gnaws away a part of one of the pips of the grape. As soon as it has got its growth, it drops out of the berry, where up to this time it has kept itself carefully secluded from view, on to the ground, unless, which happens sometimes, the berry has previously fallen to the ground off the bunch — burrows a little distance under the surface — scoops out for itself a small cell in the moist earth by wriggling its body round and round — and there transforms into the pupa state. The pupa I have not seen, but from analogy it must be a whitish or blackish creature, intermediate in robustness between the perfect beetle (fig. 1) and the larva (fig. 1b), incapable of either walking, eating, or discharging *fæces*, with rudimentary wings pressed tightly against the side of its body, and with legs and antennæ regularly arranged in a backward direction along its lower surface. The above operations take place from about the last of July to the fore part of August. About the beginning of September the pupa-shell splits open in front, and the perfect beetle works its way out of the ground, and flies abroad to take its pleasure and enjoy this beautiful green world — which, be it remembered, was made for the benefit of my little friends, the small six-legged Bugs, as well as for that of their more consequential brethren, the Big Bugs with two legs. The sexes then probably couple, and likely enough the males perish, as is known to be the case in several analogous instances; but the females must undoubtedly survive the winter in some snug retreat, sought out by them for this especial purpose. Otherwise it is impossible to account satisfactorily for grapes being punctured by this species of Snout-beetle in the June of the following year. At all events, I have repeatedly found dozens of different species of Snout-beetles, very closely allied to the Grape Curculio, snugly ensconced in moss and other such matters in the early spring months, before the universal World of Insects wakes up from its wintry sleep, to hymn the praises of their Great Creator through all the joyous months of summer.

According to Col. Forbes, of Cobden, Illinois, grapes stung by the Curculio mostly drop from the vine. According to Mr. Murray, of Clay City, South Illinois, as quoted above, some fall off and some remain until the time of ripening. According to Mr. Read, of Hudson, Ohio, large numbers of them hang on the bunch, as we have seen above, till they are ripe. According to Mr. Wood, of Marietta, Ohio, the berry "after a while drops from the stem, before it is ripe enough to cut, sometimes showing a premature reddening." These slight discrepancies may be readily accounted for by differences either in soil, in climate, in season, or in the variety of grape especially referred to in each of the above cases.

THE LARVA of the Grape Curculio (fig. 1b) is an elongate, legless grub, four or five times as long as wide, nearly cylindrical behind, but tapered in front towards the head. When fully extended, its length is about two-tenths of an inch. The head is large, horny, and of a pale brownish yellow; the jaws (mandibles) are chestnut brown, robust, acutely pointed, and gradually curved inwards; and their general direction in repose is parallel with the axis of the body. Along the upper surface of the skull is a very distinct longitudinal groove or suture. The color of the body is a semi-transparent, yellowish white, with a darker stomach. Each segment of the body bears upon each side a large, fleshy, acutely-pointed tubercle, directed sideways; by which character this larva may be distinguished at once from those either of the Plum Curculio (*Conotrachelus nenuphar*, Herbst) or of the Plum Gouger (*Anthonomus prunicida*, Walsh); and in addition the last or anal segment bears at each of its hind angles a similar tubercle, directed backwards.

This larva, though legless, walks readily, and, like those of all other beetles known to me, never uses its head by way of foot to assist its progress, as those of almost all two-

winged Midges and Gnats (*Diptera nemocera*) commonly do. Neither does it curl up, belly inwards, in a semicircle, as do the larvæ of many other Snout-beetles, and as does more especially the common White Grub (*Lachnosterna quercina*, Knoch) and its numerous allies. All the specimens seen by me, whether from Ohio or Kentucky, were in green grapes and of a pale color; but Mr. Spaulding, of Cobden, has assured me, that the darker the grape is, the darker the larva becomes.

The Grape Curculio. (*Cœliodes inæqualis*, Say.) Fig. 1. Black, with minute, short, scale-like, appressed white hairs, so as to give the black a grayish tint. *Head*, including the beak, punctured almost as coarsely as the thorax; beak reaching a little beyond the base of the middle pair of legs, nearly cylindrical, curved inwards in a circular arc of about 60°, and sometimes tinged with brick-red. *Thorax* with rather large confluent punctures, its sides converging in a convex quadrant for ⅔ of the way from base to tip, thence to the tip converging very gradually in a straight line. Tip of thorax about ½ as wide as its base, and squarely docked with a slight central excavation (emargination); its anterior edge always more or less tinged with brick-red. A transverse impressed line ¾ of the way from the scutel to the tip of the thorax; and a deeply impressed dorsal longitudinal line, which after crossing the transverse line becomes much fainter. On each side of the deeply impressed part of the dorsal line is a very large rounded tubercle, and outside this, but rather nearer the base, and almost on the lateral edge of the thorax, is a smaller subacute tubercle. Region of the scutel impressed. The *wing-cases* (*elytra*) are slightly freckled with small gray spots caused by the greater denseness there of the scale-like white hairs; their grooves (*striæ*) are punctate with large, widely separated punctures; and the respective interstices between the 2d and 3d, the 4th and 5th, the 6th and 7th, and the 8th and 9th grooves are wider and; especially the first two, more highly elevated and rounded in front than the others. The *lower surface* of the body is punctured like the thorax, but much more sparsely. The legs are of more or less dull brick-red, the thighs unarmed, the four front shanks with a large rectangular tooth near their outer base, the hind shanks unarmed. Near the outer tip of each shank a few stiff, short bristles. Length of the body 0.09 — 0.11 inch.

Described from eleven specimens, bred September 2d - 6th from infested grapes of the same year's growth. Two specimens, captured at large many years ago in Illinois and now in my cabinet, agree in all respects with the others. I had originally referred this species to *Ceuthorhynchus* (*cœliodes*) *curtus* Say, as it agrees pretty well with Say's description of that insect, after inserting a phrase which has apparently, through some clerical or typographical error, been omitted in the printed editions; for otherwise the word "SMALLER" in Say's description is unmeaning and unintelligible. After inserting the omitted phrase in brackets, Say's description would read as follows: "Each side [of which line is a LARGE rounded tubercle, and outside of this tubercle] rather behind the middle is a SMALLER subacute tubercle." But Dr. J. L. LeConte, to whom I have forwarded specimens of this insect, has kindly shown me that this species disagrees in several characters with Schoenherr's more full and elaborate description of the *curtus* of Say, which was probably based upon specimens furnished by Say himself. And as, having in his cabinet a species which he considers as the true *curtus* of Say, he prefers referring our species to the *Ceuthorhynchus inæqualis* of Say, I willingly bow to his authority; though there is the great objection that *inæqualis* is described as "brown" by Say, and this species is most decidedly not brown but black. The size given by Say for *inæqualis* (over 0.10 inch) certainly agrees much better with the *average* size of this species, than the size which he assigns to *curtus* (under 0.10 inch). But, as I have one specimen of this species only 0.09 inch long, and as Say, like too many other entomologists, scarcely ever gives the number of specimens used by him in describing, it is impossible to be certain that he did not describe from a single unusually small specimen. After all, both of these two descriptions of Say's, like the great majority of those that we have to work on in entomology, are so brief and defective, that to determine to which of the two species the Grape Curculio belongs, or whether it really belongs to either of them, is a mere scientific conundrum.

In such a case, the best way is to allow the leading Coleopterist of the country to decide the question and abide by his decision, so as to avoid confusion and the multiplication of synonyms — that curse of descriptive entomology. At all events, I think that the Grape Curculio is now so fully and precisely

described that — no matter what scientific name we may decide to give it — it can never hereafter be mistaken for any other species. So much for this entomological riddle, to solve which with certainty would require a Guessing-machine of 1,000 Yankee power.

In the perfect Beetle state the Grape Curculio will not be easily identified by the inexperienced in such matters, owing to the obscureness of its coloring, the absence of any conspicuous markings, and the fact that many perfectly distinct species — several of which, however, have a characteristic white scutel — resemble it strongly at first sight. But almost all of these last, though they have the same general appearance as the Grape Curculio, yet belong to different genera, the described North American species of the genus (*Cœliodes*) being very few in number. Hence our species may be recognized with tolerable certainty by a remarkable character, peculiar to the genus (*Cœliodes*) and not found in the allied genera (*Phytobius*, *Ceuthorhynchus*, *Mononychus*, *Copturus*, &c.,) ; namely, the rectangular thorn or tooth on the upper and outer edge of the four front shanks (*tibiæ*). For convenience' sake, a greatly magnified figure of the front leg is given in figure 1a, where the reader will see at a glance the nature of this distinctive character. The bristles near the tip of the shank are in nature sometimes obliquely erected, as shown in the engraving, sometimes depressed so as to be almost invisible except under a lens of very high power ; some of the legs in one and the same specimen often having the bristles erect, and others having them depressed. At first sight I supposed that these bristles were a sexual character.

I have shown at great length, in my Papers on Willow-gall Insects, published in the *Proceedings of the Entomological Society of Philadelphia*, that, in the case of many larvæ dwelling in the interior of vegetable substances, and deriving their food from such substances, there are what may be called "Guest-larvæ," belonging to distinct Species, and often to distinct Genera, to distinct Families, and even to distinct Orders of Insects. These last take advantage of the tenement prepared for them by the original inhabitant, who thus becomes their Host, and feed conjointly with him upon the same vegetable food. Technically, such insects are called "Inquilines;" but until I published on the subject, entomologists were not aware how extensively this system prevails throughout the world of insects. From the "Parasites," properly so called, these "Inquilines," or "Guests," as we may call them in English, differ very widely, in that they are normally vegetable feeders, and only occasionally or incidentally destroy the life of their unfortunate Hosts : whereas the true "Parasites" feed exclusively upon the living bodies of their insect victims, and with a few exceptions live inside those living bodies, devouring the flesh piecemeal, although some few of them attach themselves externally to their prey, and gradually suck its life away like so many miniature leeches.* These last, by the way, must not be confounded with what I have called "Cannibal" insects ; for each of these externally-feeding Parasitical larvæ attaches itself to a single victim, which it never quits till it has attained its full growth ; whereas the true Cannibal larva roams hither and thither, and before it attains its full growth will probably have devoured dozens of victims. Hence, by a beautiful provision of nature, all the Parasitical larvæ, whether internal or external feeders, are legless, because they have no occasion for locomotion ; whereas all Cannibal larvæ, inasmuch as they require to move from place to place, are furnished with legs, and are usually pretty strong on the leg besides.

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* I have ascertained that a number of larvæ belonging to the *Chalcis* family have this peculiar habit, and among the *Ichneumon* flies the genus *Ophion* has long been known to feed externally in the larva state.

In two words — to return to our new friends, the Guest-larvæ — the difference between the Guest-larvæ on the one hand and the Parisitical larvæ and Cannibal larvæ on the other hand, is pretty nearly that between an American burglar on the one hand and a Polynesian cannibal on the other hand. The insect Guest and the human burglar desire the goods of their victims, and do not usually take their lives, unless, for the object that they have in view, it is necessary or convenient to do so. On the other hand, the insect Parasite, and the insect Cannibal and the human cannibal desire the bodies of their victims as food for themselves, and are necessarily obliged to slay, because it is only by inflicting death upon others that they can satiate their own carnivorous appetites.

In the case of the Grape Curculio, as in many other such cases, there is more than one species of Guests sponging upon a single Host. I find that two very distinct larvæ — one of them belonging to the same Order as the Curculio, (the *Colcoptera* or Beetles,) but to a very widely distinct Family, the other to an entirely different Order, (the *Diptera* or Two-winged Flies) — occupy the grapes after they have been tenanted by the Curculio, and derive their subsistence therefrom. Whether these spongers upon the fruits of other Bugs' labors dwell as co-tenants with them in the larva state, I do not know. Perhaps they do not; at all events they do not do so for any considerable time. But most certainly the eggs, from which the intruding Guests spring, must be deposited in the infested grape by the mother-insect before the larva of the Curculio leaves it; for my infested grapes contained the Curculio larvæ when I received them from Ohio, and were thereafter isolated in a closed vase, to which the mother of the Guest-larvæ could gain no possible access. As one species of these Guests arrived at the perfect state about 6 weeks, and the other about 11 weeks after the Host, it is likely enough that the eggs of both of them were deposited, in the wounded grape, not very long before the larva of the Grape Curculio was ready to descend to the earth and leave a clear stage for the operations of his successors; and that consequently these eggs did not hatch out till about the time that the spoiled grape was vacated by its original tenant.

The former of the two Guests just now referred to is the Twin-spotted Nitidula (*Stelidota geminata*, Say) — a flattish oval beetle, of an obscure brown color with dull yellow markings, and rather less than one-tenth of an inch long. It belongs to a somewhat extensive group (the *Nitidula* family), all of which feed in the larva state upon decaying animal or vegetable substances, and several of which may be often met with in decaying cheese, old half-picked bones, old sheep-pelts, &c. Of this insect, from some 50 infested grapes, I bred Oct. 12th — 20th no less than 33 specimens. So that manifestly their occurring in such grapes was not a mere casual phenomenon, but part of the regularly pre-ordained system of Nature. Nature, indeed, in whatever direction we turn our eyes, is always economizing and utilizing what would otherwise be uselessly expended, and she cries aloud everywhere to those who know how to interpret her sacred mysteries, that nothing shall go to waste, nothing be lost, nothing be created in vain, whether in the animal or in the vegetable kingdom; and that even death and decay and corruption shall, by her holy alchemy be transmuted everywhere, in the most bountiful profusion, into life and health and happiness.

The second of the two Guests is a species of Midge, belonging to the genus *Sciara* and to the same group of Two-winged Flies as the notorious Wheat Midge, commonly known in Illinois as "the Red Weevil," (*Cecidomyia tritici*, Kirby), and the equally notorious Hessian Fly (*Cecidomyia destructor*, Say). We may call it in English "the Grape Midge." It is a small, slender, long-legged, blackish Fly, measuring to the tips of its wings about one-tenth of an inch, and with no conspicuous markings whatever.

The genus to which it belongs is a rather extensive one, no less than *seven* U. S. species (not *three* as incorrectly stated by Dr. Fitch, *N. Y. Rep.* I. p. 255) having been described by a single author, Thos. Say; and moreover the species are difficult to distinguish from one another, owing to the monotonous uniformity of their coloration.* I think that my grape-inhabiting species is probably identical with the Fickle Midge (*Sciara* [*molobrus*] *inconstans*) of Dr. Fitch, which is described by him as making its appearance at the same unseasonable time of the year—the latter part of December—and as running about in the same fickle, rapid, restless manner as I have observed mine to do. Of this Guest-fly, from the same lot of about 50 infested grapes from which I had previously bred the Grape Curculio and the Guest-beetle, I obtained November 19th–29th, no less than 35 specimens; and probably, owing to their lively movements, about as many more escaped out of the breeding vase, when from time to time I opened it in order to catch them. As to their habitually living in these infested grapes, the observations already made with regard to the Guest-beetle apply with two-fold force, inasmuch as they were about twice as numerous as the Guest-beetle.

It is worthy of remark, as illustrating what I have called the "Unity of Habits" in the same genus of insects, that another species of the same genus, the Apple Midge (*Sciara* [*molobrus*] *mali*, Fitch) was found by Dr. Fitch to be a Guest in apples infested by the common Apple-worm (*Carpocapsa pomonella*, Linnæus), and to appear in the winged state at the same inclement period of the year as my Grape Midge, namely in February.

Fruit-growers must observe carefully the important practical point, that NONE OF THESE GUESTS DO THEM ANY HARM. It is the Grape Curculio, for example, that in the first instance attacks the berry; and after the berry for all practical uses is ruined, the Guests merely pick up the stray crumbs that fall from the Curculio's table, and clear away from off the face of the earth decaying vegetable matter, that would otherwise become putrid, unwholesome and offensive. To make war upon the Guests would therefore be as irrational, as for a sheep-grower to shoot the turkey-buzzards that are feeding upon the dead carcasses of his sheep, and overlook the bloodthirsty curs that in the darkness of night had carried death and destruction among his flocks.

Nothing is more common among young entomologists than to jump to the conclusion that, merely because they breed a certain insect from some vegetable organism which has manifestly been destroyed by insects, therefore the bred insect is the author of the mischief. No mode of reasoning can be more unsafe and unsound. The bred insect

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*Having found the descriptions of Say's seven species and Fitch's five species of this genus very unsatisfactory, and being unable to separate into distinct species scores of specimens which I had captured at different times, though, by way of guide, I had, besides the "Grape Midge," considerable numbers of two distinct species which I had formerly bred from larvæ found in decaying wood, I sent specimens of the "Grape Midge" to our great N. A. Dipterist, Baron Osten Sacken, with a request that he would, if possible, determine the species to which it rightfully belonged. For the benefit of young entomologists, I give his reply in this note, without making any alteration in my text. He had previously expressed to me the same opinions with regard to the allied genus *Ceratopogon*, and I have myself published nearly the same views with reference to another allied genus, *Cecidomyia*.

"Your fly is certainly *Sciara*, but the species is indeterminable. I would not give anything for the determination even of a European *Sciara*. It is a difficult genus which has never been satisfactorily studied. The number of species seems to be very large, their coloring uniform, and their characteristic marks unknown. One does not know what to take hold of in describing such a species."

may be, and very frequently is, a Guest; and the Host, who is the real guilty party, may be entirely unknown to them. Or, what is still more common, the bred insect may be a Parasite, feeding upon the body of some unknown species that had originated the damage, and consequently not our foe but our friend. To solve satisfactorily such questions as these, requires careful and long-continued observation and experiment, and an extensive familiarity with the habits and peculiarities of insects. And even then the very best and most careful entomologists will sometimes be led into error. For although it is a very general rule that species belonging to the same Family of Insects have the same general habits, yet every now and then certain remarkable exceptions to the rule are brought to light. For example, I have myself bred almost a hundred different species belonging to the great *Chalcis* family (Order *Hymenoptera*), which I know to be parasites; and hundreds of others peculiar to Europe have been ascertained by European entomologists to be also parasitical in their habits. Hence it was supposed formerly that all *Chalcis* flies without exception were parasites. But there is now no doubt that, as Dr. Fitch asserted long ago, the true author of what is known as "joint worm" in Virginia wheat and in Massachusetts and New York barley is a veritable *Chalcis* fly. So that in reality, although the great *Chalcis* family is almost universally carnivorous in its habits, it yet contains at least one species which feeds exclusively upon living vegetable matter.

To return to the Grape Curculio. The practical question still remains to be discussed: "How are we to get rid of it?" I think that, beyond all question, the mother-beetle, if carefully looked for, will be found laying her eggs in the young grapes some time in June. From the accurate figure given herewith, and from what has been already said, the species may, I think, be recognized with ease by the vineyardist; though, after it has fallen to the ground, it will hide its beak in the groove along its breast expressly provided by nature to receive that very organ, and fold up its legs so close to its body that it looks exactly like a round, black seed. In this position, as it "plays 'possum" and shams dead for a minute or two after it has fallen, it would never be suspected of being a living animal by the unwarned and inexperienced. The Grape Curculio should therefore, in localities where its evil works have been already noticed in preceding years, be watched for in June; and as soon as it appears, shaken off the vines upon a white cloth, or — what will be found perhaps still more convenient — into something like an inverted umbrella, lined with white cloth, but modified in shape so as to suit the mode of training the vines which may in each case be practised. The least touch will fetch them off the vines; for this whole group of roundish Snout-beetles (genus *Ceuthorhynchus* and its allies) drop to the earth when alarmed more readily even than the Plum Curculio. Indeed, I have repeatedly observed that they will often drop as soon as they see you looking at them, although the plant on which they are sitting be not touched at all.

The Grape-grower will perhaps exclaim that the woods must be full of this Grape Curculio, and that it will be no use killing a few scores of them off his grapevine because myriads of others will fly in upon him from the forest. I can assure him that this is not so. The Grape Curculio is comparatively a rare insect, though, like many other rare insects, nature occasionally concentrates it in considerable numbers for a particular object upon a particular point, i. e. the fruit-bearing grapevine. For ten years I have been collecting insects in various parts of Illinois. I have in that time beaten into my net thousands of wild grape-vines, to say nothing of forest trees growing in the immediate neighborhood. Yet in all those ten years I never captured but two poor s

itary specimens of my newly-discovered little friend, the Grape Curculio. Moreover, Dr. J. L. LeConte tells me that, until I supplied him with some additional specimens, he had but two representatives of this species in his whole collection of N. A. Beetles, which, so far as regards the number of species, is well known to be the most extensive of any in the country.

It is, indeed, undoubtedly true that, if a vineyardist is surrounded by other grape-growers and all their vines are infested by this Curculio, it will be comparatively but little use for him to destroy the Curculio upon his own vines, unless he can also persuade his neighbors to do the same. For his little black enemy has got good long black wings of his own, and can fly with ease from one vineyard to another, although undoubtedly he is not by any means as strong on the wing and as fond of flying as a Bee or a Butterfly. Still, this only proves the absolute necessity of fruit-growers becoming familiar with the habits of their insect foes, and of their making war upon them systematically and generally. For attaining these two objects, nothing can be more practically useful, than those organized Associations of practical and intelligent fruit-growers, which are now happily becoming so common in all the great fruit-growing regions of the United States.

INSECTS INFESTING THE GRAPE. — On the Leaf.

CHAPTER II.—The Grape-leaf Gall-louse. (*Dactylosphæra* vitifoliæ*, Fitch.

This is the insect which Dr. Fitch described long ago under the above specific name, though it most certainly does not belong to the genus of Plant-lice (*Pem-*

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* The genus, *Dactylosphæra* was proposed by Dr. H. Shimer, of Mt. Carroll, Illinois, in a short Paper, published in *Proc. Acad. Nat. Sc.*, Jan., 1867, pp. 1–9. I adopt this generic name, simply because the group of insects to which this species belongs, forms, in my opinion, a very distinct and a very anomalous genus of the Bark-louse (*Coccus*) Family, and there is no other name for it extant. Why this genus of Insects ought to be referred to the Bark-louse (*Coccus*) Family, rather than to the Plant-louse (*Aphis*) Family, I long ago explained. (See *Pract. Entom.* II., p. 19, and *Proc. Ent. Soc. Phil.* VI., pp. 283–4, notes.)

To this new genus of his, Dr. Shimer refers, not only the insect which forms the subject of this chapter, but also a mythical and entirely imaginary species — *Dact. globosa*, Shimer — which he has concocted by taking the wingless individuals of the Bark-louse of a very small Hickory-gall (*Caryæ semen*, Walsh MS., *Proc. Ent. Soc. Phil.*, VI., p. 283,) and the winged individuals of the Plant-louse of a much larger and very distinct Hickory-gall (*Caryæ globuli*, Walsh, *ibid*, I., p. 309,) and assuming, *without a particle of proof*, that the latter are the winged males of the species to which the wingless females of the former appertain. And yet, even according to his own account, (p, 2,) the galls containing these so-called males are "0.25 inch, and even more, in diameter," while the galls containing the wingless females are according to him, only "0.09 — 0.14 inch" in diameter, and, in reality, are still smaller than he represents them to be, ranging from 0.06 to 0.10 inch in diameter; and, moreover, as will be shown below, the two galls differ by a very remarkable structural character. It is a very suggestive fact, too, that the large galls, containing the so-called males, occur abundantly and commonly on the Shellbark Hickory and but in small numbers and rarely on the Pignut Hickory; while the galls containing the so-called females of what is supposed to be the same species occur exclusively on the Pignut Hickory, and in the most exuberant profusion. Whereas, if these two galls appertained to the same species of insect, on whatever species of Hickory one of them was found, the other one would be found there also, and, in all probability, always in the same relative proportion.

If any one doubts the validity of the above statement, he has but to refer to the figure of the wings of the so-called male *Dact. vitifoliæ*, in Dr. Shimer's Paper (fig. D., page 1); and he will see at once that

phigus) to which he referred it, nor even, in my opinion, to the Plant-louse Family but rather to the Bark-lice. It causes on the lower surface of the leaves of the grape vine immense numbers of green, fleshy excrescences, about the size of a small pea. was the first to observe, in the columns of the *Practical Entomologist*, that it does no attack indiscriminately all our native and cultivated grape-vines, but is peculiar to th Frost Grape (*Vitis cordifolia*) and to a small number of our cultivated varieties, namely the Clinton, the Delaware, and, according to Mr. George Husmann, of Missouri, th Taylor. Dr. Morse, of Missouri, who has had great experience with the grape, confirm the truth of the above assertion, and informs me that in Missouri the Delawares ar sometimes covered with these galls, so as to injure them greatly, and that he has occa sionally seen a few of these galls even on the Iona vine, which, according to Mr. Willian Saunders, is a variety of the Northern Fox Grape (*Vitis labrusca.*) One of my corres pondents has informed me, that a whole vineyard of Clintons near Bloomington, in Cen tral Illinois, was destroyed by this insect in 1866; and it is undoubtedly this variety o the cultivated grape that is the most subject of any to its attacks. Even at such remote point as Clinton County, in the North West corner of Missouri, the Clintons ar reported as "not doing well" on account of their leaves being covered with these galls (*Agricultural Report Missouri, Appendix*, p. 135–6.) What is very remarkable, and wel illustrates how certain species of insects swarm periodically and then are not heard o

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it displays the unmistakable wing-neuration of the genus of Plant-lice which Dr. Fitch considered probably identical with the European genus *Phylloxera*, (see my fig. of it, *Proc. Ent. Soc., Phil.*, I., p. 29 fig. 8) — which I have since proposed to name *Xerophylla* (*ibid.* VI., pp. 282–3, note) — and to which th Plant-louse of my *Caryæ globuli* gall belongs. This figure of Dr. Shimer's, it may be added, is total unlike a drawing of the wings of the veritable male *Dact. vitifoliæ*, which was kindly executed for m by Mr. Cresson, from specimens presented to the Entomological Society of Philadelphia by Dr. Shim himself, and which drawing I sometime ago communicated to Baron Osten Sacken. For, in this las the neuration of the front wing is almost exactly identical with that of a male Bark-louse (see West *Introd.*, II., p. 443, fig. 7), and the hind wing lacks entirely on its front margin the characteristic hoo to fasten on to the hind edge of the front wing, which is found in all the genera of Plant-lice with whic I am acquainted. Dr. Shimer, indeed, lays great stress upon the absolute necessity of such drawing being executed from the living or recent insect. (Page 5, note.) So far as regards the *body* of th insect, this is true enough; but every entomologist knows, that the *wings* of any insect can be draw just as accurately from the dried as from the recent specimen.

With similarly unfortunate results, this same author has recently re-described and re-named, *Hamamelistes cornu*, a gall-making Plant-louse (*Hormaphis hamamelidis*, Fitch), which had been alread named and described twice over many years before he wrote — namely, once in 1851 by Fitch, and on in 1861 by Osten Sacken — and to receive which Osten Sacken had very properly founded the gen *Hormaphis*, of which Dr. Shimer's so-called new genus *Hamamelistes* is a mere synonym. It is ve true that we are all of us liable to such oversights, when the book in which a supposed new speci has been already described is out of print, or very rare, or only to be met with in foreign countri But, in this particular case, all the details, which prove the above facts, were collected together a published by myself eleven months before Dr. Shimer himself published, *and in the very work in whi he himself published*, which can be procured by any one, with the greatest ease, by paying the ve moderate price demanded for it. (Compare my Paper, *Proc. Ent. Soc., Phil.*, VI., p. 281 and Dr. Shime Paper, *Trans. Am Ent. Soc.*, I., pp. 283–4.)

In order to clear away as much as possible the mystery in which Dr. Shimer has enveloped this ve interesting subject, I annex, from my Journal, a full account of the Bark-louse Hickory-gall, whi I had referred to, as quoted above, under the MS. name of *Caryæ semen.* I am now acquainted in a besides the Grape-leaf gall *Vitifoliæ*, Fitch, with three very distinct galls on the Hickory, all apparent formed by this same genus of Bark-lice (*Dactylosphæra*); namely, *Caryæ semen*, new species on t Pignut Hickory (*Carya glabra;*) *Caryævenæ*, Fitch, on the Shellbark Hickory, (*Carya alba;*) and

for years : — Although in 1866 these leaf-galls covered the leaves of the wild Frost Grape and of the cultivated Clinton near Rock Island, Illinois, and, so far as I could hear, throughout the State, yet in 1867 on the most diligent search not a single one was to be found, even on vines which had swarmed with them in the preceding year.

Previous to what I published on the subject, authors had always supposed that this Gall-louse attacked indiscriminately all kinds of grape-vines. I was led to remark that it was not so, because I had discovered it to be a general, though by no means a universal rule, both with Plant-lice (*Aphis* family) and with Bark-lice (*Coccus* family,) that the same species of insect is confined to the same species of plant. Even when a species, belonging to one of these two families of insects, inhabits promiscuously two or more species of plants, these plants will usually be found to belong to the same botanical Genus, and invariably to the same botanical Family. We shall meet with another illustration of the practical importance of attending to this law of nature, when we discuss the history and habits of the Apple-root Plant-louse in chapter 10.

Mr. William Saunders, in an excellent article on the Mildew of the Grape, has asserted that the Delaware is a hybrid between the Northern Fox Grape and the Summer Grape (*Vitis æstivalis.*)* If a bug-man may venture to dispute the opinion of a plant-man, I should infer that as neither of the above two wild grapes are subject to these leaf-galls, so far as I know and as the Frost Grape notoriously is, the Delaware, which I have

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undescribed species, *Caryæ fallax*, Walsh MS., with a strong external resemblance to the Plant-louse Hickory-gall, *Caryæfoliæ*, Fitch, but opening, not above, as is always the case with that gall, but invariably below. This last gall I found June 17th–29th, 1867, absolutely swarming on the leaves of a bush of the Shellbark Hickory. In none of these three Hickory-galls, though I have opened hundreds of each of them, have I ever yet met with the winged males; and in the Grape-leaf gall the males are equally scarce.

Gall CARYÆ SEMEN, new species, made by *Dactylosphæra caryæ-semen*, new species. On the general surface of the leaflets of the Pignut Hickory (*Carya glabra,*) in prodigious abundance, a subglobular, smooth, seed-like, hollow, sessile gall, 0.06–0.10 inch in its widest diameter, sub-hemispherical above, rather flatter below, with a nipple-like opening in the middle. Walls of the gall rather stout, fleshy and not woody. The external color is greenish-yellow above, and pale green below, with the open central nipple whitish. There are frequently as many as one hundred of these galls on a single leaflet. Inside may often be found as many as three or four mother bark-lice, similarly shaped, and of the same yellow color as those of the *Vitifoliæ* gall, but, on the average, rather smaller, and accompanied in the same manner by eggs or very young larvæ, or both. As with the mother bark-lice of the galls *Vitifoliæ* Fitch, *Caryævenæ* Fitch, and *Caryæfallax* Walsh MS., the antennæ of this mother bark-louse are three-jointed, joints one and two short and sub-equal, and joint three longer than one and two put together. The young larvæ are about 0.01 inch long, and of the usual shape. Almost as soon as hatched — as is also the case with the larvæ of all the allied galls — these larvæ stray away to found new galls. The galls themselves are very abundant about July 24th, but by August 12th they were almost all empty and gaping open below. Out of twenty or twenty-five examined at this last date, all but one were empty, and that one contained only a single bark-louse egg. The gall-insect is infested by a Mite (*Acarus* family) and also by a *Chalcis* fly.

This Bark-louse gall may be readily distinguished from the Plant-louse gall, *Caryæ globuli*, Walsh, with which Dr. Shimer has unaccountably confounded it, not only by its being only one-third or one-fourth as wide across, but by opening below with a roundish, nipple-like hole, whereas the latter opens below with an elongated slit. (See *Proc. Ent. Soc. Phil.* VI. p. 275) Moreover, the former almost always contains eggs, the latter never; because the Bark-louse is oviparous, and the Plant-louse, at all events, so long as as it remains in the gall, is invariably viviparous.

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* Mr. Saunders' article may be found in the *Monthly Report of the Agricultural Department*, 1867, p. 333.

found to bear these leaf-galls only to a limited extent, is a hybrid between the Northern Fox Grape and the Frost Grape. Certainly its botanical characters seem to me to be intermediate between these two species.

The practical lesson to be drawn from the above theory is, that where two varieties of cultivated grape are in other respects equally desirable, and equally suited to the soil and climate of the vineyardist — say, for instance, the Clinton and the Concord — the Concord should be preferred, because, being a variety of the Northern Fox Grape, it never bears these leaf-galls, any more than the wild species from which it took its origin; while the Clinton, being a variety of the Frost Grape, is often grievously afflicted with them, like the source from which it sprang.

CHAPTER III. — The Rose-bug. (*Macrodactylus subspinosus*, Linnæus.)

In particular seasons, as is well known, and in particular localities, this insect occurs in prodigious swarms, and gathers upon grape-vines so as to strip them almost entirely of their leaves. The only known remedy that is practically available, is to jar them off the vines and kill them; and of course, if we can induce them to concentrate their forces upon one particular vine and leave the rest alone, the labor of destroying them will be very greatly diminished.

Luckily for the grape-grower, this can be done. There is concurrent evidence from a great number of different sources, that the Rose-bug prefers the Clinton to all other cultivated varieties, and will gather upon that and leave the others unmolested. In proof of this assertion, I quote the two following passages from among a number of similar ones, the first from the Report of the Winter Meeting of the Fruit-growers' Association of Western New York, Jan. 23d, 1867, the second from the *American Journal of Horticulture*, Sept. 1867, p. 163.

"F. C. Brehm thinks the Clinton the best vine to draw rose-bugs from other vines and keeps one in his garden for that purpose."

"When I saw a paragraph in a Horticultural Paper, advising grape-growers to keep one vine of the Clinton in the garden for the use of the rose-bugs, I thought it merely a feeble joke; but experience teaches me that it is no joke at all. I have a Clinton vine at a little distance from a dozen other kinds, and its leaves are entirely riddled by the Rose-bugs; while I have not found six bugs on the other varieties, and none at all on the roses. I pity the want of taste displayed by the bugs, but am glad to find that the Clinton is good for something. —— Since writing the above, I have found bugs in abundance on the Franklin; but that only strengthens the case; for the Franklin is much like the Clinton and just as worthless." J. M. M., Junr.

INSECTS INFESTING THE GRAPE. — On the Root.

CHAPTER IV. — The Grape-root Borer. (*Ægeria polistiformis*, Harris.)

This insect, which strikingly resembles the common Peach Borer, (*Ægeria exitiosa* Say,) in all its stages, both in size, in shape, and in the general style of its coloration was observed fifteen years ago by Dr. F. J. Kron, of Albemarle in North Carolina, to be very destructive to the cultivated grape-vines there. I see from the *Monthly Report of the Agricultural Department* for 1867 (pp. 329 — 330), that Mr. H. J. Krone, of the same place — who may probably be a relative of Dr. Kron's, though his name is printed with an E at the end of it — "gives discouraging reports about the destruction of grape

vines in that region" by this same Borer in 1867. In the same *Monthly Report* it is stated that "a correspondent in Cincinnati writes that a new enemy has attacked the grape-vines in that vicinity, and describes its work as similar to that of the North Carolina *Ægeria polistiformis.*" Lastly, in the summer of 1867, Mr. C. S. Jackson, of Danville, Kentucky, sent me specimens of the larva of this very same insect, along with pieces of the grape-vine roots on which it was operating. "Here in Central Kentucky," he says, "I have noticed, for a year or two past, spots throughout the vineyards suffering from decay; and where the vines are taken up and examined, this worm is found on almost every root."

Now, Danville in Kentucky lies about a hundred miles to the *south* of Cincinnati, Ohio, but it actually lies about ten miles to the *north* of Cobden, in Illinois, where grape-vines are beginning to be grown pretty extensively. Consequently, even if it should turn out that the Cincinnati correspondent of the Agricultural Department has raised a false alarm, yet as this pernicious borer indubitably exists in large numbers at Danville, there is a reasonable probability that it may within a few years, now that grapes are being grown so extensively, spread from that point into Southern and Central Illinois. It may perhaps have even done so already. Hence it appears to be a useful precaution to describe the insect and its operations in such a manner, that it may be recognized at once, wherever and whenever it may occur, by our Illinois grape-growers; more particularly as, being hitherto considered an exclusively Southern insect, it is entirely unnoticed in Dr. Harris's excellent book on *Injurious Insects*, and only receives a passing notice of eight lines in Dr. Fitch's very useful *Reports on the Noxious Insects of New York.*

Unlike the common Peach Borer, this larva lives exclusively underground, the mother-moth depositing her eggs on the collar of the grape-vine close to the earth, and the young larvæ, as soon as they hatch out, immediately descending on to the roots. They seem to confine themselves entirely to the bark and sap-wood of the roots, leaving the heart-wood untouched, which of course renders their operations much more destructive to the life of the vine. The roots that I received from Kentucky were internally sound and solid, but externally they looked all of them as if a drunken carpenter had been diligently scooping away the sap-wood with a quarter-inch gouge, almost their entire surface being furrowed by crooked and irregular channels, semicircular in their outline if a cross-section of them was made, inside some of which lay the larvæ, with their naked backs touching the surrounding earth. According to Mr. Krone, however, "the larva working underground mines and destroys the vine-roots, and *being shielded by the bark* defies the action of remedies for its extermination." When full-grown these larvæ measure from 1 inch to 1¾ inch in length; and are whitish, elongate, 16-legged grubs, scarcely distinguishable from those of the Peach Borer. Like that insect, they form an oval, pod-like cocoon of a gummy substance covered with little bits of wood and dirt, inside which they pass into the pupa state. These cocoons may be met with at various times through the summer near the roots of the infested vine; and, as is also the case with the Peach Borer, the Perfect Moths make their appearance above ground at various times through the summer. According to Dr. Kron, they are found about the vines and on the wing in North Carolina from the middle of June to the middle of September, during which time they couple and lay their eggs. The following description of the Moth, which I have not yet succeeded in rearing, is copied from Harris, (*Rep. Am. Pom. Soc.*, 1854, p. 10.)

"The moth of the Grape-vine Borer has a body of a dark brown color, more or less tinged with a

tawny orange on the sides, and banded with bright yellow upon the edge of the second ring of the hind-body. The thorax and shoulder-covers, and the fourth ring of the hind-body, are more faintly edged with yellow, or with tawny orange. The feelers, antennæ beneath, and legs are also orange-colored; the fore-wings are dusky; the hind-wings transparent, but varied and edged with black. The female has a little orange-colored tuft on each side of the tail, and the males have two tufts on each side, the middle pair longer than the others. The males are more numerous, more active, and smaller than the females; they measure from 0.50 to 0.60 inch in length, and their wings expand from 1 inch to 1.15 inch. The body of the female varies from 0.60 to 0.90 inch in length, and her wings expand from 1 inch to 1.50 inch."

The curious reader, who has noticed just now that I said that the Grape-root Borer was briefly referred to by Dr. Fitch, will perhaps be astonished, on referring to that gentleman's *New York Reports*, to find that no such insect as *Ægeria polistiformis* is to be met with, in any of the three indexes attached to the three volumes of those *Reports*. It may perhaps be worth while to explain this little scientific mystery. After the term "Ægeria" had been applied by the European entomologist Fabricius in the year 1807 to the genus of insects, to which both the Peach Borer, the Squash-vine Borer, and the Grape-root Borer belong, and had been universally current in the scientific world for half a century thereafter, some indefatigable genius, rummaging among old books, discovered that another European entomologist, Scopoli, had given the name of "Trochilium" to the same group of insects in the year 1777, or 30 years *before* Fabricius's name, was published. Hence, according to what is called "the law of priority," the name "Trochilium" has now very generally taken the place of the name "Ægeria;" and the very same insect which in 1854 Dr. Harris designated as *Ægeria polistiformis* was in 1856 designated by Dr. Fitch as *Trochilium polistiforme*. If the rules of nomenclature, promulgated long ago by the British Association for the Advancement of Science, had been regarded in this case, the term "Ægeria," having been once universally adopted, would never have been changed. But unfortunately these rules have been too generally neglected, and the "law of priority" has been for many years back enforced with the utmost rigor in the scientific world. Hence scientific phraseology is in a perpetual state of flux, chopping and changing about from year to year, as often as some obscure writer, whose writings perhaps are not worth one cent, but who had the good fortune to be born before his betters, is discovered to have named a genus or a species before the author of the current name published that name in the scientific world. The inevitable consequence is, that a great deal of valuable time, that might be usefully expended in studying out scientific *facts*, is frittered away in studying out scientific *phrases;* and an entomologist, who would keep up with the age, has to be perpetually altering the names in his cabinet, without himself gaining thereby one single new idea, or adding one iota to the general fund of scientific knowledge. To my mind, the naturalist who rakes up out of the dust of old libraries some long-forgotten name, and demands that it shall take the place of a name of universal acceptance, ought to be indicted before the High Court of Science as a public nuisance, and on conviction sent to a Scientific Penitentiary, and fed there for the whole remaining term of his scientific life upon a diet of chinch bugs and formic acid.*

*On this vexed question Dr. Schaum has the following excellent remarks:—"I am much opposed to the adoption of these obsolete names, which Mr. Dawson has substituted for the well-known and generally adopted appellations, in right of priority. * * If we cultivate Entomology for the sake of knowledge, and not for the sake of nomenclature, I can see no benefit arising from an enquiry into the data of the synonyms compiled (and very often erroneously compiled) by Schœnherr, but on the contrary

All underground insects are peculiarly difficult to combat, 1*st*, because the mischief done by them is generally discovered too late for any remedy to be applied, and 2*nd*, because entomologists know less of the Natural History of this group of insects than of that of almost any other group, owing to their being so secluded from observation and experiment within the bowels of the earth. In the case of this Grape-root Borer the only *direct* remedies that Science can at present indicate are, to dig up all the roots of vines known or suspected to be infested by it, destroying carefully all the larvæ and cocoons found thereon, and to catch and destroy all the winged moths noticed round the vines, so as to check the farther multiplication of the species. There is a *preventive* remedy, however, which, in the event of this insect ever becoming unbearably numerous in Illinois, can be resorted to with the fullest confidence in its success. Both Dr. Kron and Mr. Krone have ascertained by long observation and experiment, that the Scuppernong grape-vine — which is a cultivated variety, according to Dr. Asa Gray, of the wild Southern Fox Grape (*Vitis vulpina*) — is entirely exempt from the operations of this Borer; and the former gentleman has been successful in grafting both the European Grape (*Vitis vinifera*) and many of our cultivated North American varieties upon Scuppernong stocks, and has found that he thereby entirely escapes the ravages of the Borer. I do not find that this Southern variety of grape has hitherto ever been grown in Illinois; but there can be little doubt that it would stand the climate, at all events of Southern Illinois, *as a stock;* and, if the worst comes to the worst, rather than give up growing grapes, we shall have to fall back, as our last resource, upon Scuppernong and Southern Fox Grape stocks for all our cultivated varieties of the grape.

Since the above was written, Mr. Geo. Husmann, the Missouri King of the Grapes, has obligingly informed me that he "has had the Scuppernong on his grounds at Hermann, Missouri," which lies over 100 miles to the north of the latitude of Cairo, Illinois, "for 15 years; that it has fruited there several times, but that the fruit is entirely worthless." He adds further that this Grape-root Borer "has been familiar to him for the last 15 or 20 years, and that it now and then destroys a vine in the vineyards in his vicinity, but does not seem to increase."

INSECTS INFESTING THE APPLE. — On the Fruit.

CHAPTER V. — The Apple-worm or Codling-worm Moth. (*Carpocapsa pomonella*, Linnæus.)

Both Harris and Fitch seem to doubt the fact of there being two distinct broods of this insect every year, the one generated by the other, although Kollar and other European writers assert that it is so in Europe. Possibly Harris & Fitch may be right, as regards the more northern latitudes in the United States; but in the latitude of Rock Island, Illinois (41°, 30′) I am satisfied that there really are two distinct broods, for the following reasons: —

1st. On July 18th and 21st, I cut into 70 windfall apples bored by this insect, and

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a waste of time which can be better employed in exact observations. What we want for the sake of knowledge is *stability and uniformity* of nomenclature, not an upsetting of it by the substitution of old forgotten and very doubtful names, published in works without, or with but little, scientific merit." Stainton's *Ent. Ann.*, 1860, pp. 121 — 2.

found larvæ in but three of the 70. Subsequently about the middle of August I cut into a large number, and found larvæ in almost every one.

2d. On August 22d I cut into an apple, that was very extensively bored and had manifestly raised a larva to maturity. Yet it contained a very small larva, only three-sixteenths of an inch long, and altogether too young to have devoured so much of the core and pulp of the apple. Hence it is plain that, after the first larva had made its exit, an egg was deposited on this apple, from which proceeded a second larva.

3d. I have repeatedly, from apples, pears, and even crab-apples, of the same year's growth, raised the winged moth in the latter end of July and the forepart of August. Now, if such moths generate at all, where can they lay their eggs, except in the fruit of the same year's growth, which presupposes a true second brood? Unless indeed we assume that they live in the moth state from the latter end of July and the forepart of August all through the winter and until the following June, which can scarcely be believed. If, on the other hand, they do not generate at all, then nature has made them in vain, which is incredible.

4th. On Oct. 23d, I found 7 or 8 cocoons of this insect, in the crotches of a badly infested tree, among the loose scales. On being broken open, they were found to contain the larva still unchanged into pupa. Consequently, these were evidently destined to pass the winter in the cocoon, and come out in the moth state in the following June, in time to lay their eggs in next year's crop of apples.

On the whole, although the two broods run into one another by scattering individuals generated unusually late or unusually early — as is often the case with species proved to be really double-brooded, for example, with the imported Gooseberry Sawfly (*Nematus ventricosus*, Klug) — yet the great bulk of the later individuals must be generated by the earlier individuals, and the earlier individuals must be generated by those that had passed the preceding winter in the cocoon, and did not assume the winged state till some time in June. In other words, the species is "double-brooded," as it is called.

The practical inference to be drawn from the above is, that a fruit-grower must not believe, because a certain tree is entirely free from apple-worms till the end of July, that therefore it will be safe from them for the rest of the year. Such a tree may be, and often is, attacked by the second brood of this insect in the latter part of the summer, when the apples are quite large; and it is these infested apples that often hang on the trees to the last and ripen, whereas those infested by the earlier brood are, as a rule, too small and puny to withstand so extensive an erosion, and mostly fall to the ground. I have observed that, where early and late apple-trees grow on the same spot of ground, the early brood chiefly attacks the early fruit, and the late brood the late apples. A shoemaker or a tailor or a blacksmith would probably not be able to distinguish one kind of apple from another when they are both immature; but the mother Codling moth, as it appears, distinguishes them with ease. And yet almost any mechanic would tell you, that one of these despised "bugs" is as much a mere unthinking machine, as the awl or the needle or the anvil that he himself works with!

Almost universally, there is but a single larva in a single apple at one and the same time. But on August 15th, I found a windfall which contained *two* larvæ, one of which had evidently entered at the calyx or blossom end, and the other at the foot stalk. I have noticed a few specimens where the egg had been attached to the cheek of the apple, and the young larva that hatched out from it had made its entry there. And I have also observed that, where two apples hang so as to touch one another, the larva bred in one of them will sometimes be depraved enough, in the mere wantonness of

power, to bore out of it into the adjoining fruit, though there is an abundance of food remaining for it in its original home. Probably, on careful search, similar cases of wanton destructiveness might be met with in the human species.

Others as well as myself—Dr. James Weed, for example, of Muscatine, Iowa—have observed that the larva of this insect often leaves the apple, *before* that apple falls to the ground. Consequently the gathering up and destroying windfalls, either by man-power or hog-power, though an excellent prescription so far as it goes, is not an infallible panacea.

After all, the best and most reliable remedy, so far as my limited experience goes, when we have palliated the evil by destroying the wormy windfalls day after day, is Dr. Trimble's hay-band system; which should be commenced about July 15th and continued till about Sept. 15th, looking under the hay-bands every day or two for the cocoons. The cocoons themselves may be readily recognized by their being composed of a gossamer-like, filmy, white silk, inside which the larva or pupa will be found. On this important subject, I append the following passage, which I find in the *Western Rural* of Nov. 9, 1867.

"A correspondent of the *Country Gentleman* states that, in the orchard of Dr. Trimble, of New Jersey, he had an opportunity of witnessing the efficacy of what he calls 'Dr. Trimble's remedy for the apple-worm.' Hay-ropes had been wound around the trunks of the trees, and large numbers of insects had been caught, some of which had attained the pupa state, while others having only just reached their hiding-place were still larvæ. The whole number of insects caught on one tree during the season amounted to a thousand. Trees, which formerly had nearly all their fruit destroyed, were, under this treatment, bearing very fair crops. A complete extermination could not be expected, while the neighboring fruit-growers took no precaution against the insect. Dr. Trimble applies two belts or bandages, one of them two or three feet high and the other higher. He thinks that the worms under the higher belt descend the tree before the fruit drops, and those under the lower crawl up from the fallen fruit on the ground."

It must not be supposed that, because this insect has swarmed so prodigiously in 1867, therefore it will necessarily be as numerous, or even still more numerous, in 1868. In 1865 it abounded near Rock Island and elsewhere; yet in 1866, in the same localities, it was very scarce and did no appreciable damage. In 1867, on the contrary, I can hear of but two States—Kansas and West Virginia—in the northern half of the Union, where it has not been more ruinously destructive than was ever known before.

The Pear, being so closely allied to the Apple, has, as we should naturally anticipate, been extensively attacked by the Apple-worm in 1867. Harris merely observes that "the worms, often found in summer pears, *appear* to be the same as those that infest apples." But, from a lot of infested pears sent me from Philadelphia, under the idea that they contained a peculiar species, I have myself bred the veritable Codling Moth; and before I had bred it, I assured my correspondent that the larva was identical with that of the Codling Moth. Mr. Parker Earle, President of the Fruit-growers' Association of Southern Illinois, informs us in his Annual Address to that Society in 1867, that "in many sections of country nine-tenths of the pears are reported as ruined by the Codling Moth in 1867."

CHAPTER VI.—The Apple Maggot Fly. (*Trypeta pomonella*, Walsh.) Fig. 2.

In Illinois the fruit of the apple-tree is at present bored up only by the Apple-worm,

in the Natural History of which we have just been investigating some few points. In Massachusetts, in Connecticut, in New York, and probably in Vermont also, it has for the last few years been troubled, in addition, by a still more destructive pest, popularly known as "the Apple-maggot." The Apple-worm is an imported species, probably introduced into the Eastern States from Europe about the commencement of the present century, and has only penetrated into Illinois within the last ten or fifteen years. The Apple-maggot, on the contrary, is a native-American species, which naturally feeds upon our native haws or thorn-apples and probably upon our native crabs also, and which I know to have existed in the State of Illinois for at least five or six years.* In the Eastern States, from unexplained causes, it has within the last few years acquired the habit of attacking the cultivated apple, as well as the wild haw, and has, by the laws of inheritance, transmitted that habit to its descendants, who have reveled in the foreign delicacy, and increased and multiplied at a prodigious rate, till they have become almost an unbearable nuisance. In Illinois, on the contrary, so far as I can learn, the species has never yet acquired this peculiar habit, and perhaps may never do so. But there can be little doubt that the descendants of the improved and highly-civilized apple-maggots in the East will, in process of time and by slow degrees, spread gradually to the West; or they may be suddenly introduced in a barrel of Eastern apples into some point at the West, and thence radiate in all directions and colonize the country. What is very remarkable, the species is new to science, and was briefly described by myself for the first time in the *American Journal of Horticulture* for December, 1867 (pp. 338—343.) How I obtained the requisite facilities for investigating its history, and what is its peculiar mode of operating upon the apple-crop in the East, I will now proceed to explain.

The following paragraph appeared in the *Circular* of the Oneida Community (Nov. 12, 1866,) published at Wallingford, Connecticut; and shortly afterwards, at my request, the Editor was kind enough to send me several specimens of the larvæ.

"Two months ago we were congratulating ourselves on a fair crop of winter apples. To all appearance they were freer from worms than we had known them in this section for years. But alas! our hopes are again blasted. Although the *apple-worm* (the larva of the Codling Moth, *Carpocapsa pomonella*) is not so numerous as in some seasons, *the apple maggot* seems to be as prolific as ever. Two weeks ago we overhauled two hundred and fifty bushels of apples, that we had gathered and placed in store for winter use, and of that number we threw out fifty bushels, most of which had been rendered worthless, EXCEPT FOR CIDER or hogs, by one or the other of the above-named insects; and still the work of destruction goes on. *The apple-worm* by this time has ceased his work, or nearly so, but the depredations of *the apple maggot* continue up to the present time, converting the pulp of the apple into a mere honeycomb, and rendering another overhauling soon indispensable."

I hope cider-drinkers will make a note of the fact that maggoty apples can be converted into excellent cider. They would probably not like to eat the maggots bodily; but they smack their lips after drinking the expressed juice of millions of these tender

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*The scientific reader will, perhaps, like to know that, after I had published in the *Journal of Horticulture* the fact, that the species bred by myself five or six years ago, from Illinois haws, was identical with that bred in 1866–7 from apples received from the East, I sent a specimen of the former to Baron Osten Sacken, and he found it to be undistinguishable from a specimen of the latter which I had previously sent him.

young larvæ, Yet, as the old saying is, "One may as well eat the devil as drink his broth."

On Dec. 28th, 1866, Mr. W. C. Fish, of East Falmouth, Massachusetts, sent me a further supply of these same apple-maggots, with the following account of their operations in his vicinity:

"This insect is very numerous in this section of country, being much more abundant in the thin-skinned summer and fall apples than in the later varieties. It seems to increase every year. Within a few rods of the house in which I am writing, stand five or six trees of the old-fashioned variety called Hightop or Summer Sweets. On these trees the crop of apples is annually rendered worthless by this insect, which tunnels the fruit in all directions. Apples which, when taken from the tree, appeared sound, would in the course of a few weeks, as soon as they became mellow, be found to be alive with these pests, sometimes to the number of six or more in each apple, although not commonly as many as that. I have found that, in most cases, the fruit had been previously perforated by the larva of the Codling Moth (*Carpocapsa pomonella*,) before becoming inhabited by this insect."

During the same winter I also received pupæ of this same insect from my intelligent correspondent, Isaac Hicks, of North Hempstead, Long Island, New York, who finds it a great pest there. According to Dr. Trimble, the State Entomologist of New Jersey, "this new and formidable enemy of the apple prevails generally throughout the Hudson River country, but has not yet reached New Jersey." (*N. Y. Sem. Tribune*, July 17, 1867.) Mr. Calvin Ward, of Vermont, complains of a larva, which is probably identical with the Apple-maggot, boring his apples for the last few years in all directions, and adds that "this insect does more injury to him than all other insects combined," and that "in 1865 it injured his apples to the extent of one-half their value, though it is not the only one that preys on them; but in 1866 it has not been so bad." (*Pract. Entom.* II. pp. 20—21.) Certainly, from Mr. Ward's description, the larva which he complains of could not have been the common Apple-worm, though it may possibly have been Dr. Fitch's Apple-midge, respecting which see above, page 19.

In July, 1867, from larvæ and pupæ received from Connecticut, Massachusetts and New York in the preceding winter, I bred several specimens of the perfect fly, a magnified figure of which is given herewith. (Fig. 2.) It will be seen at once that it has no resemblance whatever to the Codling Moth or moth of the Apple-worm, which is a four-winged insect with easily removed scales on its wings, like all other moths or "millers," and belongs to the Order Lepidoptera; whereas the perfect insect of the Apple-maggot is a two-winged fly, with no scales whatever on its wings, and belongs to the same Order (Diptera) as mosquitoes, gnats, midges, horse-flies, house-flies, &c., and to the same great group as our common house-fly. The larvæ also of the two insects are notably unlike. The Apple-worm (fig. 2b) is a cylindrical, 16-legged caterpillar with a large, dark, horny head and a dark horny patch behind its head; the Apple-maggot (fig. 2a) is a legless maggot, tapered to a point in front and not very unlike the larvæ of the different blow-flies that lay their eggs, or "fly-blows" as they are commonly called, on meat. Even the pupæ are quite dissimilar. For that of the Apple-worm shows the wings of the future moth, soldered indeed to the side of the body, but still plainly visible, while that of the Apple-maggot is what is technically termed a "coarctate" pupa; that is to say, instead of the larva moulting its skin to assume the pupa state, the larval skin is retained whole and unbroken, although greatly contracted in length, by the pupa, so that the true pupa can only be seen by dissecting away the

shrunken skin of the larva. The little elongate-oval, mahogany-brown bodies that we often see in cheese infested by the common Cheese-fly (*Piophila casei*, Linnæus) afford a familiar example of this kind of pupa; and any one may easily satisfy himself that they are really the pupæ of the cheese-fly, by enclosing a few of them for a few days in a vial, till the perfect fly comes out from them. Again, the Apple-worm, as we have already seen, is double-brooded, the first brood of Moths appearing in June and laying its eggs in the blossom end of the apples when they are no bigger than hazel-nuts, and the second brood of Moths appearing about the beginning of August to work on the more fully matured fruits. The Apple-maggot, on the other hand, is single-brooded, the perfect flies not making their appearance till July, and the maggots, produced from the eggs inserted by the ovipositors of these flies into the flesh of the apple, not changing back again into flies till the following July. Furthermore, the Apple-worm spins a slight silken cocoon above-ground; while the Apple-maggot spins no cocoon at all, and burrows under-ground to pass into the pupa state, remaining under the surface of the earth, without eating anything, all through the winter and until the middle of the following summer. Even the modes in which the two larvæ operate upon the apple are perceptibly different. The Apple-worm burrows chiefly in the core of the apple and the part immediately around the core, though it occasionally makes an inroad upon the pulp, and often bores its way out through the cheek of the apple. The Apple-maggot, on the contrary, so far as I can find out from the statements of my correspondents and from the specimens of infested apples sent me, never penetrates into the core, but tunnels exclusively the flesh or pulp of the apple, making therein little, rough, roundish, irregular and discolored excavations about the size of peas; which, when several larvæ are at work on the same fruit, often run together, so as to render the whole a mere mass of useless and disgusting corruption.

This Apple-maggot Fly must be carefully distinguished from Dr. Fitch's Apple Midge (*Sciara mali*,) previously referred to in connection with the Grape Midge. (See above, p. 19.) The whole Order of Two-winged Flies (*Diptera*) — with the exception of the small and very anomalous group comprising the Bird-flies (*Ornithomyia*) and the Sheep-tick — is divided into two grand groups, one of which (*Nemocera*) comprising the Musquitoes, Buffalo-gnats, Midges, Crane-flies, &c., has long, many-jointed antennæ in the Fly State; while the other group (*Brachycera*,) comprising the Horse-flies, the *Syrphus* flies, many of which are cannibals, the parasitical *Tachina* flies, and several families containing the House-flies, Onion-flies, Cabbage-flies, &c., has short antennæ apparently composed of only three joints, and usually with a slender bristle growing out of the last. It is to the former of these two great groups that Dr. Fitch's Apple Midge belongs. It is to the latter of these two great groups that my Apple-maggot Fly belongs. They are therefore radically and fundamentally distinct.

It only remains, in order to complete the History of this very beautiful, but destructive species, that I should annex descriptions of it in all its stages, so that for the future it may be scientifically recognizable. A species of the same genus, not very unlike it in the Fly state, (*Trypeta solidaginis*, Fitch,) produces a round gall or swelling about the size of a hickory nut on the stem of a species of Golden-rod (*Solidago*) inside which, any time in the winter and early spring, its fat white larva may be easily discovered reposing calmly in a little central cell surrounded by white pithy matter. By placing some of these galls, which are very common both in the East and in the West, in any convenient vessel, the Fly may be easily obtained from them as the spring opens. According to my friend Baron Osten Sacken, who has paid special attention to the Order Diptera

there is a European species of the same genus (*Trypeta signata*, Meigen, otherwise called *cerasi*,) which infests the cherry, the barberry, and several other fruits.

The Apple Maggot Fly. (*Trypeta pomonella*, Walsh.) *Head* rust-red; eyes and all the bristles black; front edge of the face and hind orbit of the eye, more or less tinged with white. *Thorax*, shining black; a humeral fillet, (vitta) and all but the extreme base of the scutel, white; on each side of the thorax, above, a gray fillet, opaque, with short, dense, gray pubescence. *Abdomen*, black, pubescent, with dusky hairs; the tip edge of the four basal segments white above, the white terminal edge of the first of these segments with short, white hairs; beneath, except the tip and a more or less distinct medial fillet, dull rust-red. Oviduct, short. *Legs*, pale rust-red; the four hind thighs, except the knees, black; the tips of the four hind paws (tarsi), and sometimes the front thighs, tinged with dusky. *Wings*, whitish-glassy, banded with dusky somewhat in the form of the letters I F—the I placed next the base of the wing, and its lower end uniting rather indistinctly with the lower end of the F; the base and the extreme tip of the wing being always glassy. The anterior end of the I commences on the transverse shoulder-vein and extends over the basal two-thirds of the second basal cell, and the whole of the third basal cell, beyond which it unites in a faint cloud with the foot of the F. The main leg of the F extends nearly in a transverse direction across the middle of the wing, straddling the middle transverse vein and the tip of the first longitudinal vein; from which last proceeds the anterior branch of the F, skirting, but not quite attaining the costa and the apex of the wing, and terminating on the tip of the fourth longitudinal vein. The posterior branch of the F commences opposite to the middle transverse vein, straddles the hind transverse vein, and terminates on the tip of the fifth longitudinal vein. Length of body, 0.15–0.20 inch; expanse of wings 0.30–0.43 inch.

Described from six males bred from Eastern apples, July 15th–23rd; two males and one female bred from Illinois haws July 23d–28th. I am informed by Mr. Sanborn, of the Boston Society of Natural History, that the species is quite commonly taken in Massachusetts, although nobody had hitherto recognized it as the Apple Maggot Fly. According to Osten Sacken, "this species seems to belong to the same group of *Trypeta* as the European *signata*, living in fruits, and not in the heads of plants belonging to the botanical family *Compositæ*, as the majority do." There are forty-two species of *Trypeta* exclusive of *asteris* Harris, which Osten Sacken has since proved to be a mere synonym of *solidaginis* Fitch, described in Loew's and Osten Sacken's work on *N. A. Diptera;* and from all of these it differs essentially, though it comes pretty near to *cingulata* Loew. After I had satisfied myself upon this point, and forwarded a specimen to Baron Osten Sacken, this gentleman was kind enough to inform me that, since the publication of the work on *N. A. Diptera*, Loew had described in certain foreign publications, not accessible to me, several additional N. A. species belonging to this genus. Subsequently, at my request, he examined the descriptions of all these additional species, and ascertained that not a single species of them agreed specifically with my *pomonella*. So that now there can be no reasonable doubt that the latter has hitherto been undescribed as a North American insect, though there is still a possibility that it may prove to be identical with some *Trypeta* found in the Old World.*

The larva (fig. 2 a) is of a greenish white color, 0.15–0.20 inch long, and about four and one-half times as long as wide, cylindrical behind, with the tail-end squarely docked, tapering in front from the middle of the body to the head. Head pointed, but narrowly excavated (emarginate) in front; its inferior surface with two slender, bluntish, coal-black hooks projecting in front, when the mouth is protruded, at the base of which there is a smaller pair connected with the base of the others, like the antlers on a buck's horn. At the base of the first segment behind the head, a dorso-lateral, transverse, pale-brown, flattish, rough tubercle. Last segment below, with two pale-brown, horny, rough tubercles, each composed of three minute thorns longitudinally arranged; and above, with two whitish, retractile ones, each pair of tubercles transversely arranged.

The puparium scarcely differs from the larva, except in being of a pale yellowish-brown color, and contracted in length, so as to approximate to an oval form and be only two and one-half instead of four and one-half times as long as wide.

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*Loew has since informed Osten Sacken that "*Tryp. pomonella* is a new species, and not identical with any European species."

INSECTS INFESTING THE APPLE.—On the Leaf.

CHAPTER VII.—The Rascal Leaf-crumpler. (*Phycita nebulo*, Walsh.)

I figured and described this small moth, and the curious house in which its larva lives, for the first time, in the *Prairie Farmer* for May, 1860, (p. 308) and the description was subsequently reprinted in the *Proceedings of the Boston Society of Natural History*, (Vol. IX. pp. 312–3.) It infests in the northern part of Illinois both apple, crab and plum trees, the larva traveling about in a little crooked horn or case, and tying together with silken threads the terminal leaves of young twigs, inside which it feeds at its leisure. Frequently, in passing from twig to twig, it anchors its case by strong silken cables to the naked side of a limb, and in this situation it has very much the appearance of a piece of dry bird's dung. It remains in this case in the larva state all through the winter and until the forepart of the following June; shortly after which date it changes into the pupa state, from which the winged moth emerges about the middle of July. I formerly conjectured that there were two or more broods of this species every year, but I am satisfied now that there is but one. It is not preyed on by any *Ichneumon* fly, so far as I have discovered; but I have bred from it a species of the parasitic *Tachina* family, so closely resembling, both in size and coloration, the common House-fly, that almost any ordinary observer would be sure to mistake the one for the other.

When this insect does not occur in extraordinary numbers, it is probably rather beneficial than otherwise on large trees, by operating as a summer pruning and thereby checking the exuberant growth of wood and throwing the tree to fruit. But in 1859 I found them so abundant on one of my apple-trees, that if I had not destroyed them, I believe they would have greatly injured it; and in June 1867 I received specimens of it from "J. M. K.," of Clarence, Iowa, with the statement that "it had destroyed his apple-crop for the last three years." When the trees are bare in the dead of the year, it is a very easy thing to find the little bunches of dry leaves—tied to the twig by silken bands—in which the larva has hidden its case, to protect itself from the cold blasts of winter; and it may then be readily picked off the tree, and destroyed by forcibly crumpling up the whole establishment, leaves and all, between the fingers. Comparatively a very slight pressure will effect this; for we are dealing here not with a hard shelly beetle, but with a soft delicate caterpillar. Although this insect is so common in Northern Illinois, and I have noticed plenty of them annually for the last 10 years near Rock Island, and they are equally abundant, as I am assured by Mr. C. V. Riley, near Chicago, yet, on the most careful search, I could not discover a single specimen, even in the dead of the year, in the apple orchards near Cobden in South Illinois; and Mr. Riley tells me that he also has failed to find it there. Neither, so far as I can ascertain, does it occur in the Eastern States; and most certainly it is not mentioned either by Dr. Harris or by Dr. Fitch. We may set it down, therefore, for the present, as an exclusively northwestern species.

INSECTS INFESTING THE APPLE.—On the Bark.

CHAPTER VIII.—The Oyster-shell Bark-louse. (*Aspidiotus conchiformis*, Gmelin.

There is no noxious insect existing throughout the length and breadth of the United States, about which more nonsense has been written and talked—concerning the Nat

ural History of which more erroneous ideas prevail — and against which a greater number of ridiculous and useless panaceas have been recommended — than the Oyster-shell Bark-louse. The reasons are many. In the first place, except for a very brief period of the year, all we can see of it is a small, motionless and apparently lifeless scale, closely appressed to the bark, of precisely the same color as the bark itself, and so totally unlike the popular idea of a "bug," or even the scientific idea of an animal, that it is sure not to be noticed by the unpractised eye, except when it has increased so prodigiously as to overspread almost completely a whole limb. So closely indeed at this period does it resemble a mere vegetable growth, that when, as often happens, it is located round the base of a young apple-twig or apple-spur, scarcely any but the acute eye of a field-entomologist can distinguish it from the natural wrinkles and crcases of the bark. Again: these scales, after the eggs underneath them have hatched out, and the young larvæ have dispersed themselves in various directions, still adhere to the bark for years, and even 12 or 18 months after the eggs have hatched, present exactly the same external appearance as they did in the first instance. Hence nothing is more natural than for an inexperienced person to suppose, that these old dead last year's scales, with no eggs whatever under them, are scales which were alive but yesterday, and which have been killed, eggs and all, by some ridiculous and useless wash, which he has been recommended, on what he supposes to be the highest authority, to apply to them. Moreover, as I shall afterwards explain, there is a minute and almost microscopic Mite (*Acarus*), that preys most extensively upon the eggs under the scales during the autumnal and early spring months, not only in the West, but also in the East; and this opens another door for error and delusion. Some quack nostrum is applied — a few dozen scales are lifted, and the eggs under almost all of them are found to be shriveled up to nothing — and then *hey presto!* the conclusion is jumped to, that it was the quack nostrum, not the Cannibal Mite that had killed the eggs, and the wonderful discovery is paraded immediately in the nearest Agricultural Journal. Lastly, at one particular time of the year, as I shall afterwards show, a very slight degree of friction with a stiff brush will destroy these Bark-lice — horse, foot and dragoons. Now see what follows from this fact. Some worthless Patent Wash is applied to the infested limbs with such a brush at this particular period — it is in reality the *brush*, and not the *wash*, that destroys the Bark-lice — and yet the cozened fruit-grower firmly believes, that it is the Grand Infallible Never-failing Anti-Bark-louse Specific that has done the business for them, and the papers ring with certificates of the great reliability of the newly-discovered nostrum, sold by all Druggists and Patent Medicine Venders at the low price of $5 per pint.

It would be easy to fill a volume with the history of the different remedies that have been published against this miserable Bark-louse. Lime-washes, soda-washes, tobacco-water, dry ashes, tar, fish-brine, potash-washes, sulphur-washes, common brine, solutions of soap, solutions of quassia, solutions of aloes, the ammoniacal fumes of sheep-manure, and combinations of two three and four of the above ingredients in every conceivable proportion that the wit of man could devise — have all been strongly recommended in print on what seemed to be the very best authority. Yet, with the exception of two or three of these articles — and these only if they be applied at a particular period of the year — I believe them all to be equally useless and ineffiecacious. Indeed, after filling one volume with certificates from the most respectable sources highly recommending, one after another, every one of the above panaceas, it would be easy to fill another volume with the doleful lamentations of men, who have tried them

and found them worthless. I know several orchardists troubled by this vile pest, who have arrived at the conclusion, after experimenting in vain with a dozen different remedies, that it is no use trying to fight it, and that their apple-trees are irretrievably ruined and "gone up."

As with all other Noxious Insects, before we can fight this Bark-louse understandingly, it is necessary to know who and what she is, how she is propagated from year to year, how she spreads from one tree to another, and what are her peculiar habits and mode of life. I put her in the feminine gender, because, without a single exception, all the scales that come under the notice of the fruit-grower contain eggs under them, and are consequently all of them females. And here, at the very outset, the inexperienced observer is often involved in error and confusion. There are two perfectly distinct Bark-lice, with different habits and modes of life, commonly found in Illinois on the apple-tree, which are popularly confounded together — by a very indefinite application of the Definite Article — under the appellation of "THE Bark-louse." The first — which is the one with which we are now more immediately concerned — is a species introduced into the Eastern States more than seventy years ago from Europe, but which only penetrated into Illinois about fifteen years ago; occupying at first the districts bordering upon Lake Michigan, where it committed terrible ravages, and thence spreading gradually Westward and Southward, till only a few years ago it touched the Mississippi River. The second — which we may call "Harris's Bark-louse," and which will be referred to more fully in the following Chapter — is a native-American species, and has existed for time immemorial both in the East and in the West, its original home being our native crab-trees, upon which I observed it many years ago. The first cannot thrive except in comparatively northern latitudes; for even in Champaign Co., in Central Illinois, as I am informed by Mr. M. L. Dunlap ("Rural"), although it has been long known there, yet it does not increase so as to be at all formidable; and, as I was told in Southern Illinois, it actually dies, when it is introduced there upon young apple-trees brought from the north.* Harris's Bark-louse, on the contrary, flourishes vigorously, to my certain knowledge, so as to be a great pest in the latitude of Philadelphia, which is somewhat south of Champaign; and in Missouri it probably extends to a point at least 180 miles further south, where it does a great amount of damage. It occurs also in considerable numbers throughout the whole State of Illinois, but is nowhere anything like so destructive as the Imported Species. Indeed almost all our worst Noxious Insects have been imported from the Old World, and are far more destructive than the corresponding species indigenous to North America — a curious fact which I have explained and illustrated at some length in the *Practical Entomologist*, (Vol. I. No. 12.)

"But," the reader will ask, "how am I to distinguish these two Bark-lice, the one

*Since the above was written, I have received the Oyster-shell Bark-louse from Mr. J. Huggins, of Macoupin county, Central Illinois, with a statement that it swarms at Shipman, in that county, on two trees that were imported eight years ago from New York, though "the other trees in the orchard are not yet seriously affected." On examining the infested twigs sent by Mr. Huggins, I found that about 19-20ths of the eggs under the scales had been destroyed by the same Cannibal Mite that, as will be afterwards shown, operates upon them in Northern Illinois. Now, in North Illinois, the largest proportion of eggs, that I ever found to be destroyed by this Mite, was only two-thirds. Hence, I infer that the Mite is a far more efficient check upon the multiplication of this Bark-louse in Southern than in Northern latitudes. Certainly if this Bark-louse had been introduced into any county in North Illinois eight years ago, it would have been all over the county long before now; whereas, in Macoupin county it seems to have scarcely spread beyond the two trees on which it was originally imported eight years ago.

from the other?" The answer is short and simple. The scale of the Oyster-shell Bark-louse is the shape of a very elongate pear, considerably hunched, and of the exact color of the bark. That of Harris's Bark-louse is usually the shape of an egg, almost entirely flat, and of a pure milk-white color. Lift up the former with the point of a penknife any time between the middle of September and the middle of May, and you will see underneath it a score or two of very minute milk-white eggs, many of which will often drop out and on any dark surface look like so many grains of corn-meal. Lift up the latter in the same manner and at the same period, and you will find that the eggs, though of the same size and shape as those of the other species, are not milk-white, but blood-red. If these distinctive characters are not sufficient — and they certainly ought to be sufficient in all conscience — the reader can refer, in addition, to the figures of the two kinds of scales given in the *Practical Entomologist*, (Vol. II. p. 31.) Both scales are alike in being about one-eighth or one-tenth inch long.

The Oyster-shell Bark-louse is not double-brooded, as Dr. Harris erroneously supposed, but single-brooded. That point is now conclusively settled by the unanimous testimony of many recent observers; and, if necessary, I could confirm the fact. In the latitude of Rock Island, the eggs hatched out about the 4th of June in 1867, the spring of that year being unusually backward. In McHenry county in 1854 Dr. E. G. Mygatt — who published an admirable Paper on the habits of this insect in the *Transactions of the Illinois State Agricultural Society* (I. pp. 514—7) — found them to hatch out about May 23d; at Batavia, Kane county, about May 17th; and at Oswego, Kendall county, on May 18th. "But," as he adds, "in no case were they found till after the apple-blossoms had fallen, and the young fruit commenced growing — it is vain to look for them before." Of course, the time of hatching will vary somewhat with the season and the latitude; but Dr. Mygatt's rule will probably be found sufficiently accurate for all practical purposes. According to my Journal, my apple-trees were in full blossom on the 26th of May in the year 1867; so that by June 4th, the date when most of the young bark-lice were hatched, the young fruit must have been just about set. I noticed that on May 31st, or four days before the general hatch, although not a single egg had then hatched, some few of them — perhaps one out of every 40 or 50 — instead of remaining milk-white had turned yellow. Changes of this kind are quite usual with the eggs of different kinds of Bark-lice shortly before hatching-time; for I have myself observed in the case of several distinct species, that the color of the future larva often shows through the translucent shell of the egg a few days before it hatches out. The young larvæ on June 4th, when observed under the lens, were nearly of the same oval shape as the eggs, that is to say about 1¾ times as long as wide; but they were considerably larger than the eggs, of a yellowish color, with distinct beak and antennæ, *and with their three pairs of legs equidistant at their origin from each other.* This last character I have found to be universal in the larvæ of all the numerous kinds of Bark-lice with which I am acquainted, and, as we shall see afterwards, it is an important one both theoretically and practically. At this date the young larvæ were scattered so densely over the bark, that it looked as if it had been sprinkled with fine corn-meal; and at a casual glance no one would suppose them to be living animals, were it not for the fact that many of them might be seen, even with the naked eye, to crawl slowly along, having the appearance of little moving pale dots. Seven days subsequently, and probably sooner, these larvæ had all become stationary, and never moved afterwards from the point in the bark to which they had attached themselves. At this date, they presented under the lens the appearance of conspicuous, flat, white scales, oval and one-third

longer than broad, their long diameter being now about equal to one-third of the ex treme transverse diameter of the old scales. The white appearance of these larvæ found to be due to a white powdery secretion from the general surface of their bodies which being removed by a moist camel's-hair pencil, their bodies re-assumed thei original pale yellow color. As with the larvæ of many other Bark-lice and some Plant lice, there were, in addition to this powdery secretion, threads of exceedingly fine hair-like, cottony floss irregularly attached to them, and evidently secreted from th general surface of their bodies. At this period, they could without much difficulty b detached from the bark by a moist camel's-hair pencil; but already they had los almost all appearance of organization. Their legs, which only seven days before were distinctly articulated and as large comparatively as in ordinary insects, and which ther discharged all the functions of locomotion with ease, were now almost entirely obso lete; so that even on holding the insect up to the light, under the most powerful Stan hope and Coddington lenses, but the faintest traces of legs could be perceived. Thei antennæ had now disappeared altogether. As to any organized beak, I could discove nothing of the kind; but not improbably it might have been inserted in the bark an broken off short by detaching the insect from that bark. Motion in this creature ther was none whatever; and but for having seen them crawl about with ease only seven day before, and knowing that in the course of two or three months almost every one o these apparently inanimate scales would generate scores of living white eggs, I shoul never have supposed them to be living animals. On the preceding day, i. e., only si days after the general hatch, I had closely examined dozens of them, and could no perceive that a single one moved in any way. According to Dr. Mygatt, who says tha his trees were watched closely by the members of his family, the first bark-louse see to hatch out was on the 23d of May; and after the 27th not one was seen to move. S that the process of degradation, by which the animal loses all its locomotive and senso rial organs, probably commences about three days after the hatch, and is almost com pletely consummated in the space of four days.

Agassiz lays it down as a universal rule, that "the earliest condition of an anima cannot be its highest condition — it does not pass from a more perfect to a less perfec state of existence." (*Methods of Study*, p. 75.) But here — as also in the case of th common Barnacle, which begins life as a highly-organized locomotive crab, and end life by becoming permanently attached like a plant to a ship's bottom, and by havin many of its former organs either aborted or degraded — we clearly find an exception t what is undoubtedly a general, though not a universal rule. Nor is the exception con fined to this one species of Bark-lice. So far as I have ascertained, it prevails univer sally throughout two of the commonest genera of the great Family of Bark-lice (*Asp diotus* and *Lecanium*.)

After this most anomalous and wonderful transformation, the body of the origina insect grows scarcely at all, the total increase in its length or breadth being only abou one sixth. But now commences another most strange and anomalous process. Fro the tail end of the limbless and apparently lifeless scale, which is all that remains o the once highly-organized larva, there gradually in the course of a few days protrude backwards a thin membranous sack, closely appressed to the bark like the origina scale, and so far as outline goes forming an elongated continuation of it, but differin from it very obviously in color and texture. In 14 days time this elongated sack ha become in many specimens as long as the original body; and it grows and increase backwards at a prodigious rate thereafter, till by the middle of August the whole ha

assumed its permanent shape; and what remains now of the original body of the larva forms merely a minute, yellowish-brown, oval plate, pressed down obliquely upon the forward end of the so-called scale-insect, just as one of these stylish modern trencher-caps is pressed down upon the forehead of a fashionably dressed young lady in the year of our Lord 1867. Examine the Oyster-shell Bark-louse when you will, from the middle of August to the middle of the following May, and you will find it is externally always the same. In front there is what is left of the originally perfect, but now degraded and defunctionate larva, being an oval scale, of a somewhat shining yellowish brown color, and with one longitudinal ridge running from end to end, on each side of which are several indistinct transverse grooves, being all that remains to indicate that this was once a highly-organized animal, divided by the usual transverse sutures into the normal 13 segments found in the larva of almost every insect. Behind this yellowish-brown scale — which I shall for convenience' sake call "the larval scale" — may be seen a rather longer and wider one — which I shall call "the medial scale" — without any ridges or grooves and of the same opaque greenish-brown color as the bark, but often, especially at its hind end, tinged more or less with yellowish; and behind this again, and closely connected with it, the rest of the enormous elongated sack protruded in the space of about two months from the tail end of the larva, which is always of the same greenish-brown color as the bark. This posterior sack, which I shall call the "anal sack", is in its widest part about twice as broad as the "larval scale" is long, and, together with the "medial scale," is from 4 to 10 times as long as the "larval scale," but most commonly about 8 or 10 times as long. If the whole scale-insect is lifted up by the point of a penknife about the middle of August, the white eggs previously referred to may be found underneath it, the delicate part of the protruded sack that adheres to the bark being usually more or less torn open by the operation; and the eggs remain under the scale, without further development, all through the winter and until the middle of the following May. In the course of the winter they doubtless freeze and thaw, and thaw and freeze, scores of times; but, as with almost all insects when they are hybernating, this produces not the slightest effect upon their vitality.

Authors, who have never traced a Bark-louse day after day through all these astonishing transformations, have erroneously hinted that the "larval scale" represents the head, that the "medial scale" represents the thorax, and the large "anal sack" behind the whole represents the abdomen of a normal insect. (See Fitch, *New York Reports*, I. p. 257.) But no such thing can possibly be; for there is externally no perceptible change in the "larval scale," except a very slight one in size, from the days when the first rudiments of the "medial scale" and of the "anal sack" are protruded from behind it, to the day when both are fully developed. Consequently, as the "larval scale" represented originally both head, thorax and abdomen of a normal insect, and as it ever afterwards remains unchanged, it cannot afterwards represent the head alone of a normal insect.

What may be the precise nature of this singular "medial scale" and "anal sack," is hard to tell with absolute certainty. They are not, however, peculiar to the Oyster-shell Bark-louse, but are characteristic of the whole genus (*Aspidiotus*,) to which both this species and Harris's Bark-louse belong. In a very elongated and narrow species of the same genus, the Pine-leaf Scale-insect, (*Aspidiotus pinifoliæ*, Fitch,) found on the leaves of the White Pine (*Pinus strobus*) — which, by the way, I have ascertained to contain in November eggs of the same blood-red color, as those of Harris's Bark-louse — the "anal sack" is of a pure milk-white color, and the "larval and medial scales" are

very distinct from each other and from the "anal sack," and are both of them of yellowish-brown color. In an undescribed species, which may be called the "Black willow Bark-louse" (*Aspidiotus salicis-nigræ*, new species,) and which I find on the bark of the Black willow (*Salix nigra*,) the perfected scale-insect is of exactly the same size and shape as the perfected Oyster-shell Bark-louse; but, instead of being of the same color as the bark, it is milk-white, with the "larval and medial scales" pale yellowish-brown, precisely as in the Pine-leaf species, and in Harris's Bark-louse; and moreover the eggs under the scale, instead of being milk-white, are blood-red, as in the above-named two species. I incline to believe that, throughout this genus, what I have called the "medial scale" and the "anal sack" is formed by the anal surface of the original young larva being at two successive periods abnormally dilated and extended backwards, in the form of a sack closed at tip; and that, after this process is accomplished, the insect always moults or sloughs off the whole of the external scale, including both "larval scale," "medial scale" and "anal sack," which has been formed in the manner detailed above; and the eggs are then developed inside the scale and at the tail end of the moulted insect, and afterwards laid in the ordinary manner under the protecting scale. In confirmation of this theory, it may be observed here that on August 15th, I found, under numerous scales of the Oyster-shell Bark-louse that I then lifted, a white fleshy, juicy mass still enveloping some of the eggs, and that, under many others that I dissected in the autumn, I found towards the small or head end of the scale a dried-up mass, (which was apparently the legless body of the mother Bark-louse,) perfectly separated from the enclosing scale. In the case of Harris's Bark-louse, as will be shown hereafter, I found under the scale in the autumn, before any of the eggs were developed, *the living and moving body* of the mother Bark-louse, perfectly separated from the scale. And in a closely allied species found in Sweden, the description of which is quoted from Dalman by Harris, the very same thing is stated to occur. (*Injurious Insects*, p. 255.) So that, in these two cases at all events, it is impossible to believe, as most authors have hitherto done, that, at the time when the eggs are developed, the outer scale is part and parcel of the living Bark-louse. Neither is it reasonable or consistent to hold with Dr. Harris that, in the case of the Oyster-shell Bark-louse, the scale is composed of the dried-up body of the insect, while in the case of Harris's Bark-louse it is a mere cocoon. For in both these two cases the scale consists of precisely the same three parts, arranged in precisely the same manner, namely the "larval scale," the "medial scale," and the "anal sack:" and if it is a cocoon in one case, it must be a cocoon in both. But, after all, these matters, though of the highest scientific interest are of no manner of practical importance.

Hitherto we have spoken only of the mother Bark-louse. I have not actually bred the males of the Oyster-shell species; but there is good reason to believe that a small per centage of the larvæ — considerably less than five per cent., on a rough estimate — which never, like the egg-bearing females, have any long "anal sack" grow out of their tails, subsequently develop into males, and again acquire the power of locomotion. Even in the winter time, the empty shells of these individuals may be seen still adhering to the bark. Throughout the Bark-louse Family, it is the males only that ever acquire any wings, or even any rudiments of wings; and in comparison with the females of this species, the males, judging from the minute size of the scales out of which they, in all probability, come, must be very small and insignificant fellows indeed. The same law obtains throughout the whole Family.

It is a curious question how a species of insect, which, like the female of this Oyster

shell Bark-louse, never acquires any wings at all, and which loses even its legs when it is only a few days old, and becomes as stationary as a cabbage for the remaining period of its existence, can pass from tree to tree in the manner that we know it to do. Dr. Fitch, indeed, talks very glibly and fluently about the Bark-lice on some trees, that were "perishing" with their enormous numbers in the month of September, "preferring starvation at home" to being "poisoned by invading" some neighboring trees that had been dosed with one of the thousand-and-one Anti-Bark-louse Specifics. (*N. Y. Rep.* I., p. 38.) He might as well talk about the apple trees, in a badly-cultivated orchard, "preferring starvation at home" to emigrating into some well-kept and well-tended orchard. For, in September and, indeed, during the entire year, with the exception of three or four days in the spring, the female Bark-louse is as incapable of emigrating as an apple tree; and, as to the males, they, of course, could do no harm to a tree, even if they covered its entire surface; for, like all male insects belonging to this family, they have no beaks or mouths of any kind, and of course they lay no eggs. In my opinion, the only way in which, as a general rule, Bark-lice can spread from tree to tree, when the boughs of those trees do not interlock, is by a few of the very young larvæ, when they are first hatched, and are scattered over the limbs of a tree in such prodigious numbers, crawling accidentally on to the legs of some bird, that chances to light upon that tree and afterwards flies off to another. I have long observed that, when a tree first begins to be attacked by Bark-lice, it is only particular limbs and branches that are at first infected, and that these will be swarming while the rest of the tree will be free from lice. And I have further observed, that it is the lower horizontal limbs and branches, or such as birds, with the exception of Woodpeckers and Nut-hatches, would most naturally perch on, that are first attacked. The process of transmission, however, is by no means so sure and speedy as in the case of winged insects — for example, the Plant-lice (*Aphis* family.) For every one must have often noticed trees standing not far from one another, some of which were swarming with Bark-lice while others were not in the least infected. If all the birds in the world were killed off, I believe that these Bark-lice, in a very few years, would cease to exist. They would first of all destroy the trees of which they had already got possession; and then they would all of them die of starvation themselves. As to the popular idea that all Bark-lice crawl along the ground from one tree to another, that is altogether out of the question. They only possess the power of crawling for a few days, and they crawl so exceedingly slow, that I do not believe that in that whole time they could make more than a few yards, even on a perfectly smooth surface. Is it likely, then, that they can ever crawl down the trunk of their own tree, make their way over many yards of ground which is always more or less rough, and then crawl up the trunk of another tree and pass along on to its branches?

Mites (*Acarus* family) are not true Insects, but belong to the same Class (*Arachnida*) as the Spiders and the true Ticks as distinguished from the so-called Sheep-tick, which is a wingless true Insect and — if the hibernicism may be pardoned — a wingless Two-winged Fly (Order *Diptera*). In common with the rest of the Class to which they appertain, Mites differ essentially from all the true Insects in having the head and thorax all in one piece, without any free joint or even any suture between them. They differ further, almost all of them, in having *eight* legs in the perfect state; whereas all true Insects without a single exception have in the perfect state exactly *six* legs, never more and never less. In very many genera of Mites, however, as in certain genera of Insects, the first pair of legs are not used in walking, but are constantly vibrated up and down

as they progress, after the fashion of antennæ. Now in Insects, where the head an thorax are always distinct, as the antennæ always grow out of the head and the leg out of the thorax, there can be no possible confusion between leg and antenna, n matter what the function of the leg may be; because, if the organ in question grows ou of the thorax, it is to be considered as a leg, even if it discharges the duties of a antenna. But in Mites, where the head and thorax are confounded together, just a they are in a Crab, or a Lobster, or a Crawfish, the inexperienced observer, althoug none of the great Class to which the Mites belong have any antennæ at all, is yet ver apt to consider the front pair of legs as antennæ, whenever he sees them used as an tennæ. Consequently, as a general rule, the easiest mode for beginners to distinguish Mite from a true Insect is, to see whether the animal under examination has a distinc head or not. If it has, it cannot be a Mite. If it has not, it cannot be a true Insect.

So far we have been talking about the structural peculiarities of the *perfect* Mite and th *perfect* Insect. In the *larva or imperfect state* the case is somewhat different. Just a *in the larva state*, many Insects have legs so minute that they are scarcely distinguishabl others again have no legs at all, others again, in addition to the six normal jointed leg have at their tails a sham leg (or "pro-leg") or fleshy excrescence not divided into joint like the true legs, but still performing the same functions as they do, and others agai have from four to sixteen of such sham legs strung along the hinder part of their bodie besides having the normal six true legs in front; so, *in the larva state*, many Mites hav only six legs, although, when fully grown, they acquire an additional pair. In this cas as these Mite-larvæ are always exceedingly minute in size, it is sometimes not very eas to distinguish them from the similarly minute larvæ of certain Bark-lice and Plant-lic to which they bear a strong general resemblance. There is, however, one distinctiv character by which, so far as a pretty extensive observation goes, I believe that the ver young six-legged oval larvæ of the Mites may be always readily distinguished from th very young six-legged oval larvæ of the Bark-lice and the Plant-lice. In the two latte groups the three pairs of legs are always equidistant, or nearly so, from each other, a their origin on the the lower surface of the body. In the former group the two fron pairs of legs are placed close to one another on the lower surface of the body and no very far from the front end, while the hind pair of legs are placed wide apart from th others and not very far from the hind end. In a somewhat wide experience with thes creatures, I have met with no intermediate grades whatever in these very remarkab characters.

Of course, as the larvæ of all Bark-lice and Plant-lice have antennæ, and those Mites have none, if you can make out the antennæ clearly in the larvæ that you hav under examination, they cannot be Mite-larvæ. But as the larvæ of Bark-lice an Plant-lice very frequently do not raise up their antennæ as they crawl along, and as th legs can generally be made out pretty distinctly whenever larvæ of any kind are craw ing along, characters drawn from the legs are evidently the most generally availabl

The number of distinct species of Mites to be found in the United States is rath large, but still very greatly inferior to the number of distinct species of Insects foun within the same limits. Unlike the true Insects, they are all of them quite small size, the largest Mite known to me being much less than one-tenth inch in lengt They swarm everywhere; but their Natural History is so far almost entirely a seale book to the scientific world, because no one hitherto has devoted his exclusive attenti to them. I am myself acquainted with no less than twenty distinct species, that for curious "galls," or unnatural growths, upon the leaves of various trees. One of the

causes the singular pod-like growths, about one-eighth inch long, upon the upper surface of the leaf of the wild plum-tree (*Prunus americana*),* which often swarm so prodigiously, that I calculate that the number of young Mites, in one small clump of Plum-trees, frequently exceeds the number of human beings now living and breathing upon the face of this earth. This will perhaps be considered a wild exaggeration; but see what the figures themselves will say. I have often counted as many as sixty of these galls on a single leaf, and each gall contains towards the end of July several scores of microscopically minute young Mites. Such a leaf will therefore contain about 3,000 young Mites, and putting the human population of the whole globe even at the enormous number of 900,000,000, it will only take 300,000 such leaves to verify my estimate. Now, Dr. Fitch has calculated (*New York Reports* I. p. 127) that there are about 17,000 leaves on a young cherry-tree only ten feet high; and I presume that there would be fully as many on a plum-tree of the same size. Let us suppose that in a particular group of such plum-trees there are, on the average, only 3,000 leaves on each tree fully stocked with young Mites, as calculated above; or, if any leaves are less fully stocked, as many leaves in all as would be equivalent to 3,000 fully-stocked leaves. Then it follows that there need only be 100 plum-trees, each about ten feet high, in the group, to make up the whole number of 300,000 fully-stocked leaves, which, according to the calculation, are required in order to sustain a population of young Mites, equal to the very highest estimate that has ever been published of the entire human population of this earth!

Now pluck one of the gall-bearing leaves from such a group of 100 plum-trees, which might easily grow upon a piece of ground much smaller than a common-sized village-lot. Open one of the galls on it. Examine its inhabitants with a powerful magnifier. You will see at once, that all this infinite multitude of infinitesimally minute beings are as perfect in every limb, and in every joint of every limb, and probably in every nerve and muscle of their tiny bodies, as the gigantic animal that is watching their operations through a piece of glass. They are all busy. They are all evidently healthy, and happy, and in the full enjoyment of their existence. They contribute in no wise to our pleasures or to our necessities; neither do they molest or trouble us in any way whatever. We are separated from them by as wide a gulf, as if they were denizens of the far-away planet Neptune. And yet we fondly dream, in our vain-glorious hallucination, that all this vast world of life and happiness—so minute in size, but so inconceivably large in numbers—was created for our sole benefit, and has no right to exist but by our sovereign permission and at our good will and pleasure!

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*For the benefit of the scientific reader, I copy from my Journal the description of this one gall. The general reader will be thankful that I omit the descriptions of the other nineteen galls:

Gall PRUNI CRUMENA, new species. On Prunus americana. A fleshy, smooth, elongate, blunt-tipped, fusiform, opaque, hollow gall, constricted at its base, and with a few erect hairs, 0.10–0.16 inch long, and about four or five times as long as its extreme breadth. Walls of the gall thin. Color outside a very pale green, often tinged with rosy; inside, rough and of a rosy color. Always grows upon the upper surface of the leaf, whole trees frequently swarming with it, the number of galls on a single leaf varying from one to sixty. Ten galls opened July 27th all contained *Acarus* larvæ, scores of them in each gall. These larvæ are exceedingly minute, of a hyaline-whitish color, of the usual elongate-oval form, thrice as long as wide, six-legged, with their legs arranged as usual. They are very sluggish. Some of a yellow color were crawling on the leaves outside the galls. A similar but distinct gall (*Cerasi crumena*, Walsh MS.) is almost equally abundant on the leaf of the Wild Black Cherry (*Cerasus (serotina.)*

All the Mites, however, do not feed upon living vegetable substances, like these gall-makers that I have just been picturing to the mind of the reader. As with the true Insects, many groups of them feed upon decaying substances, either of animal or vegetable origin, many are Parasites, and many others are Cannibals. For example, the common Cheese-mite, an imported European species, feeds upon decaying cheese, where, when it is once established, it soon multiplies with the most astonishing rapidity. Again: the common Itch, in that two-legged animal that Linnæus designated as *Homo sapiens*, is caused by a microscopically minute Mite (*Acarus scabiei*, Linnæus) burrowing under his skin, and there carrying out the great Law of Nature, "Increase and multiply and replenish the earth." This species, therefore, is a true Parasite. Again: I have noticed many species of Mites that are what I have called "Cannibals," haunting leaf-galls constructed by certain Plant-lice and Bark-lice, and feeding apparently upon the tender bodies of the unfortunate young lice. Galls made by other groups of insects they do not usually enter, because these last are invariably closed, till the gall-maker gnaws his way out. But galls made by Plant-lice and Bark-lice — which insects have no jaws at all to gnaw with, but only a beak to suck with — always burst open towards the latter part of their existence, so as to allow the young Lice a free exit into the external world. Hence into these the wandering Cannibal Mites, who are always remarkably fleet-footed in the mature state, find a ready entrance, and often carry death and desolation into what was before the happy home of a flourishing colony of Lice. "Eat and be eaten; kill and be killed." Everywhere this is the great universal Law of Nature.

Of these Cannibal Mites, I have discovered that there is at least one species, and perhaps more than one, that preys most extensively upon the eggs of the Oyster-shell Bark-louse; insomuch that upon a particular apple-twig infested by these Bark-lice I have found, on lifting and carefully examining six hundred scales about the last of October, that at least two-thirds of the whole number were either already gutted, or were undergoing the process of being gutted, by the minute larvæ of a Mite.* What I believe, though I am not absolutely certain, to be the eggs of this Mite are deposited here and there upon the bark among the scales, in little patches of six or eight, and are exceedingly minute, smooth, shining, perfectly globular bodies, rather less in diameter than the transverse diameter of the egg of the oyster-shell Bark-louse. Most of them are blood-red, but some, which appear to be the empty shells of such as have already hatched out, are transparent and colorless. Repeatedly, on raising the Bark-louse scales both in the autumn and in the early spring months, I have found from one to eight of the larvæ of some kind of Mite — whether hatched out or not from the above-mentioned eggs is not perfectly clear — interspersed among the eggs of the Bark-louse. In some of these cases the eggs of the Bark-louse were sound and untouched; in others there were only a few of them sucked dry and shriveled up; in others again, at one end of the scale the eggs would be sucked dry and at the other end perfectly plump and

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* During my attendance at the inauguration of the Horticultural Society of Northern Illinois, at Mt. Carroll, Dec. 18th–20th, 1867, and before I had said a word there about these Cannibal Mites, but after the whole of this chapter was in the hands of the printer, I was much gratified by hearing Dr. H. Shimer, of Mt. Carrol, inform the meeting that he had himself discovered that the imported Bark-louse was preyed on quite extensively by a species of Mite (*Acarus.*) Thus, as often happens, the same discovery has been made at the same time, by two independent observers. Of course, Dr. Shimer's evidence is cumulative proof, if any be needed by any one, of the reality of the discovery. — Dec. 21, 1867.

sound, the young Mites being stationed in the middle, as a mower stations himself between the standing grass and the swath that he has already cut; finally, in still other cases, nothing but the empty shells of the eggs remained, and occasionally the hungry young Mites might still be discovered among those empty shells, kicking and struggling in the snug retreat that they had so ruthlessly desolated, as dogs sometimes fight over a bone that has been already picked clean.

Towards the spring, or late in the autumn, many of the scales, some of them still containing a few eggs, may be observed to have rather large, irregular, ragged holes in their external surface, quite unlike the smaller, regularly-rounded holes, bored by Parasitic insects when they make their escape from the shell of an insect of this size that they have preyed on. Early in the autumn scarcely any such holes are to be met with in the recently-formed scales. I suspect that these ragged holes are the work of the Mites, and that, after having sucked all the eggs dry, they feed upon the dry scale, until hunger compels them to vacate the tenement and search out a scale that has not as yet been preyed upon by their brethren. Dr. Fitch mentions that he found a small Parasitic larva — which as usual bored a small round hole to escape by — to be very common under these scales. I have never met with any such larva; but I have occasionally seen scales, both of the Oyster-shell Bark-louse and of Harris's Bark-louse, perforated by just such a small round hole as Dr. Fitch deseribes; and I should judge them to have been made by a parasitic four-winged Fly (*Chalcis* family or *Proctotrupes* family.)

Some of these Mite-larvæ that were discovered in May, are described in my Journal as being of a glassy-white color, six-legged, and with the hind pair of legs placed as usual far backwards; their bodies oval, 2½ times as long as wide, not at all hairy, and of about the same length as the egg of the Bark-lousc. Others, noticed about the last of October, agreed pretty accurately with the above description. Others, again, found about the same time, differed in being rather larger and more elongate — thrice, instead of 2½ times as long as wide — and in having 8 distinct legs, the two hindmost pairs separated by a very wide interval from the two foremost pairs. These were probably the pupa form of the others. All of them had the thorax separated from the abdomen by a transverse suture; and, as is universally the case, so far as I have observed, with immature Mites, were sluggish in their movements. On the other hand, all Cannibal Mites that I am acquainted with, are, in the adult state, exceedingly active, and run with astonishing rapidity for creatures of their minute size.

I think it not improbable that there are several distinct species of Mites that prey upon these Bark-louse eggs. I have descriptions in my journal of adult Mites, belonging to what seem to be four distinct species, two of which were merely found running about among the scales, one was found under a scale where one-third of the eggs were white and plump aud the rest yellowish and shrunken, and the other one under a scale in company with two Mite-larvæ, that were undoubtedly preying upon the eggs of the Bark-louse. As is usual with Mites arrived at maturity, there was no distinct transverse suture, dividing the head-thorax from the abdomen, in any of these four. I have not been able to succeed in rearing any of the Mite-larvæ found under the scales to the adult state; so that I will mercifully forbear for the present inflicting upon the general reader long descriptions of adult Mites, which, although they were certainly some of them found under very suspicious circumstances, yet cannot be positively proved to prey upon Bark-louse eggs, and in any case cannot be identified with the larvæ that I know to prey upon these eggs. Not improbably, some of what I have supposed to be distinct

species of adult Mites, may be merely the two sexes or two different stages of one and the same species; or very possibly, as is common in several families of insects, species of Mites, which are perfectly distinct in the adult state, may be undistinguishable in the larva state.

I have only to add, by way of caution to the reader who may desire to verify the above new and very curious facts, that these young Mites, being so nearly of the same size, shape and color as the eggs of the Bark-louse among which they are found, and being also exceedingly dull and inactive in their movements, are not very easily recognizable. By long and attentive watching, however, and by trying several scales one after the other, a leg or two will at last be perceived, even under a common pocket magnifier, lazily flopping about; and even when the legs cannot be seen, a good lens will often discover the transverse suture across the body of the young Mite, which of course is not to be seen in the unhatched egg of the Bark-louse. It will be found that the shrunken eggs recently preyed upon by the Mite are of a yellowish color; while the empty egg-shells (from which the young lice have hatched out,) that are constantly met with under old last year's scales, are at first, not of a yellowish, but of a transparent white color. It is therefore among such shrunken eggs as are yellowish, not among such as are white, that these Cannibal Mites are to be looked for. So strongly, again, do these young Mites resemble the young Bark-lice when the latter are first hatched out, that even so practised an observer as Dr. Fitch evidently mistook the one for the other. For he says that the young Bark-lice of this species mostly hatch out about May 26th, but that so early as May 12th he found *some still under the scale* with "three pairs of legs, two placed anteriorly, the other posteriorly and distant." (*New York Reports*, I. pp. 36–7.) As the legs of all young Bark-lice are equidistant or very nearly so, and those of all young six-legged Mites, so far as I know, precisely in accordance with the above description, these must clearly have been, not young Bark-lice, as the Doctor supposed, but young Mites. But even out of the errors, to which we are all of us subject, we may sometimes deduce useful and important truths. For Dr. Fitch's error proves to us, that Mites must prey upon Bark-louse eggs, not only in Illinois, but also in New York.

And now, after this protracted and tedious description of the Natural History of this mischievous insect, which has been made necessary by the prevalent errors and misconceptions on the subject — let us approach the great practical question, "How are we to get rid of this pest?" It is with considerable reluctance that I enter upon this question, because I have in operation a long train of experiments upon this important point, which are not yet finally concluded. I should much prefer, therefore, to wait till I can treat the matter as a whole at some future day, instead of taking it up piecemeal now. Still, as the conclusions at which I have already arrived seem to be of great practical moment, imperfect and fragmentary as they may be, I will lay them before the reader. They may be briefly stated thus: —

1st. Strong tobacco-water has no effect whatever upon these Bark-lice, no matter at what time of the year it may be applied.

2d. Strong alkaline washes have no effect whatever upon these Bark-lice, no matter at what time of the year they may be applied.

3d. A strong solution of soap will kill almost every one of these Bark-lice that it touches *shortly after they hatch out;* but has no effect whatever upon *the perfected scale.*

4th. Petroleum, or kerosene, or probably any oily or fatty substance, will kill every Bark-louse, eggs and all, that it actually touches at any time of the year. And there

is pretty good evidence, that such substances, if spread thinly over a great part of the surface of a tree, and even if spread over its entire surface, are not perceptibly injurious to it, or at all events not invariably so.

5th. Scrubbing the limbs of a tree with a stiff brush, shortly after the Bark-lice have hatched out, will destroy them and remove them from the infected surface; but no such mechanical appliance can remove or otherwise affect the perfected scale, simply because it sticks too tight, and is of too hard and solid a texture.

6th. By scraping the bark with the edge of a knife or other such tool, even the perfected scale may at any time of the year be removed and destroyed.

To give all the details of all the experiments that I have made, bearing upon the above general rules, would occupy entirely too much space and only weary the reader. But I may be pardoned, perhaps, for giving the details of a few of them, and for particularizing several facts obtained from other sources, in order that it may be seen upon what kind of evidence my general conclusions are based. Each statement is numbered, so as to correspond with the six general laws already laid down.

Statement 1st.—On June 12th, 1867, being eight days after the Bark-lice had hatched, and probably about four or five days after they had become permanently stationary, I prepared some tobacco-water, by boiling for three hours one part, by measure, of common smoking-tobacco and seven parts of water, renewing the water as it boiled away. This fluid I squeezed with a sponge over a badly infested branch, so as to wet the whole of it thoroughly both above and below, using no brush or swab of any kind, so as absolutely to eliminate the effects of mechanical friction upon the young Bark-lice. I had previously pruned the branch so as to cut off all communication with neighboring branches, except at its origin; and of course I labeled it and registered it in my Journal. From time to time through the summer I examined it, and found the young Bark-lice apparently growing as vigorously as on the rest of the tree. On October 30th I cut off a portion of it, one foot in length and averaging one-third of an inch in diameter, and examined the scales one by one under a lens. This piece, be it observed, was so distant from the origin of the branch which I had washed with the tobacco-water, that it was very improbable that any amount of young Bark-lice could afterwards have crawled out on to it from the other parts of the tree, even supposing them to have retained their original powers of locomotion. I found, on examining it, at least 200 scales containing good, plump, healthy eggs, and about 400 that had either been completely gutted by the Mites, or were undergoing that process. There were about seven or eight scales from which no "anal sack" had developed; these might possibly have been larvæ killed by the tobacco-water, but I took them for scales from which males had developed; for this is about the proportion of such scales usually met with in branches that have not been medicated in any way. The old dead last year's scales upon this piece of a branch, I did not think it necessary to count. Hence, I infer that strong tobacco-water cannot kill the Bark-louse at any period of its existence; for if it has no effect upon it when it is in the tender larva state, *a fortiori* it will have no effect upon the matured or partly matured scale.

That most accurate observer, Dr. Mygatt, arrived at similar results. "When I had ascertained," he says, "the hatching season, I fondly hoped that the decoctions of quassia and tobacco, which I have for several years used on the Plant-lice, (*Aphides*), would also destroy the young Bark-lice (*Coccids;*) but in that I was doomed to be sadly disappointed on trial." (*Trans. Ill. State Agr. Soc.*, I., p. 516.)

Statement 2d.—On June 12th, 1867, I prepared a solution of common saleratus,

which, as soda has been very much cheaper than potass ever since the mode of obtaining it from common salt was discovered, was, in all probability, nothing but purified soda. It was mixed in the proportion of one part, by measurement, of saleratus to fifty parts of water. This I applied, precisely in the same way as the tobacco-water in the preceding statement, to another branch, prepared and labeled in a similar manner. Repeatedly, as the summer progressed, I examined this branch, and the young Bark-lice on it seemed to be growing as nicely as on the rest of the tree. The results, on cutting off, October 30th, a piece of the same size and length, and similarly situated, as compared with that used in the preceding experiment, were almost precisely the same. For I found 201 matured scales containing plump, healthy eggs, and nine that I took to be male scales, though possibly some or all of them might have been young larvæ killed by the soda-wash. I did not count the old, dead last year's scales, or those of the current year which were infested or gutted by Mites; but I estimated that they were in all about 200 in number. From this experiment I conclude that a solution of soda will not kill the Bark-lice even in the larva state; and I draw the same inference as to the effect of alkaline solutions upon the matured Bark-louse, that I have already drawn in the tobacco-water experiment.

The proportion of soda used was nearly that recommended in the *Horticulturist* of March, 1867, namely, "one pound of potash to six gallons of water;" for, as every druggist knows, a pint of such substances as soda is nearly the equivalent of a pound. All accounts seemed to agree that stronger solutions were injurious to vegetable life. But from the following statement, made by Wm. Mead, Jun., of Taunton, Massachusetts, it appears that even the very strongest alkaline solutions have no effect upon Bark-lice. "To kill the scale-insect," he says, "upon my pear trees, I have ie potash — one pound to a gallon of water — which has no effect upon the insect, p to make it brighter." (*New York Sem. Tribune*, March 16, 1866.) Judging from h date of publication, Mr. Mead must have operated in the dead of the year, and e fore upon the perfected scale. Dr. Houghton, of Philadelphia, used in the su ne time a wash of the same unusual strength, as he has informed me — one pound of "concentrated lye" to one gallon of water — upon the ot her species (Harris's Bark-louse) that were infesting his pear trees in prodigious numbers, without its produ in the least perceptible effect in diminishing their ravages, though he was of op .o that it injured the trees to a considerable extent.

STATEMENT 3d. — On June 12th, 1867, I prepared a solution of good, home-made soap, manufactured from soap-grease and what is sold under the name of "concentrated lye," and is probably nothing but impure soda. I took one part, by measurement, of soap to six parts of water, and stirred the mixture over a fire till it got warm and had about the consistence of thin paint. This I applied, in the same way as the tobacco-water in the first experiment, to a branch prepared and labeled in the same manner, except that I had unfortunately omitted to trim off a few of the small, terminal twigs, and neglected to apply the soapy solution to those twigs. On examining this branch, from time to time through the months of June and July, it was quite plain that the great bulk of the young Bark-lice on it had ceased growing and were dead, though they still adhered firmly in their original form to the bark. On October 27th, I cut off a portion of this branch, of the same size and length as in the other two experiments, and carefully lifted and examined, under the lens, all the matured scales upon it, whether of this year's or of last year's growth. I found but seven scales containing plump, healthy eggs; the number of last year's scales, and of those

that had been operated on by Mites, I did not count, nor did I estimate them separately from each other; for, up to this day, I had not become aware of the nice distinction between last year's scales, containing *white* egg-shells, and scales recently gutted by Mites, which contain *yellowish* egg-shells. But I estimated the whole number of matured scales, containing no living and plump eggs, at several hundreds. After the above process had been gone through with, which necessarily obliterated or removed many of the young Bark-lice killed by the soap, I counted 422 dead Bark-louse larvæ still adhering to the bark, *with the "anal sack" not at all developed*, and most of them without even a "medial scale," the great bulk of which must therefore have been killed by the soap while still in the larva state. If we assume that 22 of these were males — which is a rather large estimate — and deduct these from the total, we get 400 female bark-lice killed by the soap, to 7 that survived the operation of the soap; or, which is the same thing, out of the whole number of females 98¼ per cent. killed. It is possible, however, though not at all probable, that the seven female Bark-lice that survived might have been late-hatched individuals, that crawled down, before they became stationary and after the soap was applied, from the small, terminal twigs that I neglected to soap. In this, as well as in the other three experiments already detailed, the portion of the branch examined under the lens was altogether too far removed from the main limb which was not soaped, to allow of any considerable number of Bark-lice crawling on to it from the main limb; and besides, when all these experiments were tried, the great bulk of the Bark-lice had certainly become stationary.

Dr. Mygatt tried the same experiment about the same time of the year, but used a much weaker solution of soap, which seems not to have been quite so effectual. "One tree," he informs us, "was treated with soap-suds, two tea-cupfuls of soft soap to a pail of water. Every part was wetted by immersing the ends of the branches and using a syringe. The leaves and young growth became yellow, but were not destroyed. About of the lice were killed, probably half or more." (*Transactions Illinois State Agricultural Society*, I., p. 516.)

On Nov. 7th, 1867, the scales being now of course fully matured, I made a still stronger solution of the same soap, namely one part by measure of soap to four parts of water, and applied it when warm with a very soft shaving brush to a branch prepared and labeled as in the other experiments. On Dec. 5th, I cut off a portion of this limb and examined the scales under the lens. From some cause or other, upon this limb, which was upon a different part of the same tree and not so badly infested, the Mites had not operated at all, so far as I could discover. After lifting and examining several scores of scales, and finding that every one of them without exception contained good plump, healthy eggs, I became fully satisfied that the soap had not in any wise affected the vitality of the eggs, and did not think it worth while to continue the examination. The weather during the whole of November had been remarkably mild and genial and dry; and, from my experience with the eggs of this and other insects, I am sure that, if these eggs had been killed by the soap, they would have shriveled up to nothing in much less than a month of such weather. But be this as it may, I shall be able to ascertain in the spring of 1868, from the portion of the branch that remains on the tree, whether these eggs that were soaped in November will hatch out as usual in the following spring, or whether some or all of them were killed by the soap.

From the above facts, I infer that soap will kill Bark-lice when they are very young, but has no effect whatever upon the matured scale.*

*Since the above was written, Dr. Mygatt has informed me that pure, undiluted soft soap is largely

It is proper to add that, in all the above experiments that were tried in June, there was no rain for at least 6 days afterwards; and that in the November experiment there was no rain for several weeks afterwards. So that the various articles applied had a sufficient time for operating, before the rain washed them off.

STATEMENT 4th. — In April, 1866, I had an apple-tree, the lower limbs of which were infested, some of them pretty badly, by the Oyster-shell Bark-louse. I pruned them all quite closely, removing all wood under ½ inch in diameter, and then with a common painter's "sash-brush" painted them all over as thinly as possible with kerosene. Not many weeks afterwards I examined scores of the scales on these limbs, and found the eggs under all of them dead and dried up; and not a single Bark-louse, so far as I could discover, subsequently hatched out on them. Out of the whole number of limbs, but a single one died, and that was so completely covered with scales, that it would probably have died anyhow. The remainder put out fresh shoots, and are now alive and healthy. The tree was about 6 or 7 inches in diameter at the butt, and probably about one-tenth part of it was operated upon in this manner. In several other trees that I treated on the same system, the results were similar, it being uniformly only such branches as were completely coated over with scales, that subsequently perished.

Dr. Mygatt in 1854 gives the following testimony: "Lard was used on three bearing trees soon after the eggs hatched out; every insect touched with the lard perished; the limbs are now clear, except the spots missed. The trees grew finely, with no apparent injury to them. * * * I applied lard to several bearing trees in August; those scales are all dry and apparently dead, and no insects to be seen. * * * One tree, thickly covered with the white variety," [Harris's Bark-louse; see chap. 9] "was oiled over from the ground to the minutest branch, this was done in April; not an egg hatched. The new growth was luxuriant; and the tree is now clear of lice, and does not appear to be injured by the oil." — (*Transactions Illinois State Agricultural Society*, I. p. 516.)

In 1856, Dr. Fitch writes as follows: "Now at last it is pretty well ascertained, that anointing the trees with grease or oil is an effectual remedy [against the Oyster-shell-Bark-louse.] I am assured of this by Dr. Hoy, of Racine, Wisconsin, and other correspondents, and by several communications in the *Prairie Farmer*, and other agricultural periodicals." (*New York Reports*, II. § 15.)

Mr. Sherman, of Waukegan, Lake Co., Illinois, is reported in 1861 as using a mixture of equal quantities of linseed oil and tar, to destroy the Bark-louse in the perfect scale state. "These articles," it is stated, "are mixed over the fire by a gentle heat to dis-

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applied in his neighborhood to the matured scale, under the erroneous idea that it destroys the eggs. He has been kind enough to send me (February 29th) an infested twig soaped in this manner, and another twig cut off the very same limb which had not been soaped at all. On lifting and examining under the lens 100 scales upon each of these twigs, I found that on the *soaped* twig there were 31 scales containing plump, healthy eggs, and 69 scales, mostly gutted by the Mites, which contained no such eggs; while on the *unsoaped* twigs the numbers were respectively 30 and 70; showing that, where the soap had been applied, the number of healthy normal scales was actually one per cent. greater than where nature was left to her own devices. In this case the soap had been applied only 12 days before I lifted the scales; but in a specimen sent at the same time, to which the soap had been applied for considerably more than a month, there was a still larger proportion of healthy normal scales, namely 37½ per cent. instead of 31 per cent. Hence, it may be inferred that even pure undiluted soft soap produces no effect upon the matured scale; although, as Dr. Mygatt informs me, "it kills all the foliage, fruit or young growth that it touches."

solve the tar. The mixture is put on with a brush at any time during the winter or early spring, and has the appearance of a varnish. It has the advantage over the alkaline washes, used on the young insects, that it can be applied to all parts of the tree without the least injury to the shoots or buds, while it is death to the insect. His trees are nearly free of the insect, and have become vigorous and fruitful." (*Transactions Illinois State Agricultural Society*, V. p. 190.) The tar is probably inert here, except so far as it dilutes the oil, and it is in reality the linseed oil that kills the eggs.

In 1866 Mr. Cavanach, a market-gardener residing at Brooklyn, New York, said that he "had succeeded in destroying the scale-insect by the use of kerosene, without injury to the trees." (*New York Sem. Tribune*, March 16, 1866.) And subsequently he states as follows: — "We use kerosene regularly every year to kill the scale-insect and other parasites upon our plants and trees without injury to them; and it has frequently been stated that crude petroleum has been used for the same purpose with good effects. Gas tar has proved injurious." (*Ibid.* March 30, 1866.) Two years afterwards the same man speaks in the following manner of petroleum: — "If any one wants to kill his trees, let him use petroleum; yet it is beneficial in a diluted state when applied to shrubs and plants to keep off insects, but it is death when applied to the roots." (*Ibid.* Jan. 10, 1868.) Whether these observations are intended to apply to kerosene as well as to petroleum, is more than I can say.

At the Meeting of the Iowa State Horticultural Society, Oct. 19, 1867, Mr. J. L. Budd, a fruit-grower residing at Shellsburg, Benton Co., Iowa, stated that he "had found 10 parts of benzine and 4 of soap the best remedy against Bark-lice." The benzine would in all probability be effectual at any time of the year; but, as I think I have shown, the soap would be useless, except early in the summer and except also by its diluting the strength of the benzine.

Finally, Dr. Pennington, of Sterling, Whiteside Co., Illinois, told me in 1867, that he had applied pure petroleum to the trunks of about 100 apple-trees, infested by the Oyster-shell Bark-louse, and to about one half of such of their limbs as were 1½ inches and over in diameter; and that he can perceive no injurious effects. Before applying the petroleum, he pruned the trees well.

I think that there can be no doubt whatever, that petroleum, kerosene, benzine, lard, and generally any kind of animal or vegetable oil, will kill Bark-lice at any time of the year, though all kinds of watery infusions fail to have any effect upon the matured scale. The reason is obvious. The eggs under the scale can only be killed by some substance capable of reaching them through the protecting scale, which is glued too firmly and closely to the bark to allow of anything penetrating underneath it. Now, nature has made the scales *rain-tight;* but, as we have no showers of oil, she has not thought it necessary to make them *oil-tight*. Hence, oily substances will soak through the scale, and reach the culprit eggs; but watery infusions are incapable of doing this.

Whether some or all of these oily applications may not be more or less injurious to vegetable life, is a much more doubtful and disputable question. I saw an account in the *New York Tribune* several years ago, of a whole orchard being killed by applying "tanners' oil" to it, whatever that kind of oil may be. Perhaps it might have been applied in exorbitant quantities. Again: I have known a plum-tree killed by saturating a large cloth with kerosene, and wrapping it round the butt, under the ridiculous idea that the Curculio could thus be prevented from getting at the plums. Again: Mr. Mitchell, of Pennsylvania, writes to the New York Farmers' Club, that having been advised in the Proceedings of that Club to apply kerosene with a feather to young

cabbage plants, in order to keep off flea-beetles (*Haltica*,) he had tried it, and thereby killed 200 plants. (*New York Sem. Tribune*, June 26, 1866.) On the other hand, G. Goodsill, of McHenry Co., in North Illinois, asserts that he applied coal oil with a feather to young melon-vines, to keep off the striped Cucumber-bug, (*Diabrotica vittata*, Fabr.) without any injurious effects. (*Prairie Farmer*, April 1, 1865, p. 234.) Again: "W. T. W.," of Belleview, Iowa, says that he "lost one set of trees, some fifteen years since, by greasing them to keep off the rabbits, and would no more think of greasing fruit-trees than of chopping them down." (*Ibid.* Jan 6, 1866, p. 5.) And Mr. J. C. Plumb, of Madison, Wisconsin, asserts that he "has seen thousands of trees, from the nursery graft to the bearing size, ruined by greasy applications;" that if the trees are greased in the winter, "the grease should be washed off by lye or soft soap in the spring," and that "the worst possible time to apply grease is in the winter; and the same amount which would cause death, if applied then, would be harmless if applied during the flow of sap in the growing season." On the other hand, "Young Sprout," of San Jose, says: "I have greased my trees for the last three winters with equal parts of lard and coal oil, and in the spring washed off with a strong lye, and I have good thrifty trees." (*Ibid*, March 10, 1866, p. 151.) Lastly, which is the most important consideration of all, I find that there is a very general prejudice, both among practical and among theoretical men, against the application of oily substances to vegetable organisms. The subject is certainly a most difficult and important one, and the evidence rather contradictory; and it will require a series of carefully conducted experiments, which I hope to complete during the ensuing year, in order to arrive at any conclusive and satisfactory results. Probably benzine, as it evaporates more quickly and completely than kerosene (and, by the way, it is also much cheaper,) may be the least injurious of any of the oily applications; and perhaps all these oily substances may bear to be considerably diluted without losing their efficacy. Nothing but actual experiments, however, on an extensive scale can solve satisfactorily these and similar problems.

STATEMENT 5th. — In June, 1867, I used an old painter's brush, which had been worn to a stump, to scrub off the young newly-hatched Bark-lice from the larger limbs of an infested tree; and found it perfectly effectual. The lice fell before it as the grain falls before a reaping-machine.

STATEMENT 6th. — "An ounce of prevention is better than a pound of cure." When young apple-trees are purchased from the nursery, it will always pay well, in the northern parts of Illinois, to look them carefully over, and scrape off with a knife any scales of the Oyster-shell species that may be found on them. In the extreme southern parts of the State, this need not be done; for, as already shown, the Oyster-shell Bark-louse does not like the climate of that region and perishes if it is imported there. Recollect that every full-grown scale is a female full of eggs, and that the eggs average over 50 in number. There are absolutely no males in this crowd, to lessen the number of fruitful individuals. "Always plant a clean tree," is Dr. Mygatt's advice; and this advice of his is indisputably excellent. But unfortunately fruit-growers often wait till it is too late to fight the foe to advantage, and in the hurry and press of business the homely old adage is apt to be forgotten, that "a stitch in time saves nine."

Dr. James Weed, of Muscatine, Iowa, believes that this Bark-louse was almost entirely extirpated in his neighborhood by the intense cold — 27° below zero — of the winter of 1855–6. From the fact already twice stated, that it is a northern species, intolerant of a high summer temperature, I strongly incline to believe that there must be some mistake here. In the *Prairie Farmer* for Oct. 29, 1864, J. C. Plumb, of Madison, Wisconsin,

writes that the cold winter of 1863–4 had effected no diminution of the numbers of the Bark-lice, even in that high latitude.

As to what is a very current opinion amongst many of our most intelligent fruit-growers, namely, that it is only diseased, unhealthy, and badly-cultivated trees that suffer materially from Bark-lice, I am satisfied that this is an error. My own trees grow in garden soil, dug originally two spit deep, with a porous gravelly subsoil two or three feet below the surface, manured moderately every year with old thoroughly rotten cow manure, and cultivated through the summer; and the chief difficulty that I have with them is, that they grow too exuberantly and run too much to wood. Yet, in spite of palliatives applied from time to time, and in spite of my little friends the Mites, the Bark-lice are steadily gaining on me; and unless I make a vigorous onslaught on them before long, they will probably in the end overrun all my trees. The truth seems to be, that, after a certain number of years, the Mites and Insects that prey upon the Bark-lice become so numerous as to check them up permanently. And thus we can account for the notorious fact that in those northern regions, where only the Oyster-shell Bark-louse can thrive — as for example in Northern Illinois and Wisconsin — it is death upon apple-trees, for 6 or 8 years after it is introduced, but afterwards sobers down, and, though still a grievous pest, becomes, comparatively speaking, innocuous.

Before concluding this long chapter, I ought to caution the reader against a very prevalent, but a very delusive idea. People are perpetually reasoning upon the assumption, that any fluid substance, that they may apply to the limbs of a tree, is taken up by the sap and carried to the remotest twig; as if plants, like the higher animals, had a complete circulatory system of veins and arteries; whereas every botanist knows that it is no such thing. Whatever you apply to your tree to kill the Bark-lice, whether soapy solution or oily fluid, can only kill those insects that it actually touches, and will not be absorbed by the sap and carried unchanged to other parts, so as to kill the Bark-lice upon those parts. If it were otherwise, the apples on a tree that had been soaped would taste of soap, and those on a tree that had been treated with kerosene, would taste of kerosene. But that this is not so, every one may satisfy himself by an easy experiment, if he does not, as I do, know the fact already. Possibly, to a very limited extent, such substances as those referred to above may be absorbed by the cellular system of the tree; but even in that case they will undergo chemical changes, which will totally unfit them for destroying insect life. To believe that pure kerosene, or pure soap, applied to one end of a tree, will pass in the very same chemical form to the other end of it, is as absurd as to believe that liquid manure can be taken up by the roots of a tomato-plant, and pass in that form and without any chemical change into the ripe tomatoes.

CHAPTER IX. — Harris's Bark-louse. (*Aspidiotus Harrisii*, Walsh.)

I have discussed the Natural History of the Oyster-shell Bark-louse at such exorbitant length, that it will not be either necessary or advisable to dilate upon that of this species, further than to point out the very remarkable characters in which it differs from the other.

1st. The difference in the shape and color of the scales, and in the color of the eggs, has been already explained. (See above, page 37.) The eggs hatch out at almost exactly the same date, (June 5th, 1867,) but, instead of the young larvæ being yellowish white, and soon afterwards becoming covered with a white powdery bloom, so as to form conspicuous although very minute white objects on the bark, they are blood-red

at first and afterwards blood-brown, without any powdery bloom; and consequently, from their extreme minuteness and from their being very sluggish in their movements, they can scarcely be seen on the bark with the naked eye. On June 12th, I observed some — which I identified as belonging to this species because they were still under the parent scale — to be of a pale blood-brown color, without any powdery bloom; they had the same longitudinal ridge and transverse grooves as the other species. The inexperienced eye, if it noticed them at all at this date on the bark, would be almost sure to confound them with the natural pores of the bark, which at first sight they greatly resemble.

2d. I have been unable to trace satisfactorily the history of Harris's Bark-louse from June to September, because the Oyster-shell species had invaded every one of my trees, that had been originally occupied exclusively by the native species; so that it was difficult to distinguish one kind of larva from the other kind. I could only ascertain one point clearly, namely, that the matured scale of the female, which is milk-white, is not formed till about the middle of September, and that the eggs are not developed under that scale till the end of September or some time in October; whereas, as we have seen, in the other species the matured female scale, which is the color of the bark, is formed, and the eggs fully developed, by the middle of August. Certainly, from the middle of June to about the middle of September, the females must remain of the same dark inconspicuous color as before; for the white scales, which are so conspicuous, appear all of a sudden on the bark in the middle of September. Dr. Houghton, of Philadelphia, as well as myself, noticed this fact. He has 20,000 pear-trees badly afflicted by this pest. "Up to Sept. 15th," he says, "I flattered myself that there was not a living insect of this description in my orchard. I thought that the winter of 1865–6 had been so cold, that it had killed them all. But lo! on the 20th of September there were millions upon millions of Bark-lice on my pear-trees." (*Practical Entomologist*, II., p. 30.)

3d. On Sept. 17th, or some weeks before any eggs were developed, I lifted up over 10 perfected female scales. Under each of them, and entirely separated from the scale itself, I found a legless, beakless, fleshy, elongate-oval Bark-louse, about 2½ times as long as wide, with its body divided into pretty distinct segments, the 3 first of which, and in a less degree the 2 next, were very much hunched laterally. The color was yellow, blood-red, or pink, and the length about 0.03 inch. One of these *I saw move very distinctly*, showing that it was really alive.

4th. The scale of this species is of a much more delicate consistence than that of the Imported Bark-louse, and it rarely remains unbroken on the bark after the eggs hatch out, but is generally either more or less mutilated or entirely removed by the weather. The empty egg-shells are white, as in the other species.

5th. The empty scales, which are supposed by Harris to have produced males, may be found in considerable numbers in the autumn loosely attached to the bark, or some of them scarcely attached at all. Towards the spring they are generally most of them washed off by the weather. As these never occur on trees infested exclusively by the Oyster-shell species, they cannot belong to that species; and I therefore, by the method of exhaustion, infer them to belong to Harris's Bark-louse. They are oblong-oval in shape, of a pure white color, with the usual yellowish "larval scale" attached at one end, the remaining portion having its sides perfectly parallel, and being as wide as the "larval scale" is long, and in length from 2 to 2½ times as long as the "larval scale." There is no "medial scale" behind the "larval scale," as there always is in the ma-

tured female scale of every species of this genus known to me. I have never actually bred the males from this type of scale, neither, as it seems, did Harris; but I have now little doubt that Harris's opinion is the correct one, and that I was entirely mistaken when I formerly imagined, that these empty scales were the cast skins of the immature females. (*Practical Entomologist*, II. p. 32.)

As to the geographical distribution of Harris's Bark-louse, Harris found it, but apparently only in small numbers, in Massachusetts. Dr. Houghton is pestered with it awfully in Pennsylvania, and Dr. A. Chandler, Montgomery Co., Maryland, must also have it in abundance; for he says that his pear-trees "have stopped growing and are covered with *white* lice, which, when mashed with the point of a knife, discharge a *red* fluid." (*New York Sem. Tribune*, March 26, 1867.) I have myself seen specimens near Cobden, South Illinois, some of which occurred on the European Mountain Ash (*Sorbus aucuparia*,) a tree which Dr. Asa Gray places in the same genus as the Pear and the Apple. I have likewise received specimens from the orchard of W. C. Flagg, near Alton, in South Illinois. And it must occur in St. Clair Co., also, in South Illinois; for at a Meeting of the Alton Horticultural Society, May 2, 1867, President Pearson reported that he had found "upon trees purchased in St. Clair County, Bark-lice or Scale-insects containing eggs, which when broken gave out a *red-colored* juice." Dr. Mygatt mentions it, under the appellation of the "white variety" of the Oyster-shell species, as common in Kane and McHenry Cos. in North Illinois, and I have long found it pretty abundantly in Rock Island County, both on apple-trees and on the crab. Lastly Bark-lice, which, as it would seem, can only belong to this species, are reported from Hartville, Wright Co., Missouri, which is nearly in the latitude of the extreme southern point of Illinois, as "utterly destroying the best apple-orchards in that county, starting on the trunks of the trees, spreading rapidly on the branches, and then on the apples — killing large trees in two years." (*Rural World*, Oct. 15, 1866.) I heard no complaints of this insect being at present at all troublesome near Cobden, South Illinois; but at some future day it may likely enough make an irruption upon the pear orchards of Southern Illinois in full force.

I observe that on all my apple-trees, which were infested a year or two ago by Harris's Bark-louse, this native species is being gradually supplanted by the improved and highly-developed species from the other side of the Atlantic; just as the White Man is supplanting the Red Man in America, or as in New Zealand the European House-fly (*Musca domestica*, Linnæus,) and the Brown Norway Rat (*Mus decumanus*, Linnæus), are driving out the Native Fly and the Native Rat. (See Spencer's *Principles of Biology*, I, p. 389.) It is preyed on by the same Mites as the other kind, and, being so closely allied to it, must be attacked on the same principles and with the same weapons.

INSECTS INFESTING THE APPLE. — On the Root.

CHAPTER X. — The Apple-root Plant-louse, (*Pemphigus pyri*, Fitch,) commonly but incorrectly called in Illinois "The Woolly Aphis."

This insect has been very generally confounded with the true "Woolly Plant-louse" or "Woolly Aphis" (*Eriosoma lanigera*, Hausmann), which, so far as is known at present, occurs only on the Atlantic seabord, though it may perhaps eventually work its way Westward into the Northern parts of the Valley of the Mississippi. It is very true that both insects are "woolly," inasmuch as they both secrete a woolly or cottony substance

from the general surface of their bodies, and both are "Plant-lice," inasmuch as they both belong to the *Aphis* family; but they differ in their native country, they differ in the structure of their wing-veins and consequently in the genus to which they are referable, and they differ very widely in their habits.

The true "Woolly Plant-louse" is an imported insect, having been in reality introduced into America from Europe; though, singularly enough, it was misnamed in England "the American Blight," when it was first noticed in that country towards the close of the last century, and was erroneously supposed to have been introduced there from America. It is now, however, pretty clearly ascertained to have existed on the continent of Europe for time immemorial, and it probably emigrated thence into England on imported apple-trees.* The Apple-root Plant-louse, on the contrary, is a native American species, and in all probability infested our wild Crabs and Thorns in the olden time, and, when apple-trees were introduced here, saw fit to attack them also.

In the typical or normal Plant-louse there are in the front wing three branch-veins, springing successively out of the main or rib-vein which coasts along the outer or anterior edge of the front wing. In the genus to which the Apple-root Plant-louse belongs (*Pemphigus*), the 3rd of these branch-veins is *perfectly simple;* in the genus to which the true "Woolly Plant-louse" belongs (*Eriosoma*, otherwise known as *Schizoneura* or *Myzoxylus*), the 3d of these branch-veins is *once-forked;* in the genus to which the common Apple-tree Plant-louse belongs (*Aphis*,) the 3d of these branch-veins is *twice-forked.* Thus, on the very same Apple-tree, may be found examples of all these three genera — namely, the Apple-root Plant-louse, the true Woolly Plant-louse and the common Apple-tree Plant-louse — all distinct from each other by a very obvious character, and only in very rare and exceptional individuals of any of them running together by intermediate grades.

Harris indeed, on the authority of Hausmann and Knapp, asserts that the true "Woolly Plant-louse" never has any wings at all.† But Amyot and Serville describe the male as winged, (*Hemipt.* p. 612); Westwood describes both sexes as winged, though he confounds the genera (*Pemphigus* and *Eriosoma*) together, (*Introd.* II. p. 440 and *Synops.* p. 118); and lastly Mr. A. E. Verrill discovered in Connecticut in October numerous winged specimens, both of the males and of the females. (*Practical Entomologist*, I. p. 21.)

The true "Woolly Plant-louse" is a northern species, and, according to the European entomologist, Blot, cannot stand a hot climate even in its native country, Europe, being confined to Belgium, the north of France, Germany and England. Hence, so far, it has occurred in this country almost exclusively in New England. The Apple-root Plant-louse, on the other hand, seems to be far more destructive in a hot southern climate than it is towards the north. Again: the true "Woolly Plant-louse" never burrows underground to get at the roots, but inhabits exclusively the trunk and limbs of the Apple-tree, where it secretes large masses of cottony down. The Apple-root Plant-louse, on the contrary, lives habitually undergound, sucking the sap from the roots and causing thereon large excrescences and swellings, among which it secretes a bluish-white downy substance, which, at first sight, has much the appearance of mouldiness. It is, doubtless, true that, according to Dr. E. S. Hull, of Alton,

* See Harris's *Injurious Insects*, p. 242, and Amyot and Serville's *Hemiptera*, p. 606.

† See Harris's *Injurious Insects*, p. 243.

South Illinois, "it crawls upon the branches of the trees, during the summer, and is distributed broadcast through the orchard by the force of the winds, retiring underground and congregating about the roots on the approach of cold weather;" (*Agr. Rep. Mo, Append.*, p. 451;) and that, as Wm. Carpenter, of Cobden, South Illinois, informed me, "it occurs in young trees in the nursery, two or three feet from the ground, but only," as he thought, "in damp weather." But I myself saw three or four wingless specimens, subsequently taken by Mr. Carpenter off the trunk of a good-sized apple-tree during the long drought of the autumn of 1857, which I carefully compared with similar specimens captured by myself on the roots, and found to be identical. Moreover, in December of the same year, Mr. W. C. Flagg, of Alton, South Illinois, sent me, alive and in excellent order, quite a number of specimens, gathered at that unseasonable period off the trunks of good-sized apple-trees, which, on the most careful comparison, differed in no respect from the root-feeding individuals. Mr. Flagg, however, informed me that "it is found more generally on the surface of the ground, where there has been straw or some such substance heaped around the tree." Still, all such cases as these are evidently the exception, and not the rule; and there can be little doubt that the great bulk of this species live underground, and that it is on the roots that they are to be dreaded, and on the roots that they are to be fought.

As long ago as 1848, Mr. Fulton, of Chester Co., Pennsylvania, found this insect and the knotty swellings produced by it to be so abundant on nursery-trees in his neighborhood, that thousands of young trees had to be thrown away, and it became difficult to supply the market. (Downing's *Horticulturist* III., p. 394.) M. L. Dunlap, (*Rural*), in a letter to the *Chicago Tribune*, (in August, 1858,) writes nearly as follows: — "In the orchard of Dr. Long, near Alton, the 'Woolly Aphis,' infests the roots in immense numbers, and by sucking up the sap destroys the trees, which in its effect has much the appearance of dry rot. Dr. Long erroneously attributes the death of his trees to water standing about the roots." Mr. Jordan, one of the St. Louis nurserymen, informs me that at this present day he is greatly troubled with it on his land, so that he finds it difficult to get enough of clean roots to graft with. According to Dr. Hull, "it is one of the worst enemies against which our apple-trees have to contend, and is much more common in our region than is generally supposed." (*Agr. Rep. Mo. Append.* p. 451.) In the summer of 1867 Mr. O. B. Galusha, as one of the *ad interim* committee of the Illinois State Horticultural Society, visited Cobden, South Illinois, and collected large quantities of the roots infested by this Plant-louse, which he transmitted to Mr. C. V. Riley for examination, expressing the opinion, at the same time, that "the destruction of the apple-orchards, in this vicinity, by this insect, or by the fungus that accompanies its operations, seems inevitable, unless a remedy is soon discovered." (*Prairie Farmer*, June, 1867, p. 397.) When I was at Cobden myself, in November, 1867, I personally examined the orchard of Mr. Paul Wright, and found that small groups of apple-trees had been killed by this Plant-louse in several directions, some of them having perished with the half-matured fruit still hanging on their boughs. In one spot of ground no less than nine trees, all in one square patch, had been killed by it; and separated therefrom by only a single row of living trees, there were two or three more dead trees. Digging down to the roots of the live trees, that intervened between these two gaps in the orchard, I found at once great numbers of the enemy — none of them, however, in the winged state — and also abundance of roots, clubbed, knotted and distorted, in almost every imaginable form, by their punctures. On examining the trees, that had been killed, several months previously in the summer, I found that their roots were

now completely rotted, so that nothing remained of them but a few short snag attached to the butt, and the first high wind that came would necessarily blow th tree over. On the dead and decayed roots of such trees, I found, of course, no Roo lice; but Mr. Wright assured me that they were to be met with on the roots in grea numbers in the summer, when the trees first began to droop and wither. Among th living roots on which I had found living Root-lice, there were a few roots as completel dead and rotten as those of the dead trees.

At first I imagined that every tree must have been infected, when it was originall received from the nursery. But Mr. Carpenter subsequently informed me, that he ha found the insect in abundance on the roots of seedling apple-trees, in the autum following the spring when the seed was sown; and another fruit-grower told me, tha he had seen it on the roots of seedling apple-trees, when no other apple-trees wer within 200 yards, and on land lately reclaimed from the forest. Clearly, therefore, th insect must pass from tree to tree, either in the winged form which Dr. Fitch foun it to assume in October, in the State of New York, or by some of the wingless indivi uals, that inhabit the trunk or limbs, being blown to and fro by the winds through th instrumentality of the light, feathery down, which exudes from their bodies. Prob bly the species has always existed on the roots of certain forest-trees in this whol region of country; and when apple-orchards began to be planted, it emigrated on t the apple-trees.

This rotting away of the roots, which, as it appears, had been noticed as long ag as 1858 by Mr. Dunlap, and attributed to its true cause, is popularly known in Sout Illinois as "rotten-root," and was, at one time, considered as a mere natural deca superinduced by the system of root-grafting now so very generally adopted in th West; while, as we have seen, Dr. Long, of Alton, attributed it to the operation stagnant water on the roots.* The "Early Harvest" apple is said to be peculiarl subject to this mortal malady. Similar cases, where insects give the preference to on particular variety, or avoid one particular variety of a cultivated plant, are commo in Economic Entomology. For example, the Colorado Potato-bug (*Doryphora* 1 *lineata*, Say) is known to avoid the Peach-blow Potato, and, as has been already showu (above, page 24), the Rose-bug prefers the Clinton to all other grape-vines.

But although the more southern parts of Illinois are far worse afflicted by this insec than the northern counties, yet it exists and does considerable damage even in Nort Illinois. Mr. Kinney, the Rock Island nurseryman, informs me that he has often notice a woolly louse, which can be nothing else but this species, on the roots of his youn apple-trees, along with just such knots and swellings as it usually produces elsewhere and he has himself lost four or five bearing apple-trees, and knows of 20 or 25 othe

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*Mr. Riley informs me that apple-trees, and more especially those that are young, sometimes die South Illinois "with their roots ENTIRE and discolored throughout from the surface-mark downwards but with "no trace of any insect whatever;" and that this very distinct disease is "known in the We and by Warder, Flagg and others as 'Rotten-root.'" I am quite confident that the dead trees, with the roots almost entirely rotten, in Mr. Wright's orchard were killed by the Root-louse; and the peculi appearance which they presented has been already described, so that it can be recognized with facilit But I by no means wish to be understood as asserting, that every apple-tree that dies in South Illino dies of the Root-louse. Perhaps, under the popular name of "Rotten-root," two very distinct affectio of the roots of the Apple-tree have been confounded together, the one caused by the Root-louse, and t other arising from unknown causes. I hope to investigate this question more fully during the comi season.

that have been lost by his neighbors, through what, from his description, must be the same "rotten-root" that prevails, so extensively in South Illinois. Mr. L. Woodard, nurseryman, of McHenry county, North Illinois, also told me, that he had occasionally noticed a few woolly lice on the roots of his young apple-trees, accompanied by the usual deformation of the root. Mr. Ira L. Bailey, President of the Carroll County Horticultural Society, North Illinois, likewise informed me that he had himself lost three large apple-trees by the same universal "rotten-root." And finally I heard that Dr. Pennington, the extensive fruit-grower of Whiteside Co., North Illinois, had sometimes noticed "woolly plant-lice" on the limbs of his apple-trees, but not in any considerable numbers. Hence there is pretty satisfactory evidence that this insect exists, though apparently in greatly reduced numbers, up to the most northerly parts of the State.

I found it to be a very general notion at Cobden, that the soil there was full of this Root-louse — that it existed in earth that contained no roots at all and in old rotten stumps — and that it was abundant on the roots of almost all forest-trees, especially on those of the Persimmon (*Diospyros virginiana.*) No plant-louse, however, can possibly live, except on the sap of some living and growing plant; and therefore, if any of these Root-lice are found in old dead stumps &c., they must, for purposes which will be afterwards explained, have been carried there by the ants; as I have ascertained to be actually the case with certain other species of the very same genus. That there is a Plant-louse infesting the roots of the Persimmon in that neighborhood, I fully believe; because, on digging down among the roots of that tree, Mr. Riley and myself discovered the peculiar bluish-white mould, which is characteristic of Root-lice, though we failed to find the insect itself. But it is impossible that this can be the same species as infests the Apple-tree, because the Persimmon and the Apple-tree belong to widely distinct botanical families; and it is a rule to which there is not one solitary exception, that, when a particular species of Plant-lice infests more than one species of plants, those species of plants always belong to the same botanical family, and usually to the same botanical genus. For the same reason, if any Root Plant-lice are found on Oak, Beech, Ash, Mulberry, Sassafras, Tulip-tree (Poplar), Cucumber-tree, Elm, Hickory, Walnut, Birch, Poplar (Cottonwood &c.,) Hackberry, Sumac, Dogwood, Grape-vine, Sycamore (Plane-tree,) Hazle, Basswood, Maple, &c., they cannot possibly belong to the same species as infests the Apple-tree, and, if transferred to the roots of the Apple-tree, they would soon starve to death and perish. On the other hand, it is highly probable, that the very same species, that infests the roots of the Apple-tree, infests also the roots of the Crab and the Thorn; and it may possibly occur on those of the Plum, the Cherry and the Peach, and even on those of the Blackberry and the Raspberry; for all these last named plants belong to the same botanical family as the Apple-tree. It is observable, however, that, although Apple-trees and Peach-trees are commonly grown in the same orchard near Cobden, yet I did not hear of a single case, where the roots or bark of the Peach-tree had been found to be infested by this insect, or any other at all resembling it.

Persons, who are not familiar with the habits and classification of Insects, are apt to think that all Plant-lice — different as some of them are in shape, color, size and habits — are mere varieties of one and the same species; just as all dogs, however much they may differ from one another in such respects, yet belong to one and the same species. But it is by no means so. Whatever food one variety of Dog will live on, another variety of Dog will live on equally well. But shift the Apple-tree Plant-louse on to a

Cherry-tree, or the Cherry-tree Plant-louse on to a Plum-tree, or the Plum-tree Plant-louse on to a Peach-tree, and it will before many days die of starvation. Yet these trees all belong to the same botanical Family. Dr. Fitch has remarked that the imported species of Plant-louse, that inhabits the tame Cherry-tree, cannot live even upon any of our wild Cherry-trees, and that even the wild Black Cherry (*Cerasus serotina*) and the Choke-cherry (*Cerasus virginiana*), closely related as they are, are inhabited by distinct species. (*N. Y. Rep.* I. p. 131.) Again: the Currant and the Gooseberry belong to the same genus. The Currant is notoriously infested by a Plant-louse (*Aphis ribis*, Linnæus) which has been imported along with that shrub from Europe. Yet, although these two plants are often grown in gardens side by side, nobody ever saw any plant-lice of any kind on the Gooseberry, much less the true Currant Plant-louse. Yet, if the same species of Plant-louse can feed almost indiscriminately upon any kind of plant, why does not the Currant Plant-louse emigrate on to the Gooseberry? I have myself observed that different species of Plant-lice (*Aphis*) inhabit different species of Oak; for example, the Handsome Plant-louse (*Aphis bella*, Walsh) is peculiar to the Black Oak (*Quercus tinctoria*), where, since I described the species, I have found it in abundance in company with its larva; and an undescribed species of the same genus, with remarkably stout branch-veins to its front wings, is peculiar to the Swamp White Oak, (*Quercus prinus*, var. *discolor*.)

As regards the Root Plant-lice, we know but very little of the species found in this country, because, like other underground insects, they are hidden from our observation in the bowels of the earth. Indeed, besides the species now under discussion, the only other described North American species are two, which I myself was the first to discover and describe in the winged state, and which I found to be carried home by certain Ants to the nests inhabited by the young larvæ of these Ants, for the sake of the sweet, woolly matter secreted by them, and thence carried back again to the roots on which they fed—just as a dairyman drives his cows up to be milked and then drives them back again to pasture.* Both these species are quite distinct from the Apple-root Plant-louse; and I am acquainted with several others, but only in the wingless state, which are also quite distinct from that insect. As to the true "Woolly Plant-louse" of the Apple-tree, the European entomologist Blot says, that "it can only live upon the Apple-tree, and if transplanted upon any other tree, it very soon perishes." (Amyot and Serv. *Hemipt.* p. 610.)

What is probably THE WINGLESS FEMALE FORM of this APPLE-ROOT PLANT-LOUSE measures, when fully grown, about 0.07 inch long, at which time, after removing the white down, it is of a dull lead color. The antennæ are indistinctly 6-jointed, with the length of the joints proportioned nearly as 2, 2, 4, 2, 2, 3, the last joint including a short terminal seta (*unguiculus*). The beak extends to the base of the middle legs.

The color of THE YOUNG LARVA is dull yellowish, as described by Fitch. The antennæ are indistinctly 5-jointed, the joints nearly equal, joint 3 a little the longest, and 5 with a minute terminal seta. When the larva is very young indeed, the beak is longer than the body, and projects behind so as to resemble at first sight, the honey-tube of the genus *Aphis* and its allies. When older, the beak is about two-thirds, as long as the body.

I have not yet obtained THE WINGED FORM OF THE FEMALE; but a full description of it is given by Fitch. It occurred in New York on October 29th. (*N. Y. Rep.* I. pp. 9—10.)

After a group of these lice has been stationed on a root in the open air for two or three

*See Proc. Ent. Soc. Phil. I. pp. 307—8; and Trans. Ill. State Agr. Soc. V. pp. 493—4.

days, they become completely enveloped in a white cottony mass, the filaments of which are five or six times as long as the insects themselves, and, though somewhat crinkled and irregular, radiate in general from the body of the insect as from a centre. Attached to this mass may almost always be seen one or two globules of sap, such as we often meet with rolling about among the powdery matter secreted by the Plant-lice that inhabit "Galls." Dr. Fitch figures and describes the cottony matter as protruding only from the tip of the abdomen of the larva; (*N. Y. Rep.* I. p. 9); but in reality it proceeds in an infinity of very fine filaments from the general upper surface of the insect, though perhaps, as stated by Mr. Riley, it is secreted rather more densely on the hinder portion of the back. Most certainly it is not secreted exclusively either from the mouth or from the tail; for I have had hundreds of these lice sucking away at apple-roots in a glass vase for a month, and have thus been enabled carefully to study the mode in which the cottony matter is produced. So far as regards the winged insect, Dr. Fitch expressly says that "the head and the abdomen on its back are covered with a dense mass of flocculent down;" (*ibid.;*) and Dr. Harris, speaking of the larva of the true Woolly Plant-louse, says that the cottony down "seems to issue from all the pores of the skin of the abdomen." (*Inj. Ins.* p. 243.)

Dr. A. S. Packard, junr., of Maine, has published some very amusing and sprightly banter, in ridicule of my theory, that the cocoon of all Gall-gnats (*Cecidomyia*) is *exuded from the general surface of their bodies*, not, as in the case of Caterpillars &c., *spun from the mouth*, which this author maintains to be the true theory in the case of Gall-gnats. If he had given himself the trouble to read the paragraphs which he undertakes to criticise, he would have seen that, in the case of two distinct species of Gall-gnats, the fact of the cocoon being *exuded* and not *spun* has been proved by actual observation by Winnertz and by Osten Sacken.* And as to his disbelief in the possibility of any cocoon being exuded from the general surface of the body, if he had ever examined with his own eyes any of these Woolly root-feeding Plant-lice, he would have seen at once that the woolly matter is not secreted from the mouth, nor even from the tail, but from the general surface of the body. Many other larvæ do the same thing. On May 25th I found in a nest of Yellow Ants (*Formica aphidicola*, Walsh,) situated in the decayed stump of a Honey-locust, several remarkable woolly larvæ, which a month afterwards produced a species of Ladybird (*Hyperaspis punctata*, Melsh.) These larvæ were covered on the back with dense white cottony down, precisely like that of root-lice; on removing some of which *lightly* with a moist camel's hair pencil, little globules of a yellowish fluid started out from the skin of the larva, evidently from the same pores from which the cottony down had previously exuded. This is the only genus of Ladybirds (*Coccinella* family) known to me, the larvæ of which exude matter of this precise description from their bodies; but it was long ago discovered that in another genus (*Scymnus*) the larvæ have their bodies garnished with whitish cottony tufts; and on examination it will be found that these tufts also are mere secretions from the pores of the body, and not organized appendages like the hairs of a caterpillar or the scales on the wings of a butterfly. The bluish white powdery matter, which is well known to form gradually on the outside of the bodies of certain male Dragon-flies (*Libellula* and *Agrion* families) as they approach maturity, and also on those of several other insects belonging to other Families and Orders, for instance the so-called Locusts (*Cicada* family,) must

*Compare my Paper *Proc. Ent. Soc. Phil.* III. pp. 560, 562 and Dr. Packard's Paper *ibid.* VI. pp. 214—5.

manifestly be produced on similar principles. And, as we have seen in the case of the larva of the common Oyster-shell Bark-louse, the powdery bloom and the cottony floss, spoken of above, are met with at the very same time and in the very same insect; both of them proceeding, not from the mouth nor even from the tail, but from the general surface of the body.

It is scarcely worth while, however, to argue such points as these with a writer, who is actually so ill-informed as to assert that "everybody knows that the silk spun by insects is exuded through the mouth." (*Dr. Packard's Paper*, p. 214). It is very true that it is so in the case of caterpillars, &c.; but in the case of the Ant-lions (*Myrmeleon*), the Caddice-flies (*Phryganea*), the Lacewing-flies (*Chrysopa*), and probably of all true Neuroptera, as distinguished from the Pseudo-neuroptera, everybody knows, or ought to know, that it is "exuded," not from the mouth, but from the tail.* Moreover, all the spiders without exception — which group of Articulate Animals Dr. Packard, in common with the school to which he belongs, classifies as Insects — also spin from spinnerets placed, not in their mouths, but in their tails. Yet, because this writer had happened, perhaps, once or twice in his life, to see a caterpillar spin from its mouth, he jumps to the conclusion — with the same propensity for sweeping generalizations that characterizes everything that he has published — that all insects without exception spin from the mouth! ! !

From the enormous rate at which all Plant-lice multiply, it is plain that, if there were no check upon the increase of this species, it would, in a few years' time, destroy every apple-tree in South Illinois. But, in all probability, there does exist one such check, at all events. Right in the middle of a little colony of these Root-lice I discovered in November the pupa of what I am pretty sure is a *Syrphus* Fly; and Mr. Riley, to whom I showed the specimen, told me that he had formerly found great numbers of the larva of the same species among the infested roots — that he had reared it to the pupa state — but that he could never succeed in breeding it to the winged state. Apparently, this is the same insect, which, in the *Prairie Farmer* of June 15th, 1867, that gentleman mentions as, "having been always found by him in conjunction with this Root-louse, though he had failed to breed it," and which he there describes as "a footless maggot five or six times as large as the Root-louse, and of a dirty yellow color, attenuated at both ends, the head being quite retractile;" and which he afterwards pronounces to be "doubtless the larva of a *Cecidomyia*, the same Family to which the Hessian Fly belongs," and to "take some part, probably, in inducing the deformities of the roots." But certainly the insect that I showed to Mr. Riley does not even belong to the same great group of the Two-winged Flies as the Gall-gnats (*Cecidomyia*), inasmuch as it has what is called a "coarctate" pupa; (see above, pp. 31–2; and I feel pretty confident that it will prove to be the Cannibal appointed by Nature to prey upon these unruly root-feeders, and keep them within reasonable bounds. The *Syrphus* family, however, to which it apparently belongs, includes many genera which, in the preparatory states, can scarcely be distinguished from each other, and some of which feed upon decaying animal and vegetable substances, (*Xylota*, &c., while others (*Syrphus*, *Scæva*, *Volucella*, &c.,) are Cannibals and feed upon other insects. In any case, I hope before next summer is over, to solve the mystery definitively, by rearing the winged Fly from the pupa which I found. If, as I confidently anticipate

*See Kirby & Spence's *Introduction*, letter 13th, end; letter 21st, near the end; Fitch, *N. Y. Rep.* I p. 79; Shimer *Proc. Ent. Soc. Phil.* IV. p. 210.

it should prove to belong to one of the Cannibal genera of the *Syrphus* family, the reason why Mr. Riley failed to breed it becomes manifest at once. He supposed it to feed upon vegetable matter, and therefore his specimens, being, in all probability, not supplied with a due allowance of their natural diet — the Root-lice — perished o f starvation. Such accidents often happen to the most experienced breeders of larvæ ; and, moreover, almost all Cannibal larvæ are much harder to breed than plant-feeding larvæ.

In quoting what I believe to be a mistake made by Mr. Riley in regard to the above larva, I intend no disrespect whatever to that industrious and intelligent entomologist. There is not an entomologist, living or dead, in any country of the known world, who has not, at one time or another, made such mistakes ; and I am not ashamed to confess, that I have repeatedly myself blundered in the same manner. For example, I once took the dead and dried-up larva of a small Gall-gnat (*Cecidomyia*) for the larva of a Gall-Fly (*Cynips ;*) but, as soon as I discovered my error, I embraced the earliest opportunity of acknowledging it in print. And here lies the difference between the men that write for victory and the men that write for truth. The latter frankly confess their errors as soon as they become aware of them ; the former claim to be infallible, and never will allow that they have been in the wrong. I could name an entomologist of deservedly high standing in America, who has published, within the last twenty-five years, several volumes about insects, and has therefore, of course, made several mistakes in the course of his scientific career, which have been from time to time corrected by other entomologists in print. Yet, from one end to the other of his works, no man can point out a single passage, where he has ever acknowledged himself to have been in the wrong. Like the horse-jockey in the old story, having once said that the horse was 16 *feet*, not 16 *hands* high, he will never go back on his word.

As to remedies against this insidious little pest, I believe that the cheapest and best one will be to drench the roots of infested trees with boiling water. Mr. C. T. Farrell, of Cobden, informed me that he had tried this prescription — which was originally recommended by Mr. Riley — and that he had found it effectual. Ashes, which have been advised to be used by Dr. Fitch, he found of no use ; but a strong wash of soap and water proved to be generally, though not always, effectual. Other gentlemen had found the free application of unleached ashes injurious to their trees. There need be no apprehension that hot water, when applied to the roots, will kill or injure the tree ; for it has been extensively used without any ill effects to kill the borer in peach-trees, and to kill the maggots in young growing onions. Indeed, it is a very general law that vegetable organisms will, for a short time, stand a much higher temperature than animal organisms, without any injury to their tissues; and, in certain cases, boiling water seems actually to stimulate the vitality of seeds, instead of impairing it. For it is well known that neither Locust seeds (*Robinia*) nor Honey-locust seeds (*Gleditschia*) will grow the first year, unless they are scalded , and that, if they are scalded, they germinate as freely as Maize. As regards Honey-locust seeds, I am assured of the truth of this fact by Mr. Whitney, of Lee Co., in North Illinois.

Before young apple-trees, especially those raised in the Southern part of the State, are planted, the roots should always be soaked a considerable time, either in a strong solution of soap, or in strong tobacco-water — the latter would probably be the more effectual of the two. Thus, if the insect is not already in the vicinity, it may be prevented, perhaps, for a long series of years, from getting there ; for whatever root-lice may exist on the roots of the young trees, will, by this means, be effectually destroyed before these young trees go into the ground.

INSECTS INFESTING THE PLUM. — On the Fruit.

CHAPTER XI. — The Plum Curculio. (*Conotrachèlus nenuphar*, Herbst.)

In the *Practical Entomologist* (Vol. II. pp. 75–9) I have dilated so fully on the Natural History of this pestilent little Snout-beetle, and on the most approved methods of fighting it, that it will only be necessary to add a few items here on these two subjects and to correct such errors as I have fallen into.

Although the Curculio now infests the cultivated species of Plum (*Prunus domestica* Linnæus,) to fully as great an extent as our common wild species (*Prunus americana*, yet it is only at a comparatively recent date that it attacked our cultivated Plums, and since that epoch it has been growing every year worse and worse, and making on slaughts upon other fruits such as the Peach, the Cherry, and even the Apple. "Curculios," said the Hon. D. J. Baker, in 1855, "were unknown and never made their incursion into this region, until some years after the organization of our State Government," A. D. 1818. (*Transactions Illinois State Agricultural Society*, II. p. 48.) There can be little doubt, however, that Curculios have existed for time immemorial in our State, breeding in wild plums; because, before tame plums and peaches and apricots were imported into this country from Europe, the insect must necessarily have bred in the wild plum, and wild plums are very abundant in Illinois, and moreover we know from our present experience, that the climate of Illinois is quite congenial to the constitution of this insect. It would certainly, therefore, seem to follow that, in this as in so many other cases, when an insect has incidentally acquired a habit of feeding indiscriminately upon a different species of plants, to that upon which alone it naturally fed in the first instance, it transmits that habit by the laws of inheritance to its immediate descendants. When a race has once been formed, having such a habit, nothing seems more natural than that, under certain peculiar circumstances, such for instance as the absence of the original food-plant, another race should be very slowly and gradually formed, which exclusively attacks the new food-plant. If we suppose this second race to interbreed exclusively with itself, and to have thereby acquired, in a long series of ages, either a moral indisposition or a physical incapacity to interbreed with individuals belonging to the original race, then it becomes almost as effectually isolated from the original race, as if it were separated therefrom by the Atlantic Ocean, or by such an insurmountable barrier as the Rocky Mountains. Now, we know that races of insects, and indeed of other animals as well, when separated from each other by such physical barriers, often run into what are technically termed "geographical races;" that is, come to differ constantly from each other in more or less slight peculiarities of size, form, or color. Hence it is but reasonable to suppose, that distinct races of some particular insect, inhabiting the same geographical area, but feeding upon distinct plants and never interbreeding with each other, should also, in a long series of ages, come to differ from one another in size, form, or color. Such distinct races I have proved to have an actual existence in numerous cases, and have given them the name of "Phytophagic Species."*

I by no means infer that, in the case of the Snout-beetle that infests our Plums, our

* See my Papers on this subject in the *Proceedings of the Entomological Society of Philadelphia*, Vol. III. pp. 403–430 and Vol. V. pp. 194–216.

Peaches, our Cherries and our Apricots, such a phenomenon has as yet occurred, and that the plum-feeding form is a different species from the cherry-feeding form, and that again from the peach-feeding form, and so on. There is no reason whatever to think so. But there actually, in my opinion, does exist a "Phytophagic species" of the common Curculio, which is uniformly one half larger and which in the larva state feeds, not upon stone-fruit or pip-fruit, but upon green Butternuts and Walnuts (*Juglans*,) from the former of which I bred two individuals Aug. 13th. Of this peculiar type of Curculio I sent specimens 6 years ago to our great North American authority in the Order of Beetles, Dr. J. L. LeConte; and he pronounced them to be mere varieties of the Plum Curculio. They scarcely differ from that insect in any other perfectly constant character than size;* and at first sight we might suppose, that the increased size was caused merely by the Butternuts and Walnuts being more nourishing and stimulating food than Plums and Peaches; and that a Curculio bred in a Butternut would be just as likely as not to lay its eggs in a Plum, and the reverse; thus showing that here no distinct "Phytophagic species" has yet been formed. This was the opinion of Dr. Fitch; for he says that "the specimens found on Butternut trees are always larger in size than those found on cultivated fruit-trees, indicating that they have been better fed during the larva or growing period of their lives." (*Address on Curculio*, 1860, p. 17.) But there is a remarkable fact, which proves satisfactorily to my mind that this cannot be so, and that the two races are perfectly distinct and do not interbreed, each confining itself strictly to its peculiar food-plants. The fact is simply this:—I have beaten hundreds and hundreds of Curculios of the small-sized type off fruiting wild Plum-trees, but I never yet beat a single specimen of the large-sized type, which inhabits Butternuts and Walnuts, off a Plum-tree of any species or in any state. Of course, if that large-sized type had acquired no hereditary indisposition or incapacity to breed in Plums, it would be just as likely to occur on the Plum as on the Butternut or Walnut. But if, as the facts indicate, it really has acquired such a hereditary indisposition or incapacity, and if it interbreeds only with its own race, then—according to what I consider to be the essence of the term "species"—it is a distinct species. You may, if you please, for the sake of precision, give it a distinctive appellation, and call it, for example, a "*Phytophagic* species;" but still it is, in my acceptation of the term, a true species.

In the recent much enlarged and improved edition of the "Origin of Species," Mr. Darwin has quoted with general approbation my views upon this very interesting subject, but has incidentally remarked that I am "forced to *assume* that those forms which have lost the capacity for intercrossing should be called species." (*Fourth English edition*, pp. 55–6.) This, I think, can scarcely be called an *assumption*. It is a *definition*.

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* There is, I believe, a slight, but perfectly constant colorational character by which these two forms are distinguishable. The broad band behind the polished black humps on the wing-cases is, in the large-sized nut-inhabiting form, of a dingy white color with a few milk-white spots. In the small plum-inhabiting form, this same band is of a bright ochre-yellow color, with more or less milk-white spots, which last however, never occupy more than one-half of the ochre-yellow band. Moreover, I am informed by Dr. Hull, that the larva of the large-sized form—with which he has long been familliar—occurs with him in hickory-nuts having their shucks marked by the characteristic crescent-slit, and that this larva "penetrates to the kernel of the nut." Whereas, as is well known, the larva of the small sized form that frequents the plum, never under any circumstances penetrates to the kernel of that fruit. This difference in the habits of the two forms, is certainly very remarkable.

Naturalists have been puzzled for ages to designate satisfactorily what they mean by the term "species," and all kinds of loose and shadowy and intangible explanations of the term have been given; the latest discovery being that of an American refuter of Darwinism, flourishing in the great City of New York, who defines a "species" as a "specific form;" which is much like explaining the term "yellow" by saying that it means "that which possesses yellowness." Darwin himself maintains that species are not essentially different from mere varieties. In their origin, I allow that they are the same; for I believe with Darwin that every species originated from a variety of some pre-existing species. And I further allow that there is a transition period, during which it is impossible to say whether a particular form is a variety or a species. But that does not prove that varieties and species are essentially undistinguishable. Every man was originally a boy; and there is a certain period during which it is difficult to say whether a particular individual is man or boy; but that does not prove that manhood is undistinguishable from boyhood. For myself, more than a year before I published on the subject of "Phytophagic species," I announced it as my opinion, that the meaning of the term "distinct species" was simply "those that do not now in general mix sexually together, or, if geographically separated, would not do so, supposing them to be placed in juxtaposition;" and that "the only valid practical criterion of specific distinctness is the general non-existence, either actually ascertained or analogically inferred, of intermediate grades in the distinctive characters, whence we may reasonably infer that the two supposed species are distinct." (*Proceedings Entomological Society Philadelphia*, 1863, II., p. 220.) It is in this sense, and in this sense only, that I have ever used the term "species;" and to call such a definition an "assumption" seems to me much the same thing as saying that Euclid *assumes* a fact, when he *defines* a circle as a plane figure having all its external points equidistant from a given internal point.

But to return from this tedious digression:—It has long been a puzzle to Naturalists, why the Plum Curculio should cut the well-known crescent-shaped slit in the fruit, and why a round hole would not answer its purpose equally well. Harris and Fitch and other authors tell us, that "it first makes a small, crescent-shaped incision with its snout in the skin of the plum, and then, turning round, inserts an egg in the wound."* Misled by these authorities, and never having personally examined into the point, I copied their statements in my Paper on the Curculio. But Mr. F. C. Hill, of Ohio, has since shown, that we have all of us been in the wrong, and that the Curculio first of all bores a round hole with her snout, "not straight in, but slanting backwards, so that the cavity is just below the skin, then deposits her egg in the hole, and then cuts the usual crescent-slit in front of it, so as to undermine the egg and leave it in a kind of flap, formed by the little piece of the flesh of the fruit which she has undermined." (*Pract. Entomol.* II. p. 115.) Mr. Hill very acutely suggests, that the object of this complicated process is, "to wilt the piece around the egg and prevent the growing fruit from crushing it;" and I have no doubt at all that this is the true explanation of the phenomenon. The same end is attained, as we shall see hereafter, but by a very different process, in the case of the Plum Gouger (*Anthonomus prunicida*, Walsh), an insect belonging to a widely distinct group of Snout-beetles. It may be added here, that the "phytophagic species" of Curculio, that I bred from the green Butternut, makes just

* See Harris's *Injurious Insects*, p. 76, and Fitch's *Address on the Curculio*, p. 18.

the same crescent-cut in the green shuck of that fruit, as does the Plum Curculio in the flesh of the Plum.

In the Paper already referred to I gave my reasons for the belief, that the Curculio passed the winter in the perfect state. Mr. Holcomb, of Cobden, South Illinois, has since assured me, that he also has found the insect under the bark of his trees in the winter. Still, it was difficult to believe, that beetles coming out in the middle of July could live all through the winter, and until the middle of the following June, so as to be able to sting the plums at that period. This difficulty is now, I think, almost entirely done away with. I find that there are two distinct broods of the Plum Curculio every year, the first of which comes out in the beetle state, in the latitude of Rock Island, from about July 19th to August 4th, and the second from about August 23d to September 28th. The first brood of beetles, which is generated by females that have passed the winter in the beetle state, and have attacked the early fruit, lays in the more matured fruit the eggs from which proceed the second brood. The second brood of beetles comes out late in the same season, and the females, at all events, if not the males, live through the winter, and repeat in the succeeding season the process detailed above. Thus, as will be seen at once, the Curculio differs from the Apple-worm or Codling Moth (*Carpocapsa pomonella*, Linnæus), which, as has been already shown, is also double-brooded, in this, that the former passes the winter in the perfect state, and the latter in the larva and pupa states.

After I had made the above discovery, but before I had announced it to any one, Mr. Holcomb, of South Illinois, at the meeting of the American Pomological Society at St. Louis, Sept. 12th, 1867, in opposition to the contrary opinion of Dr. Trimble, the State Entomologist of New Jersey, asserted his belief that in his neighborhood there were two distinct broods of Curculio. And for this belief he gave as a reason, that, in jarring his trees for Curculios, he had observed that there was a particular period in the middle of the summer, during which no Curculios, or, at all events, but very few, were to be met with, while both before and after this period they swarmed. I found, in November, 1867, that many of the other fruit-growers near Cobden, and perhaps all of them, agreed with Mr. Holcomb upon this matter. I also remark in the *Prairie Farmer* for July 27th, 1867, (p. 55,) the following from Cobden, signed by "V," and evidently written shortly after July 20th, 1867. "There were scarcely any Curculios to be found before the recent rains, since which time they have been coming out of the ground in numbers, and when caught their wing-cases are usually quite fresh and soft —a fact which proves that there are exceptions to the rule that this insect is one-brooded; for, while it may invariably be so in the North, it is more frequently two-brooded in this region."

Still, it must be evident that all these facts are perfectly consistent with my old hypothesis, namely, that the Curculio is only one-brooded, and that those that come out of the ground with soft wing-cases in July, live through the winter and are the same individuals that sting the plums in the June of the following year, shortly after which they die, and a more or less brief interval ensues before the July brood makes its appearance.

Inasmuch as my bare assertion, that there are annually two distinct broods of Curculios, would very probably be disbelieved or disputed by authors, who have hitherto held the contrary doctrine, it may be as well — at the risk of being tedious — to give the details of the experiments upon which my conclusions were based. Those who have no taste for such dry things as facts and figures, can skip the two following paragraphs.

Experiment 1st. — On June 24th, I placed in a large glass vase, with moist sand at the bottom of it, a quantity of wild plums, every one of which I had previously ascertained to bear the crescent symbol of the "little Turk." During the three following weeks I added from day to day a number of plums, all of them bearing the same symbol, that had fallen from a tame plum-tree in my garden. The whole number of plums, as I subsequently ascertained, was 183, and the tame fruit probably formed about a fourth part of the whole. The first Curculio came out July 19th, and with the exception of July 21st and August 1st, there were more or less came out every day till August 4th, inclusive; after which day no more came out. The numbers coming out on each successive day were as follows, the very large number on July 25th having been probably caused by my wetting the sand on that morning rather copiously: 1, 18, 0, 3, 4, 2, 55, 8, 4, 3, 1, 2, 1, 0, 5, 4, 2. Total, 113. On examining the contents of the vase, Nov. 29th, I found five dead and dried-up Curculios among the plums, and among the sand sixteen dead and immature specimens, which had obviously failed to make their way up to the light of day, besides the remains of a good many individuals which had perished in the sand in the larva or pupa state, and were not counted. The Grand Total from 183 infested plums was, therefore, 134 Curculios in the beetle state, and an unknown number of larvæ and pupæ.

Experiment 2d. — On July 27th, or eight days before the Curculios in the preceding experiment had ceased coming out, I placed in a vase, similar to the above, 243 plums, gathered promiscuously off some badly-infested wild plum-trees. From this lot no Curculios whatever came out till August 23d, and from that day until September 14th more or less came out daily, with the exception of five out of the 23 days, the numbers on the respective days being as follows: 3, 1, 2, 2, 2, 3, 2, 2, 5, 3, 1, 0, 5, 6, 3, 2, 0, 0, 0, 1, 0, 1, 1. Subsequently, on September 18th, there came out 3, on September 24th, 1, and on September 28th, 1; after which no more made their appearance. Total, 50 Curculios from 243 plums, some stung and some not. On examining the contents of this vase on November 29th, I found a single dead Curculio among the plums, making a Grand Total of 51 Curculios bred from these plums. There were no specimens, either in larva, pupa or beetle state, to be found among the sand in the vase on November 29th; which was, perhaps, due to the contents having kept much moister than those of the first vase, though on July 25th I had, as I thought, moistened the sand in the first vase quite sufficiently.

The vases, in both the above two experiments, were examined daily, and the results noted down in my Journal, except during a three-days' absence from home, August 11th–13th, at the end of which time, however, not a single Curculio had come out. Since, therefore, it appears that in large lots of plums, gathered or picked up at various times from June 24th to July 27th, the Curculio ceased coming out for a period of no less than nineteen days, before and after which period it continued to come out for a long while as regularly as we could reasonably anticipate, the inference is unavoidable, that there must have been some cause for the long intermission in its coming out. But I do not see that it is possible to account for this intermission on any other hypothesis, than that of there being two distinct broods. Therefore I infer that there are two distinct broods, the second of which is, of course, generated by the first.

The Curculios, bred from Black-knot in New England, by Prof. Peck, in 1818, are said to have come out July 30th, and a little later. (Harris *Inj. Ins.*, p. 79.) Those bred in Canada West, from the same substance, by Mr. Beadle, in 1860, are said to have come out from the beginning of July to August 10th. (Fitch *Address on Curculio*, p. 25.)

According to Dr. Fitch, who lives about 110 miles further north than I do — where, consequently, as also in the two cases just quoted, the seasons would be a little later than with me — most of the Curculios that breed in the plum "leave the fruit and enter the ground in the early part of July, some not leaving for probably two or three weeks afterwards." "They remain," he continues, "in the ground about three weeks. Hence, it is during the latter part of July that the most of them come out in the perfect state." (*Ibid.*, p. 20.) This last writer was evidently not aware, that Curculios may be bred both from Plum and from Black-knot to as late a period as the latter end of September; and hence, believing that the species must necessarily be double-brooded, he mistook for young Curculio-larvæ certain minute bodies, that he found in the autumn embedded in a slit in a pear-twig. But these were very probably, I think, not larvæ at all, but the eggs of some small Leaf-hopper (*Tettigonia* family,) and perhaps those of my Culprit Leaf-hopper (*Chloroneura maleſica*, Walsh), which agree precisely with his description, and which I have described as common both on apple-twigs and pear-twigs.* Be this as it may, with no further proof than a general resemblance between the crescent-slit made in plums by the Curculio, and the slit containing minute elongate bodies which he once found in a pear-twig, and without any attempt to breed the perfect insect from these minute bodies, Dr. Fitch has jumped to the astounding conclusion, that the Curculio passes the winter in the larva state inside the twigs of trees! †

Making due allowance for the difference of latitude, it is plain that, in the above-quoted three cases, where Curculios were bred by three different individuals, in New England, in Canada West, and in New York respectively, all that were bred coincided in the time of their appearance with the first brood that I bred at Rock Island, between the 19th of July and the 4th of August, 1867. I myself in 1865 bred seven Curculios from Black-knot, as I have recorded in the *Practical Entomologist* (Vol. I. p. 50,) the first of which came out July 22d and the last September 24th; but unfortunately I have since destroyed the record of the dates at which the remaining five made their appearance, with the exception of an entry on my Journal, that the *second* specimen of the seven came out as late as August 31st, and must therefore, as well as the four following specimens, have belonged to the *second* brood.

The practical inference to be drawn from the above discovery is this: — I said in my Paper on Curculios that, "by destroying the wormy fruit you do not diminish the crop of Curculios for the current year, but only that for the ensuing year." This was stated on the hypothesis of the species being single-brooded. Now that we know that it is double-brooded, it must be evident that, by destroying in June and early in July, before the larvæ have left the fruit and gone underground, the wormy fruit that produces the first brood of beetles, you prevent that first brood of beetles from puncturing the fruit so as to generate the second brood, and consequently you do "diminish the crop of Curculios for the current year."

It is a mistake to suppose that no plum contains more than one Curculio egg. I counted no less than five plums, that had fallen off my tame Plum-tree, every one of which bore on its surface five Curculio crescents; and in a wild Plum I once (July 28th) counted as many as nine. It must not be imagined, either, that the Curculio ever cuts

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* See my Articles *Prairie Farmer*, Sept. 6, 1862, and April 4, 1863, p. 212, in which last there is given a figure of an apple-twig containing these egg-slits.

† See *Address on Curculio*, pp. 23–4, and *N. Y. Rep.*, II., § 52.

these crescent-slits by way of food for itself. It does really feed, in the perfect beetle state, on the flesh of the unripe plum, as I ascertained by putting a number of Curculios into a bottle along with some unripe plums that were unwounded by any insect. But, instead of cutting a curved slit for this purpose, it gouges out with its beak a gaping, hemispherical hole, varying in size from that of a radish-seed to that of a small pea. I formerly supposed that it was the Plum-gouger that gouged these holes; but — as will be shown below — that species taps the Plum for food on an entirely different system.

Holes in the plum, very similar to those made for the sake of food by the Curculio, are likewise made by the external-feeding larva of a small brown Butterfly (probably *Thecla falacer*, Bdv. and Lec.,) of which I bred two damaged specimens on June 15th, 1865, from larvæ that fed in this manner on the plum, and had been sent me by Mr. James Ferrel of Muscatine, Iowa, as "quite numerous" on certain plum-trees.

THE LARVA of the Plum Curculio (Fig. 3c), when 0.07 inch long, is 4 or 5 times as long as wide, and of a glassy-white color with a rust-red stomach occupying the middle one-half of its body, and a few pale hairs towards its tail. The head is large and horny, and tinged with yellow, and the mouth is rust-red, with the jaws (mandibles) large and often opening and shutting in a vicious-looking manner, as with many other larvæ belonging to this family.

I do not believe that there is any parasitic insect whatever that preys upon the Curculio. If there had been, so many Curculios as I have bred, I think that I should have met with it. Dr. Fitch, indeed, has figured and described a small *Ichneumon*-fly under the name of "the Curculio Parasite" (*Sigalphus curculionis*,) of which he asserts that "each one of these Flies punctures and destroys probably more than a hundred Curculio worms." (*Addr. Curcul.* p. 26.) But the only proof that he gives of such parasitism is, that he received the Parasites from a Canadian correspondent, who had bred it from Black-knot from which he bred at the same time a certain number of Curculios. Now it so happens that my Plum Moth (*Semasia prunivora*, Walsh,) of which I shall have more to say in Chapter 13th, also breeds in Black-knot as well as in Plums; and it belongs to a group of small Moths, (*Tortricidæ*,) which I know to be infested by *Ichneumon*-flies very closely allied to the so-called "Curculio Parasite." Nay, farther. From the lot of plums gathered July 27th, from which I bred 51 Curculios, I also bred about the same time no less than 13 specimens of this Plum Moth, and, on August 23d, 1 specimen of the identical "Curculio Parasite" described by Dr. Fitch. But from the lot of plums gathered June 24th and subsequently, which produced the very large number of 134 Curculios, besides a number that died in the larva and pupa state, I bred no Plum Moths at all and no Parasites at all. Taking all these facts into consideration, I have every reason to believe, that this so-called "Curculio Parasite" preys upon the Plum Moth, and not upon the Plum Curculio. And if we are to subdue the Curculio by the aid of either Cannibal or Parasitic insects, we must probably look in some other direction than that to which Dr. Fitch has called our attention.

Dr. Trimble, in the first volume of his work on "Fruit Insects," (pp. 77 and 85,) asserts that the Baltimore Oriole or Hanging-bird (*Icterus Baltimorensis*, Linnæus) — an animal very obnoxious to some most intelligent Illinois fruit-growers — preys upon the Curculio. I believe that this is a mistake. Dr. Trimble has an unfortunate crotchet in his head, that every true Plum Curculio has got exactly 147 facets or lenses in each of its compound eyes, never more and never less; and a veritable Curculio which I once sent him he would not allow to be a true Plum Curculio at all, because it happened to have either a greater number or a smaller number — I forget which — of facets to its

eyes, than the orthodox number of 147 prescribed in the Gospel according to St. Trimble. To what species it did really belong, he did not undertake to say; but perhaps he would like to grind out of his Scientific Mill a new and hitherto undescribed and unnamed species, for every deficient or additional facet in the eyes of a large lot of veritable Curculios. Be this as it may, his only reason for thinking that this wicked, cherry-stealing, grape-devouring bird, the Baltimore Oriole, does really feed upon the true Plum Curculio is, that he once found in the craw of one of them the head of some kind or other of Snout-beetle, the eye of which contained exactly 147 facets. Therefore, according to the Doctor's peculiar crotchet, it was a true Plum Curculio. Therefore the Baltimore Oriole habitually eats Curculios. Therefore we must not kill the Baltimore Oriole, no matter how many grapes and cherries it many steal or spoil. Therefore the Illinois Legislature has done right, in fining every man $5 for every Baltimore Oriole, otherwise called Hanging-bird, that he may be forced to kill, not in self-defense, but in cherry-defense and grape-defense. Which was the thing to be proved.

If closely analyzed, it would be found that a large proportion of the so-called facts, on the strength of which we are commanded to protect all manner of fruit-destroying birds, are based upon foundations as flimsy and as unreliable, as those upon which Dr. Trimble erected his Baltimore castle-in-the-air.

I dilated so fully in the *Practical Entomologist* on the best methods of fighting the Curculio, that nothing remains to be said on that subject.* Volumes might be filled with accounts of the different quack remedies, that have been strongly recommended or this purpose; but the reader will probably be satisfied with the following, with which I shall beg leave to conclude the subject.

Curculio and Gas-tar. "The remedies for the Curculio the present season are more numerous than usual. There is seldom any of them worthy attention. The last one appears in a Williamsport paper, from a gardener, who says it is a SURE PREVENTIVE. It is this: 'Take a quantity of corn-cobs, with a wire around, terminating in a hook at the end of the cobs; then dip them into gas-tar until they are well saturated. Hang a dozen or more on the tree in different parts, and no Curculio will disturb the tree.' We heard of this remedy 6 or 8 years ago, tried it thoroughly, and it had about as much effect upon the Curculio as if the cobs had been dipped in molasses. We mounted one of the trees, and saw the insect at work upon a plum within 3 inches of the tar. We do not believe that a single one was disturbed by it. Not a single plum escaped." — *Germantown (Pa.) Telegraph*, quoted in *Farmers' Advertiser*, Sept. 16, 1867.

Curculio and Gas-tar. — "I tried, the past season, gas-tar thoroughly, to keep my plums from being stung by the Curculio. I steeped corn-cobs in the tar and hung them

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*I cannot resist the temptation of quoting here from the *Transactions of the Alton Horticultural Society*, Feb. 7, 1868, some very valuable remarks by Dr. E. S. Hull, on the employment of lime to quell the curculio:

"A few years since, the lime remedy was quite generally received, as a sure protection to the plum. At the time of its appearance in print, we were operating with our Curculio-Catcher, and at once discontinued its use on several of our trees, and made a most thorough trial of the lime, which at first promised to be a success. It did not seem to deter the Curculio from depositing its eggs in the plums, but they did not hatch. Later, the weather becoming dry, the succeeding deposits did hatch, and the larvæ penetrated the plums as freely as in those not limed. Further experiments with the lime proved that, so long as the weathor was wet, the lime, or the caustic properties of the lime, was imparted to the water, and entered the perforation in which the eggs were deposited and destroyed them, but was of no value in dry weather."

all through the trees. It did no good whatever. I often caught the little rascal working over and all around the plums, close to the cobs. They paid it no attention, though you could smell it for rods. A neighbor tried it with utter failure. It is a humbug." — *L. S. F., Rolling Prairie, Wis.*, in *Western Rural*, Dec. 7, 1867.

CURCULIO AND COAL-TAR. — "Having read a statement some time since, that corncobs saturated with coal-tar, and suspended from the branches of plum-trees, would keep the little Turk away from the plums, I resolved to try the experiment. I procured a keg of coal-tar and a quantity of cobs, and, after tying a string around each, put them into the tar, and repaired to a favorite plum-tree, prepared to carry the war directly into the enemy's dominions. I first spread sheets under the tree, hammered and shook the rascals out, and gave them the most affectionate treatment. Then, after much tribulation, arising from the fact that the vile stuff would keep dripping from the cobs, and would get upon the strings, reducing my hands and person to much the condition of the cobs, I got them suspended; I mean the cobs, not the hands or the person. I also tied a newspaper loosely around the body of the tree, and smeared it also with tar; then set the keg at the foot of the tree, to heighten as far as possible the effect of the performance, and retired from the field, feeling in several respects as though I *had been and done it.* After some hours I concluded to again visit the scene of operations, and found the whole region suggestive to the olfactories of as vile an odor as it was ever the lot of man to inhale. While noticing the artistic effect of the dripping tar upon the leaves and fruit, I observed a queer-looking gray excrescence upon one of the half-grown plums. A nearer view revealed the appalling fact that it was a CURCULIO 'pegging away' at his favorite pursuit, as much at home in the vile atmosphere around him, as if it were the spicy breezes wafted from 'Araby the Blest.' Need I say that I left the scene in disgust, feeling that coal-tar as a remedy against Curculios was a failure." — *Geo. W. Campbell, Delaware, Ohio*, in *American Journal Horticulture*, August, 1867.

CHAPTER XII. — THE PLUM GOUGER. (*Anthonomus prunicida*, Walsh.)

I have but little to add to what I stated respecting this insect in the *Practical Entomologist;* (Vol. II. pp. 79—80); and I may say likewise, that I have but very little to correct or modify in that article.

These insects take wing quite readily, almost as readily indeed as a Tiger-beetle (*Cicindela*); so that even in my office, where the sun was not shining, on removing some of them out of a bottle, in order to bring a lens to bear on them to watch their operations as they were sitting on a plum, they would generally open their wing-cases almost immediately, and fly off a short distance. In this respect they differ very remarkably from the Plum Curculio, which is a shy flier.

The mode in which the Plum Gouger deposits her egg in the plum, differs radically from that adopted by the Plum Curculio and explained in the preceding chapter. With the minute but powerful jaws placed at the tip of her long and slender snout, the snout itself being held at right angles to the surface on which she stands, she first of all eats through the skin of the plum to a short depth, so as to form a shallow cylindrical hole of precisely the same diameter as her snout, and directed perpendicularly downwards. She then alters from time to time the position of her snout, sloping it first in one direction, and then in another, and then in another still, and all the while working away with her jaws at the flesh of the fruit. By this means she gradually gouges out a gourd-shaped hole, bellying inside and quite small outside, till she has made an opening about four-fifths as deep as her snout is long. The excavated matter is not thrown

out of the hole, as is done by a well-digger when he digs a well; but the ingenious workwoman eats her own chips as she works, and thus contrives to gratify her appetite for food, while she is at the same time obeying that wonderful instinct of providing for her future offspring, which Nature has implanted in all female insects without exception. The hole being now sufficiently deep, and sufficiently gouged out internally, the creature withdraws her snout leisurely and gradually, and, pausing for a few seconds, seems to smack her lips at the idea, that she has at one and the same time discharged her duty towards society, and likewise tickled her own liquorish palate. Alas! that we poor human beings can so seldom enjoy that double gratification! And now her maternal feelings tell her that an egg is ready to be born into this world. But she is standing with her snout poised in the air over the excavation, which is intended to receive the egg. The egg-laying apparatus is at the other end of her body. Do you suppose that she is going to drop an egg upon the smooth, slippery surface of the plum, and then trust to blind chance to dispose of it whether for weal or for woe? No such thing! Insects are not the miserable, thoughtless, careless, improvident machines that most people suppose them to be. They look before they leap. They understand their business. They know as well as the most skilful human mechanic, what would be the consequences of a clumsy movement or an untoward arrangement; and they govern themselves accordingly. Every mother insect has about a hundred, and often several hundreds of eggs to provide for; and although it may, and often does, take weeks or months of the hardest and most unremitting toil, to find or furnish suitable nests or cells or other depositaries for all those eggs, yet, before she dies, her task is almost always accomplished down to the minutest detail. In the Insect World there are no Foundling Hospitals, no Jails, no Penitentiaries. Yet, without hope of reward for well-doing and without fear of punishment for evil-doing, the mother-insects invariably do their duty towards that future progeny, which, in the great majority of cases, they are destined never to behold. Do those proud beings, that are foolish enough to fancy that all this beautiful green world—swarming as it is with life and joy upon every inch of its surface—was made for their sole and exclusive benefit, always do the same? Let us blush for our species, when we reflect that the horrible crimes of fœticide and infanticide have prevailed, in every age, to a hideous extent among every nation of mankind; while among my little friends, the Insects, whom we are facetiously pleased to classify among the "lower animals," they are, in the true and correct sense of the terms, utterly unknown. It is undoubtedly the case that the Social Wasps, when at the approach of winter, (with the single exception of the young Queen Wasps, which are destined to pass the winter in a torpid state and to originate new colonies in the following spring,) inevitable starvation stares the whole colony in the face, do, under the stern pressure of necessity, mercifully despatch their young larvæ with their stings, to save them from a painful and lingering death. But how different is this from the conduct of the human mother, who destroys the helpless being that is bone of her bone and flesh of her flesh, not out of any love for that being, but to cover up her own shame from the eye of the world, or even out of the insane ambition of prolonging the period of her youthful charms, or the mere selfish desire to escape from the troubles and responsibilities of motherhood! With a single snap of her jaws the mother Plum Gouger can easily destroy that helpless germ of future life and happiness, which is struggling within her to pass into this outer world. She can do it with perfect impunity. There are no Courts to convict her of the dreadful deed. She stands in no awe of fine, or imprisonment, or capital punishment. Yet never was such an unnatural act witnessed

by the eye of mortal entomologist. With grave and solemn deliberation she turns he body slowly round, deposits the egg as well as may be in the excavation already pre pared for it, and finally, turning round once more, re-adjusts it with her snout, till it completely embedded in its destined receptacle, with its outer surface slightly belo the general level of the skin of the plum, and its inner surface overhanging a cavit twice or thrice as large as itself.

"But," the reader may perhaps ask, "what is the use of this cavity? Why not bor a hole just about the size of the egg, and then at once slip the egg into it?" M friend! the mother Plum Gouger knows better than that! Providence has taught he that the plum, in which she is about to lay her egg, is a growing and living organism and she has learned as thoroughly as the most experienced human botanist, that an wound that she may produce in it will be speedily healed and filled up by the repara tive powers of nature. Providence taught her, too, long before human physiologist discovered this wonderful process of "endosmosis," as it is called, that an egg, fu of thick, viscid matter and with a delicate membranous shell, when immersed among th thin sap of the green plum, will necessarily absorb a good deal of that sap, and thu increase considerably in size. She therefore allows full scope and to spare, both for th natural growth of the egg and for the natural growth of the plum. For she is well awa that the slightest pressure will rupture the delicate membrane, within which sleep the microscopically minute embryo of the future Plum Gouger. And she is we aware, too, that it will be several days, at the least, before the seemingly inanimat egg will disclose the little larva, that will thereafter be abundantly able to fight th rest of his way, with his own good, strong jaws, through this sublunary world. — Wit all his acquired experience, and all his theoretical knowledge, and all his boaste reasoning powers, could a human workman have provided with more exquisite sim plicity for the important object which was to be attained?

Whenever either a male or a female Plum Gouger desires to feed on the flesh of th Plum, they proceed precisely in the same way as the female does, when she excavate in the manner already described a receptacle for an egg. A plum, studded all over wit these tiny holes, looks just as if somebody had been puncturing it with a common pi heated red hot. About the latter end of June, I shut up two Plum Gougers, whic I had captured at large, in a glass vessel, along with about a dozen green plums, whic I had previously examined and ascertained to be entirely free from punctures or cut of any kind. In a week's time, these plums were covered with just such punctures a those already spoken of, some exhibiting as many as twenty of them. None of thes punctures contained any egg, so far as I could discover; and I repeatedly watched th insects through the glass as they completed one hole, and then immediately passed o and commenced another, without making any attempt to deposit an egg in the first Possibly, however, these two Gougers might have been males, or, if females, they migh have already exhausted their stock of eggs, or they might have refused to lay eggs except in such plums as were actually growing on the tree. In not a single case, had either of them made the large, open hemispherical excavation peculiar to the Plum Curculio. Holes of the usual character, but bored simply for food, occur also in very large numbers in the plums as they hang on the trees. I have often, in the earlier par of the season, cut into eighteen or twenty of them, before I could find either egg o larva or the boring-work of a larva; and I have counted as many as nine of them i a single plum, four only of which contained an egg. Later in the season, scarcely on hole out of fifty contains either egg or larva or any signs of a larva. Almost universall

from all these holes, for whatever purpose they have been bored, there exudes a copious supply of gum, as is also the case with the crescent-slit of the Plum Curculio.

As I have already shown in the *Practical Entomologist*, the newly-hatched larva of the Plum Gouger, instead of burrowing, like that of the Curculio, solely in the flesh of the plum, makes almost a straight course for the kernel, through the shell of which, being as yet soft, a passage is readily opened by it. Here it remains, feeding exclusively upon the kernel, till it has acquired its full larval growth, when it cuts the same smooth, round hole through the now quite hard shell of the plum-stone that almost all boring-larvæ make, in order to afford a ready exit for the perfect insect. It then changes into the pupa state inside the plum-stone; the plum itself not dropping in a green state from the tree, as is almost invariably the case with plums stung by the Curculio, but hanging on the tree and ripening prematurely. Subsequently, the pupa develops into the perfect Plum Gouger, and the latter emerges through the hole already prepared for it by the provident care of the larva.

I suspect that I have rather over-estimated the destructive powers of the Gouger, as compared with those of the Curculio. The punctures, indeed, of the former are enormously abundant, out-numbering, certainly, fourfold the crescent-slits and the gouging-work of the latter; but only a very small percentage of these seem to contain eggs. No doubt such punctures greatly injure and disfigure the fruit, and the gum that exudes from them exhausts, to no purpose, the vital energies of the tree. Still, a plum that is simply punctured, without any egg being deposited in it, is not totally destroyed; for the wound is but temporary, and nature can generally repair the damage. But whenever an egg is inserted in the wounded part, then, unless that egg fails to hatch out, or the young larva dies of disease, the unhappy plum is doomed; for soon the resistless energies of the larva are, day after day, eating into its vitals. It is immaterial whether the larva, after hatching out, burrows exclusively in the flesh of the plum, as in the case of the Curculio; or whether, passing through the flesh as rapidly as possible, it strikes a bee-line for the kernel, as in the case of the Gouger. In either case, the fate of that plum is premature death; the only difference being, that the plum stung by the Curculio perishes in its infancy, while that which is stung by the Gouger attains a sickly and stunted manhood before it finally perishes.

In illustration of the wide difference between the respective habits of the Curculio and the Gouger, I will give a few statistics: 1st. On June 24th I placed 165 wild plums, all of them more or less copiously punctured by the Gouger, and none of them, so far as I could perceive, with any crescent-slits, in a similar glass vase to those already described in preceding experiments. (Above, pages 67–8.) From this vase, which was treated in the same manner as the others, I expected to have bred several Gougers. I did not breed a solitary one; and all the insects that I obtained from this whole lot of plums, were two Curculios that came out, respectively, July 30th and August 1st. Neither, on examining the sand at the bottom of the vase on November 29th, could I discover the remains of either larva, pupa or perfect insect, that had perished there prematurely. As two veritable Plum Curculios were bred from this lot of 165 plums, I presume that there must have been at least two crescent-slits on them, which I inadvertently overlooked. 2d. From the vase of wild plums, gathered July 27th, the details of which have been already given, (above, p. 68), I bred, as I showed before, no less than 51 Curculios; and yet, from this same lot — which, be it remembered, was gathered off the tree promiscuously and without any selection — I obtained only two Gougers, which came out, respectively, August 24th and 26th. The reason of all this

is pretty plain. A plum inhabited by the Gouger larva would naturally hang on th tree, so that the kernel would become fully developed; and by plucking all these plum more or less prematurely from the tree, I caused the premature death of a great man Gouger larvæ. On the other hand, a plum inhabited by the Curculio larva naturall falls from the tree, and thus my arrangements, so far as regards this species, interfere in no wise with the laws of nature.

THE LARVA of the Plum Gouger, when found burrowing in the kernel on July 20th, by which time th shell of the kernel was quite hard, was 0.12 inch long when partially straightened out, and 0.10 inc long when curled up in the usual semicircular form. The color was milk-white, not whitish-glassy as i the Curculio larva, and there was no rust-red stomach as in the Curculio larva. The head was larg horny, and of a yellowish-white color, the jaws (mandibles) being tipped with brown. The plum i which this larva occurred had only been gathered four or five days previously. Another larva, that ha already bored into the kernel and was met with July 28th, in a plum gathered the day before, differe only in the head not being tinged with yellow, and in the jaws being almost entirely brown.

Whether there be one or two broods of this insect every year, I cannot say with cer tainty, but I strongly suspect that there is but one. The perfect beetles appear on th plums early in June and deposit their eggs therein, precisely as does the Curculio a that date, though, as has been shown, on an entirely different system. According t Mr. L. C. Francis, of Springfield, Central Illinois, (who is a very successful plum-grow er and follows the plan of jarring his trees regularly during the summer,) after Jun 7th, although he had previously found "about equal numbers of the Gouger an Curculio," the Gougers entirely disappeared, Curculios being still met with up to th last of July. (*Prairie Farmer*, March 19, 1864.) This certainly seems to indicate, tha there is no such early brood of Gougers coming out in July as there is of Curculios From a large lot of plums that I gathered myself off the tree June 24th, and that mus have contained many of the eggs of the Gouger — for I found several eggs in the fe that I cut open — I failed, as already said, to breed a single Gouger; but I attribute thi to the fact, that these plums would naturally have hung on the tree till the kerne would have been more fully developed. On July 20th and 23th, as I stated just now I found in plums but recently gathered larvæ that could not have been much more tha half-grown; so that the probability is, that the plum infested by this larva must natu rally hang on the tree till the kernel is nearly perfected — that this larva requires a much longer time to mature than that of the Curculio — and that eggs deposited earl in June do not develop into the beetle state till the end of August or perhaps the earl part of September. The two Gougers actually bred by me this year came out, as wil be recollected, August 24th and 26th. And there is nothing at all improbable or anoma lous in a Snout-beetle, which comes out so late in the year, living all through th winter and until the following spring. At any rate, as all the other species of th genus (*Anthonomus*), whose transformations are known to me, are only single-brooded the presumption is that this species is the same; and if any one holds the contrar opinion, the burden of proof rests upon his shoulders.

Whether the Plum Gouger is confined to the Valley of the Mississippi, or whethe it occurs also in the Atlantic States, is not quite clear. None of my Eastern corres pondents have met with it at the East, and neither Fitch nor Harris describe the species Indeed, common as it is with us upon Plums, it was unknown to Science, until I described it in 1863 in the *Prairie Farmer*, with a brief account of its habits, whic description was subsequently reproduced in the *Proceedings of the Boston Society of Natural History*. (IX., p. 309.) From some observations, however, let fall by Dr. Fitch

I infer that fruit is infested in New York either by this or by some allied species; for in the *Address* which has been already so often quoted, (p. 18,) he says that "in addition to the crescent-shaped slit, the Curculio wounds the fruit by drilling holes therein with its beak, resembling punctures made by a coarse pin or needle;" and he adds that "one or more of these punctures may be seen upon almost every fruit which it invades," and that "it is probably for feeding upon the juicy pulp of the fruit that the insect bores these small holes in it." Now, as already stated, I have had 8 or 10 Curculios shut up in a glass vessel for a month, along with a lot of plums that I had previously ascertained to be free from punctures or wounds of any kind. These Curculios fed freely upon the flesh of the plums. But all their excavations were of the open, hemispherical type already described, and there was not a single puncture to be met with, such as the Gouger makes and such as Dr. Fitch asserts to be made by Curculios. I cannot think it at all probable, therefore, that the Curculio, as Dr. Fitch asserts, commonly causes such punctures. Possibly, as this writer appears to be speaking here with more especial reference to the apple, the punctures he mentions may have been made by the Four-humped Curculio (*Anthonomus quadrigibbus*, Say,) which species I was the first to publish as infesting the apple in this manner in Illinois, and which causes nearly the same kind of puncture in the Apple, as the Gouger causes in the Plum. But neither has this species been enumerated as among those, that are injurious to cultivated fruit in the East, either by Dr. Harris or by Dr. Fitch, though I presume that it occurs there, as Say asserts that it is found generally in the United States.

Such are some of the many difficulties which the Student of Economic Entomology encounters, owing to the custom, too prevalent among closet-naturalists, of despising the habits of an animal as unworthy their notice, and devoting their exclusive attention to its coloration, its structure, and its classification. "And yet," as Agassiz has so truthfully remarked, "without a thorough knowledge of the habits of animals, it will never be possible to ascertain with any degree of precision the true limits of all those species, which descriptive zoologists have of late admitted with so much confidence in their works. And, after all, what does it matter to Science, that thousands of species, more or less, should be described and entered in our systems, IF WE KNOW NOTHING ABOUT THEM?" (*Contributions*, &c., I. p. 57.)

Since, as has been shown above, plums infested by the Gouger do not fall prematurely from the tree like those which are infested by the Curculio, it is plain that picking up and destroying the fallen fruit, though an excellent mode of counterworking the latter insect, will be of no avail against the former. Both species, however, can be jarred off the trees and destroyed; and when this process is performed, a sharp look-out should be kept for both. It will also be a useful precaution, whenever a few stunted plums are observed to ripen prematurely on any tree, to pluck them off and destroy them. In most cases, they will be found to contain, either the perfect Gouger, or the larva that is destined subsequently to develop into the Gouger, snugly ensconced in the kernel, and often with the hole already bored through the stone for the escape of the matured insect.

The wide differences between the Curculio and the Gouger may be thus briefly stated:—The Curculio is beautifully streaked and spotted with black and white and has two shining black humps, like black sealing-wax, on its back; the Gouger is clay yellow in front and of a dull lead-color behind, without any humps at all. The Curculio cuts a crescent slit in every fruit in which it lays an egg; the Gouger bores a small round hole for this purpose. The Curculio larva bores exclusively in the flesh of the fruit; the

Gouger larva always strikes a bee-line for the kernel. The Curculio larva leaves th fruit and goes underground to pass into the beetle state; the Gouger larva remain throughout in the infested fruit. Of the Curculio there are two broods every year; o the Gouger there is apparently but a single brood. Finally, every stone-fruit excep Cherry that is stung by the Curculio falls, as a general rule, prematurely to the ground the while plums stung by the Gouger hang on the tree and ripen prematurely.

CHAPTER XIII.—The Plum Moth. (*Semasia prunivora*, Walsh.) Fig. 3.

On July 28th, 1867, I was cutting into a number of plums infested by the Plum Cu eulio and the Plum Gouger, when to my great surprise I discovered in one of the what was evidently the larva (fig 3b) of some small moth. On comparing this figur with that of the larva of the Plum Curculio (fig 3c)—which scarcely differs in outlin from that of the Plum Gouger—the difference will be seen at a single glance. Th plum in which it occurred bore the crescent slit of the Curculio; but what had bec the history of the egg deposited by the mother Curculio—whether it had failed t hatch out—or whether it had hatched out and shortly afterwards perished—o whether it had hatched out and reached maturity in the plum, and then gone under ground—I did not ascertain. In the year 1868 I hope to clear up all such points a these; upon which depend a variety of interesting questions in the history of the moth larva that accompanied the egg-slit of the Curculio.

About a month afterwards, from a lot of infested plums gathered July 27th, th details of which have been given above (p. 68,) there commenced coming out the smal moth figured and described herewith as the Plum Moth (fig. 3;) and specimens con tinued to come out from time to time until the middle of September, amounting in all to 13. Evidently all these moths must have proceeded from larvæ, such as tha which I had found in the plum at the end of July.

In the preceding year, and at the same period of the year, from the well-known Black-knot—a fungoid excrescence on the branches and twigs of the Plum-tree, which is infested by the larvæ of the Curculio to nearly as great an extent as the Plum itself—I bred several specimens of this same moth; and in this same Black-knot I had previously met with many of its larvæ burrowing in the substance of the Black-knot. I bred two other specimens of the same moth nearly a month earlier in the season from a cockscomb-like hollow gall (*ulmicola*, Fitch) on the leaf of an elm, which is produced and inhabited by Plant-lice, having previously found its larva inside the gall and among the Plant-lice. And lastly, I had bred on September 2d, 1866, a single specimen of this very same moth from a sessile, hollow gall about the size and shape of a large pea or a small cherry, on the leaf of the Red Oak (*Quercus rubra*,) which has been named and described by Mr. Bassett, (*Quercus singularis*, Bassett.*) In both these two cases, the

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* I formerly supposed that this gall was the *nubilipennis* of Harris. It is clearly the *nubilipennis* of Fitch. But I rather believe that the *Quercus-sculpta* of Bassett—a fleshy, juicy, subacid, grape-like, eatable gall growing indifferently on the Black Oak (Quercus tinctoria) and the Red Oak—is the one that Harris had in view, when he spoke of his *nubilipennis*. For the *mature* female fly produced from *Quercus-sculpta* has a very distinct dark cloud on the terminal ½ of its front wing, as Harris describes his gall-fly (*Cynips nubilipennis*); while both the male and the female gall-fly of the other Oak-gall (*Q. singularis*) have no such cloud. *Immature* specimens, indeed, of the female *Cynips q. sculpta*, cut out of the gall, do not show this cloud; and it was probably from such that Mr. Bassett drew up his descrip-

galls were of the same year's growth, and inhabited by the gall-making larvæ at or shortly before the time that the Moth made its appearance. Thus we see that the very same moth inhabits in the larva state plums that are infested by Curculio, Black-knot that is infested by Curculio, an Elm-gall that is generated and inhabited by Plant-lice, and an Oak-gall that is generated and inhabited by a Gall-fly.*

In the two latter cases my Plum Moth is clearly a Guest-moth; but whether it confines itself to feeding on the substance of the gall, or whether it also destroys the gall-makers, and whether, if it destroys them, it feeds on them, and, in the case of the Plant-louse gall, whether it may not feed partly on the sugary dust secreted from the body of the insect, are all of them points that remain to be investigated and explained. Most authors state that the larvæ of this entire Order (*Lepidoptera*) are almost exclusively vegetable-feeders;† and some have even gone so far as to say, that they feed entirely on vegetable food.‡ But, as Harris has well observed in the passage referred to in the note, there are certain species that feed in the larva state on our woollens and furs, and even on leather, meat and lard — all five of which are, not vegetable, but animal substances; and it is well known that certain other species infest in the larva state collections of dried insects. Moreover, I have long been inclined to suspect, that the larvæ of particular moths feed habitually, not only on dead animal substances, as in the instances quoted above, but even on the living bodies of other insects. The Rev. Mr. Green, of England, in his admirable little work on Pupa-digging, has stated some facts, which certainly seem to prove that there are Cannibal Caterpillars, as well as Cannibal Beetles and Cannibal Flies. For he says that the larvæ of a small moth had swarmed for years in his breeding-cages, in spite of all that he could do, devouring by wholesale the pupæ, from which he was endeavoring to rear various kinds of moths.§

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tion, which says nothing of any such cloud. The *male* fly of *Cynips q. sculpta* I have never yet met with In any case, Harris's description (of his *nubilipennis*) is so brief and indefinite, that not being sufficient to identify either the gall or the insect satisfactorily, it should be entirely neglected and thrown on one side, and we should adopt Mr. Bassett's two names. To follow any other rule in such cases as these, is simply holding out a premium to slipslop, slovenly describers, who are the curse of Science.—See Osten Sacken in *Proc. Ent. Soc. Phil.* IV. pp. 355–6.

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* Similarly, I have bred the small moth *Gelechia gallaegenitella*, Clemens, from a Willow-gall made by a Gall-gnat, and likewise from two distinct kinds of Oak-galls made by Gall-flies. Also *Batrachedra salicipomonella*, Clemens, another small moth, from a Willow-gall made by a Gall-gnat, and from two very distinct Willow-galls made by two distinct species of sawflies. (See *Proc. Ent. Soc. Phil.* VI. p. 273.) I may add here the hitherto unpublished facts, that I bred on June 26th from the Oak-gall *Quercus inanis* O. S., which is made by a Gall-fly (*Cynips*), the *Anorthosia punctipennella* of Clemens; and three other distinct species of small moths, respectively, from three other distinct Oak-galls, two of which are made by Gall-flies and one by a Gall-gnat (*Cecidomyia*). In all these cases, and in many others which I have published, the moths are clearly guests in galls made by other insects.

† Westwood *Introd.* II. p. 331; Harris *Injur. Insects* p. 258; &c, &c.

‡ Latreille *Gen. Crustac. Insect.* IV. p. 185; Wallace *Malayan Papilion.* in *Transact. Linn. Soc.* XXV. p. 2.

§ Since the above was written I have received the following valuable information from H. T. Stainton, the distinguished English Lepidopterist: "You are quite right in saying that several lepidopterous larvæ are carnivorous. Amongst the *Noctuæ*, *Scopelosoma satellitia* and *Cosmia trapezina*, and amongst the *Geometridæ*, *Crocallis elinguaria* are larvæ to be carefully avoided by those intent on rearing other larvæ. The larva of *Œcophora pseudospretella* is the mortal foe to the choice pupæ of the collector, and *Diplodonia marginepunctella* is evidently addicted to carnivorous appetites, and adorns his case with the mutilated bodies of his victims."

If, therefore, we allow that this Plum Moth of mine is a Guest in the case of the tw galls, which, as I have shown, it inhabits, it would seem to be most probable that it i also a Guest whenever it inhabits the Black-knot and the Plum. In other words, it doe not attack sound Black-knot and sound Plums, but only such as have been alread preyed on and bored by the Curculio, and where consequently an opening has alread been made for its operations. Practically, this question is of considerable import ance. For, if the Plum Moth does really attack perfectly sound plums, then it is a much to be dreaded as the Curculio. If, on the contrary, it only gathers up the crumb that fall from the table of the Curculio, then it is absolutely harmless. For no fruit grower would give one cent for a whole orchard of plums, every one of which was stun by the Curculio. The general subject of Guest-flies and Guest-moths, has been alread treated of at some considerable length. (Above, pp. 17—18.)

I have bred another species of small moth, very closely allied to the Plum Moth, fro Black-knot; and Harris long ago noticed Lepidopterous larvæ in Black-knot, which h originally mistook for those of the Peach Borer (*Ægeria exitiosa*, Say;) though he sub sequently corrected this error, and stated them to be "the naked caterpillars of minute moth."* In all probability, these caterpillars, which Harris found in Black-knot would have produced some one or both of the two species of Moths which I have bre therefrom, namely, the Plum Moth and an undescribed species. Although these larv had long been noticed by entomologists in Black-knot, yet nobody, as it seems, ha ever raised them to the mature state, until I succeeded in doing so.

As I have already shown (p. 70,) the so-called "Curculio Parasite" of Dr. Fitch prey in all probability, not upon the larva of the Curculio, as Dr. Fitch erroneously supposed but upon that of the Plum Moth. I bred a single female specimen of this pretty litt *Ichneumon*-fly on the 23d of August, from the same vase of plums from which I bred a my Plum Moths.

The Plum Moth; Fig. 3. (*Semasia prunivora*, new species.) Ground-color of *front-wing*, black. Th basal ¼ irregularly covered with rust-red, so as to leave only a few black markings. On the costa ar rather more than ⅓ of the way to the apex of the wing, a pair of streaks obliquely directed toward th posterior angle of the wing;† the inner streak of the pair is on its extreme costal end clear white, els where pale steel-blue, and extends nearly to the disk of the wing, where it almost unites with a su quadrangular pale steel-blue blotch, which is usually seen there without difficulty, though it is occasio ally subobsolete; the outer streak of the pair is only half as long as the inner one, towards which converges very slightly without actually uniting with it, and is colored in the same manner. Furth along on the costa, and not quite ⅔ of the way to the apex of the wing, there is another such pair streaks, parallel with the first pair and similarly colored, the inner one of which, when it has becom as long as the inner one of the other pair, sweeps in a gradual curve round the disk of the wing, till almost attains the inner margin a little way from its tip; while the outer streak of the two is so ver short, that the steel-blue part of it is subobsolete and can only be seen in certain lights. Beyond th second pair of streaks, and rather more than ¾ of the way along the costa to the apex of the wing, another streak, parallel with all the others and similarly colored, which strikes the outer margin abo ⅓ of the way from the apical to the posterior angle, where it terminates in a pale streak in the fring

* Compare Harris's *Injur. Insects* first edition, p. 352, and last edition, p. 80. A writer in the *Amer. Jour Horticulture* (Vol. II. p. 34.) has reiterated Harris's original error.

† In the figure this pair of streaks is erroneously engraved as being rather closer to the second pair streaks, and rather further apart from each other, than is the case in the natural wing. And the sam observation applies to the second pair of streaks as regards its distance from the third group of streak which consists, not of 2, but of 3.

And beyond this again, and equidistant from it, from each other, and from the apex of the wing, there is on the costa a pair of short white streaks, the inner one much the shorter of the two. Thus along the costa we have a series of seven very conspicuous short white streaks, arranged 2, 2 and 3. The terminal ¼ of the front wing is mostly rust-red, with a series of abbreviated, black, longitudinal lines, springing from the outer edge of the curved prolongation of the inner one of the 2d pair of streaks on the costa; and beyond these short black lines are two very oblique, short, pale steel-blue streaks, one springing from the posterior angle and the other a little above it from the outer margin. Disk of the front wing rust-red, with many indistinct, short, black, longitudinal lines, and on its centre the pale steel-blue blotch already referred to. On the middle of the inner margin, a large, elongate-triangular, rust-red patch, the apex of the triangle directed towards the apex of the wing and attaining the disk, the base of the triangle occupying nearly ¼ of the inner margin. This triangular patch is bisected lengthways by a very elongate and slender black triangle, the apex of which attains its apex; and the rust-red space on each side of this last triangle is again indistinctly bisected lengthways by a still more elongate triangle composed of confluent black atoms. Fringe dusky, with a black basal line all along it. *Hind wing* dusky-gray at base, shading into black at tip. On the middle of the outer margin, *in the male but not in the female*, an elongate semi-oval patch (fig. 3a) of metallic-brassy scales, brighter in certain lights. *Fringe of the male* (fig. 3a) long, sparse and grayish-white on its anal ½, short, dense and dusky with a basal black line for its remaining ½. *Fringe of the female* (fig. 3) nearly of uniform length, coarse and dusky throughout on the ½ next the wing, then suddenly fine and grayish-white on its outer ½. *Body* brown black. *Face* and *palpi* grayish-white. *Shoulder-covers* largely tipped with dull rust-red. Tips of the abdominal joints pale fuscous above. *Legs* dusky. All beneath, including the legs, with a more or less obvious silvery-white reflection.

Described from 13 specimens, (4 males, 9 females) bred from infested plums August 23d – September 15th. The males were readily distinguished by the exserted anal forceps. Three specimens bred from Black-knot, Aug. 31 — Sept. 7th, three others bred from the Elm-Gall (*Ulmicola*, Fitch) July 26th — Aug. 5th, and a single one bred from the Oak-Gall (*Q. singularis*, Bassett) on Sept. 2d, none of them differed from the plum-fed specimens in any important point. I sent a single specimen, bred from the Black-knot, to the late Dr. B. Clemens, about a year before his lamented death; but he never, so far as I know, investigated its classification. For the satisfaction of the incredulous, I may add that I sent specimens, bred respectively from the Plum and the Elm-gall, to the distinguished English Entomologist, H. T. Stainton, who is well known to have made the smaller moths his special study for years; and that he agrees with me that they are "perfectly identical." It is to the kindness of this gentleman that I am indebted for the generic determination of this species, and for the following very valuable comparison of it with the European species (*S. janthinana*) which, as he informs me, is the most closely allied to it. The small European moth (*Opadia funebrana*, Treitschke), which I quoted in the *Practical Entomologist* (II. p. 79) as occasionally boring into plums in England, has been referred, as Mr. Stainton informs me, both by himself and by Wilkinson to the same genus to which the Codling-moth (*Carpocapsa pomonella*, Linnæus) belongs; and is consequently widely distinct from my Plum moth. Mr. Stainton further tells me that, just as I anticipated in the *Practical Entomologist*, "in some years this insect is injurious to the Plum-crop in England, but the moth is entomologically scarce, and few collections are well supplied with it." "I have not," he adds, "obtained a single specimen for more than 20 years."

"*Semasia prunivora* is allied to *S. janthinana*, Duponchel — which, if I remember rightly, has been bred from gall-like growths on hawthorn twigs, though V. Hernemann, who gives no habitat for the larva, says that the imago frequents sloe-bushes [the English wild plum]— but with the anterior wings narrower, the pale mark from the middle of the inner margin more obliquely placed, and with four distinct transverse leaden-blue streaks from the costa. In *Janthinana* there are no leaden-blue streaks. In the centre of the pale dorsal [discal?] blotch is a distinct darker line, rather more defined than in *Janthinana*. On the surface of the anterior wings are numerous short longitudinal pale orange streaks, which give the insect a much brighter appearance than we see in *Janthinana*. Lastly, the posterior wings are, towards the hind margin, blackish, and therefore much darker than in *Janthinana*."

The Larva, when 0.11 inch long, is about 6 times as long as wide, of a dingy white color, with some fine short dusky hairs. Head, a horny obsemicircular plate on the 1st segment behind the head, and a horny semicircular plate on the anal segment, all black and polished. Legs and prolegs, dingy white.

When 0.18 inch long, the body is of a pale brownish yellow color, and the two horny plates on the bod are brown, not black, but the head remains black.

Described from one specimen found in a plum July 28th, and one (of the larger size) found in Black knot July 22d. The former was wounded; the latter I isolated in a separate bottle, and subsequentl bred the moth from it.

THE COCOON spun by the larva is formed above ground, among the plums from which the full-fed larva have made their exit, or is sometimes attached to neighboring substances. It is composed of dark-colore silk arranged in the usual elongate-oval form.

THE PUPA I have not seen.

Mr. C. V. Riley informs me, that according to H. N. Humphreys, (*Genera of Britis Moths*,) the larva of a European species of the same genus to which the Plum Mot belongs (*Semasia wœberana*,) is supposed to feed on the inner tegument of the bark o plum-trees, cherry-trees, apple-trees and occasionally laurels. This is only anothe illustration of the law of "Phytophagic Unity," as I have called it, which has lon been known to prevail to a considerable extent among the larvæ of the Butterflies an the Moths, namely, that the same group of Insects affects the same group of Plants.* I have shown that this law also holds good among almost all the groups of gall-makin insects, the gall-makers belonging to the Order of Two-winged Flies (*Diptera*) formin about the only exception.†

Of course it would be premature to talk of any remedy against the depredations o this elegant little jewel of a moth, until we know for certain whether as I suppose sh is a Guest in the Plum, and consequently a neutral; or whether she burrows into th Plum on her own account, and is therefore to be treated as an enemy. I hope that—a will sometimes happen both with Eastern and with Western juries—the beauty of th air defendant has not warped my judgment, and induced me to bring in a verdict o "Not guilty," when, in reality, she richly deserved to be sent to the Penitentiary.

INSECTS INFESTING GARDEN-CROPS GENERALLY.

CHAPTER XIV.—THE HATEFUL GRASSHOPPER, (*Caloptenus spretus*, Walsh.)

This insect, as will be seen hereafter, is about seven times as destructive to garde crops, as it is to field crops; and it, therefore, falls legitimately within the purview of thi Report. It has never yet, so far as is known, invaded this State; and I do not believ that it ever will or can. Still, as many of our farmers and gardeners in Illinois have a idea, that it may not improbably, at some future time, pass from Missouri and Iow into Illinois—just as the notorious Colorado Potato-bug (*Doryphora 10-lineata*, Say has done—it may be worth while to investigate its Natural History, and to demonstrat the improbability of its ever crossing the Mississippi in the course of its Eastwar progress. It is the province of Economic Entomology, not only to forewarn the Agri culturist of the approaching insect foe, but also to dissipate any groundless fears o such a foe that may prevail, when it can be proved that such fears are really groundless

In the *Practical Entomologist* for October, 1866, (II., pp. 1-5,) I investigated th migration of this Hateful Grasshopper, from the canons (kanyons) of the Rocky Moun tains, into the lowlands of Kansas, Nebraska and Western Missouri, which had jus then taken place. I further stated my belief that the eggs, which had been that

* See Westwood *Introd.* II. pp. 321-2 etc., etc.

† See my Papers *Proc. Ent. Soc. Phil.*, I., pp. 461-2; III., p. 635; VI., p. 277.

autumn deposited by the females in the ground throughout the infested region in countless myriads, would not generally hatch out that autumn and be destroyed by the frosts — as many fondly anticipated — but that the great bulk of them would lie safely in the ground through the winter, and hatch out as the spring of 1867 opened; when, in all likelihood, the larvæ that proceeded from them would do a vast amount of damage to the young crops. But, at the same time, I distinctly foretold, that the grasshoppers developed from these eggs, in 1867, although their general health would, perhaps, not be materially injured, would yet have their generative systems so impaired by the difference in food-plants, climate, density of the air, temperature, moisture, &c., (or what Naturalists call the "Conditions of Life,") which they met with in the low-land country, that they would become incapable of propagating their species any further; and consequently that that entire brood of grasshoppers would "then and there die out." Whence I deduced the corollary, that they could never cross the Mississippi and gradually spread eastward, as the Colorado Potato-bug has notoriously done, and as I prophesied before-hand that it would do. (See my Paper on that insect in the *Practical Entomologist* for October, 1865.)

Now let us see how far the facts have verified my predictions; and if it appear that I have been a true prophet, both in the case of the Colorado Potato-bug and of the Hateful Grasshopper, then I have a right to ask that, for the future, some little more attention should be paid to my opinions on such subjects, than to the wild fancies of men, who know no more about insects and their habits and peculiarities than a newly-born baby does of the multiplication-table. But first, let us examine a few additional details as to the operations of the Hateful Grasshopper in the autumn of 1866, in Texas and in Missouri, through which States I had not previously mapped out its course.

The Hateful Grasshopper in Texas in 1866.

"*Collins Co., North-east Texas, Oct.*, 1866. — Grasshoppers appeared in the north-west part of this county about Sept. 1st, and destroyed all the wheat that had come up, and then passed on to the south-west. They have nearly disappeared. They fly very high, and in some places were so thick, that we estimated them at one to the square inch." — *Monthly Report Agricultural Department*, 1866, p. 441.

The Hateful Grasshopper in Missouri in 1866.

"*Leavenworth, North-east Kansas, Oct.* 18, 1866. — Our *eastern* mail a few days ago was late, because the train was stopped by Grasshoppers. The track became so slippery by the crushing of their bodies, that the wheels would not turn." — *Private letter from C. H. Cushing.*

"*Atchison North-east Kansas Feb.*, 1867. — In Sept. 1866 the Grasshoppers spread over the whole of Kansas, and before cold weather they advanced about 50 miles into Missouri. They devoured all our buckwheat, turnips, tobacco and most of the green fodder, and all the young wheat that had been sown." — *L. A. Alderson, in the American Agriculturist, March* 1867.

"*Jackson Co., Missouri, March*, 1867. — The Grasshoppers did not make their appearance in this county until about the 1st of October, which was too late for them to do the amount of injury here that was done further west. Fall wheat, young timothy, and other kinds of tender grass were completely eaten off, and their eggs deposited in multiplied millions." — "B.," in *Country Gentleman, March* 28, 1867.

"*Cass Co., Missouri, Oct.* 21, 1866.—We are overrun with Grasshoppers, which apparently came here from Kansas. They are destroying everything that remains green. They have completely swept off our newly-sown wheat. They destroy all remaining vegetables, such as cabbage, turnips &c. They even stopped our neighbor across Grand River from boiling molasses; for the old gentleman said that they would persist all the time in jumping into his pan. They made their first appearance about October 8th or 10th. After they had been here some days, they commenced coupling and depositing their eggs in the ground. The eggs are encased in a small bag composed of some gummy substance."—*Private letter from J. M. App.*

"*Savanna, Andrew Co., Missouri, Dec.* 1866.—The people of this county are greatly troubled to know, what the big lot of Grasshoppers will do next year. They did not do *very* much harm this year, though their name was legion and they darkened the sky in their passage."—*Private letter from A. Kennicott, kindly communicated by Dr. W. Stimpson, of the Chicago Academy of Sciences.*

"*Clinton Co., Mo., Nov.* 1866.—Grasshoppers have eaten down into the ground every blade of green wheat that was sown this autumn, so far as they have extended over the country. They came from the west and are moving east as fast as they can, eating up all vegetation. They are as numerous as chinch-bugs ever were in Illinois, laying the ground full of eggs as they go. Cold nights seem to affect them but little. They rise and fly the same as a bird, and take very long flights."—"*B. S.,*" *in Prairie Farmer, Nov.* 24, 1866.

"*Stewartsville, Clinton Co., Missouri, Nov.* 15, 1866.—The Grasshoppers have completely overrun north-western Missouri this autumn. They began to cross the Missouri River in September, coming from Kansas and the far West. They came too late for this year's crops, save the autumn-sown wheat and rye, which have been entirely swept away by them, except in some partial spots. They seem to be pressing on due East, depositing their eggs in the ground and literally filling the whole surface of the earth with them."—*Private letter from A. Killgore, obligingly sent to me by Mr. S. S. Rathvon, of Pennsylvania.*

With the exception of Jackson and Cass counties, which lie on the middle of the extreme western border of Missouri, all the other districts referred to above lie in the north-west corner of the State. St. Joseph, Buchanan county, which will be subsequently referred to as a point where grasshopper-eggs hatched out in the spring of 1867, also lies in the north-west corner of the State. Kansas City and Oregon, which are referred to in the same series of extracts, lie respectively in Jackson Co. and Andrew Co. The whole of these districts, therefore, are separated, by a very wide interval, from Illinois.

WHAT THE HATEFUL GRASSHOPPER DID, WHEN IT HATCHED OUT, IN THE SPRING OF 1867, IN THE LOWLANDS OF THE MISSISSIPPI VALLEY.

I have inserted here all the *facts* that I could find bearing upon the above subject, omitting, for the most part, what is evidently *mere speculation and opinion.* Some few of the following reports are plainly colored by the same local feeling, that prompts almost every Western man to deny that there is any fever and ague, or any mosquitoes of any consequence, in his own settlement; although "in such a place," as he will invariably tell you, "the people are shaking the teeth out of their heads; and as to

the mosquitoes there, they will absolutely eat a fellow up alive." So far as possible, I have reduced these extracts to their proper chronologieal order.

"*Texas, about May* 6, 1867. — A eold snap has killed off all the grasshoppers that threatened to overrun Texas." — *N. Y. Sem. Tribune May* 14, 1867.

"*Padonia, Kansas, May* 13, 1867. — Farmers are through sowing their wheat, but, to judge from the look of things, the Grasshoppers will harvest it for us. They are hatehing daily, and cabbage, lettuce and onions are being devoured by them." — "*J. F.*" *in Prairie Farmer May* 25, 1867.

"*Nebraska, May* 14, 1867. — Wheat, oats, &e., are coming up, and are looking quite fresh and green, but the grasshoppers hatehed out from the eggs deposited last autumn have already commenced feasting on the green grain." — *S. C. Maxima, in Rock Island (Ill.) Union.*

"*Omaha, Nebraska, May* 18, 1867. — The eggs of the Grasshoppers are now hatehing by the million. They are deposited over the whole faee of the eountry, from the lower part of Cass county, clear through to the southern part of Kansas. We learn that they are at work upon the wheat in Kansas already, and are making their appearance in vast numbers in the southern part of this State, and as far north as Weeping Water." — *Omaha Republican.*

"*Kansas, about May* 24, 1867. — The Grasshoppers are already hatching out in vast numbers, and are devouring the winter wheat." — *Iowa Homestead May* 29, 1867.

"*Leavenworth, Kansas, about May* 25, 1867. — The Grasshoppers are hatching throughout the country in myriads, and the same accounts come from other portions of the State. Within a mile of town considerable damage to spring wheat has been sustained, and below us, on the Delaware Reserve lands, their ravages are beeoming serious. The leaves of the White Willow they seem particularly partial to, as they have stripped the young trees bare. They are not yet able to fly, but it is evident they are good eaters." — *Leavenworth Conservative.*

"*Manhattan, Kansas, about May* 25, 1867. — The Grasshoppers, which have been the terror of our farmers for weeks, proving themselves impervious to water, fire and frost, are now finding an enemy we make haste to weleome as an ally. We refer to the beautiful blaekbirds, immense floeks of whieh are luxuriating upon the hoppers, and returning thanks in exultant notes, and from throats almost splitting with joy." — *Manhattan Independent.*

"*Kansas and Missouri, about June* 6, 1867. — As regards Grasshoppers in Kansas and Missouri, of which innumerable eggs were deposited last autumn, and whieh greatly diseouraged farmers, we learn that these eggs hateh out, and that in two or three days the Grasshoppers disappear." — *N. Y. Sem. Tribune, June* 11, 1867.

"*Nebraska, about June* 6, 1867. — Papers south of the Platte, where the Grasshopper plague was threatened, announee that the reeent storm has eleaned the pest out whereever it prevailed. The *Nemaha* (Nebraska) *Courier* states, that great numbers of blaekbirds, plovers and other varieties of birds are gulping down the young Grasshoppers by wholesale quantities." — *Ibid.*

"*St. Joseph, Missouri, June* 8, 1867. — The [wingless] Grasshoppers, after doing serious damage to erops in this vieinity, are leaving — going west and southwest." — *Prairie Farmer, July* 13, 1867.

"*Jackson Co., Kansas, about June* 10, 1867. — The Grasshoppers threaten the crops saw wheat-crops entirely ruined. Spring backward. Small grains look well where the Grasshoppers have not made their appearance." — "*W. M.,*" *in Prairie Farmer, June* 15, 1867.

"*Ottawa, Kansas, about June* 10, 1867. — When the Grasshoppers first hatched out they did a little damage to the young wheat and garden vegetables, but did no harm worth naming. Soon after hatching, they left the cultivated fields, and seem to have been disappearing ever since. I have a 25-acre field planted in young trees, which they are fond of, but they are all growing finely, and have not been injured, though millions of the 'varmints' hatched right among them. Moreover, I have cut within twenty feet of a park, where immense numbers of Grasshoppers hatched, a handful (?) of orchard grass two and one-half feet high, with no mark of a locust [grasshopper] tooth on it. The reports from other sections, so far as I can hear, are that they are disappearing without harming the crops, and nearly everybody is now satisfied that they will not injure us. What becomes of them all I can't tell. There are immense numbers of birds devouring them, and the general opinion is, that *they are dying off from some unknown cause.* The season has been rather cool and backward, as in other sections." — *S. T. Kelsey, in Prairie Farmer, June* 15, 1867.

"*Atchison, Kansas, June* 11, 1867. — We saw and conversed with a prominent citizen of Brown county this morning, and in conversation about the Grasshoppers he assured us, that on his farm one day this week he noticed thousands of young ones that had just hatched out, and in a very short time he noticed a large flock of blackbirds in the same place, which he discovered had effectually cleared out all the Grasshoppers, not one being left. He assures us that the prairie chickens and quails are eating them, nearly as fast as they hatch out on the prairie." — *Atchison Free Press.*

"*West Kansas, about June* 13, 1867. — With us Grasshoppers have at no time been so abundant, as in the more eastern portions of the State, and their advent was followed by great numbers of birds (mostly blackbirds), which have taken nearly all of the little pests, *and, at the same time, many fields of the late-sown wheat.* [When was it ever known that *blackbirds* devoured whole fields of young wheat? — B. D. W.] The blackbirds, having done their work, have betaken themselves to other counties, and we find that new swarms of Grasshoppers are being hatched. So far as my observation extends, the wet, cold weather does not affect them either for good or evil, and we can only hope to be freed from them through their natural enemies, the birds. They are already so reduced in number, that we apprehend little or no trouble from them, unless they swarm from the east or west." — *N. Y. Sem. Tribune, June* 18, 1867.

"*Oskaloosa, Jefferson Co., Kansas, June* 14, 1867. — We have had a very backward spring. The grasshoppers hatched early in large quantities, and are lively, industrious, and persevering. I think they will take all the wheat, oats and corn, if they do not leave soon. Farmers are very much discouraged." — "W. A. C." in *Prairie Farmer,* June 22, 1867.

"*Leavenworth, Kansas, about June* 15, 1867. — The Grasshoppers are doing great damage on both sides of the Missouri River for a distance of 100 miles. Gardens and corn-fields are being devastated." — *Rock Island (Ill.) Union,* June 30, 1867.

"*Missouri, about June* 15, 1867. — The Grasshoppers have greatly injured the crops in Missouri." — *Corresp. of Chicago Tribune.*

"*Nebraska City, Nebraska, about June* 16, 1867. — The Grasshoppers, although hatching in countless millions, seem to scatter and disappear." — *N. Y. Sem. Tribune*, June 21, 1867.

"*Leavenworth, Kansas, about June* 16, 1867. — Something more than a week ago a farmer of this county informed us, that the wingless Grasshoppers were gradually moving in a southerly or south-western direction, and were averaging from a tenth to an eighth of a mile per day. We thought he might be mistaken, and mentioned it to one or two others, who, to decide it, determined to closely observe them for a week. They informed us yesterday that there is no mistake about it, and that all the young ones that are large enough gather in large bodies and steadily proceed south. One gentleman closely observed a particular body, and in a week's time they had progressed over two miles, which is doing pretty well, considering it was done by short hops. It does not seem to be for the purpose of procuring food, as they pass through a field of spring grain or other good pasture, as speedily as over naked plowed land. A field will be full of them one day, and the next not one can be found in it, except perhaps an occasional couple or stray. It is a curious movement, and worthy the attention of persons who are fond of investigating the mysteries of nature." — *Leavenworth Tribune.*

"*Leavenworth, Kansas, June* 25, 1867. — The Grasshoppers are making a clean sweep of every green thing in the gardens, throughout the southern and western portions of the city, and on the country farms beyond, so far as we have been able to hear. Millions filled the air yesterday, from 11 A. M. to sundown, without any apparent diminution of the numbers on the ground. As fast as their wings are developed, they take flight; and their course is steadily south-east. It will require a couple of weeks for all of them to become fully fledged, as those now here vary in growth from the size of a very small fly to that of the matured hopper. In the meantime, in this vicinity, the devastation of crops and vegetables is general and complete." — *Leavenworth Bulletin.*

"*Kansas City, Missouri, June* 26, 1867. — The Grasshoppers have taken up their line of march. Yesterday afternoon they were passing over the city in such millions, that it looked like a furious snow-storm raging in the heavens. They appeared to be at various heights — some seemed only like white masses against the blue sky, and others low down were lighting on the house-tops. They were going north-east." — *Kansas City Advertiser.*

"*Peru, Nebraska, about June* 30, 1867. — In October last the Grasshoppers came from the north-west, and covered this country and deposited their eggs. In the spring they began to hatch, and they have done much damage to the crops. Wheat and oats are mostly destroyed, and they are now working on the corn. At the end of the month they began to take wing, and soon the air became so filled with them that they appeared like fleecy clouds." — *Monthly Rep. Agr. Dep.*, 1867, p. 270.

"*Holton, Kansas, June* 30, 1867. — June 5th, Grasshoppers destroying the gardens in town; June 10th, [wingless individuals] passing by the million south-east; June 28th, on the wing, going north-north-east with the wind by the million; June 30th, getting scarce; supposed to be done here, or nearly so, unless they come from some other place. Some fields of wheat are eaten up, while others are not hurt." — *Ibid.*, pp. 269-270.

"*Jefferson Co., Kansas, July* 1, 1867. — A great deal has been said in the papers of this and other States of the devastation by Grasshoppers, but I have had good opportunity of noticing through this County and State, and consider the injury to wheat and rye to

be not more than 1-20th of the crop. They are now flying, and ten days will relieve us of them in a great measure ; and the injury by them has not been 1-100th part of what was anticipated three months ago." [Then, sir, your folks must have expected to lose 1-20th of their wheat and rye multiplied by 100, or 500 per cent. of the entire crop ! ! ! B. D. W.] — *N. Y. Sem. Trib. July* 16, 1867.

" *Oregon, Missouri, July* 1, 1867. — Farm and garden produce much injured by grasshoppers." — *Monthly Rep. Agr. Dep.*, 1867, p. 305.

" *Omaha, Nebraska, about July* 3, 1867. — Grasshoppers are said to be very destructive to wheat and cereals south of the Platte River as far as St. Joseph, Missouri." — *Chicago Tribune July* 6, 1867.

" *Leavenworth, Kansas, about July* 4, 1867. — In many parts of this State no Grasshoppers are reported, and the general testimony is that the crops never were better. They are having a high old time with Grasshoppers in Atchison Co., and fears for the onion crop are entertained. The *Press* says that a full-grown Grasshopper was lately seen marching off with a good-sized onion under each wing, another lying across his horns, and with the tears streaming down his face, either because he was not strong enough to carry more, or because the onions he did carry were too strong for him." — *N. Y. Sem. Tribune*, July 9, 1867.

" *Jackson Co., Kansas, July* 8, 1867. — Such crops as have escaped the ravages of the Grasshoppers look well. The Grasshopper panic seems at an end. The most of them have taken flight to the north or north-west." — " *Bani* " *in Prairie Farmer, July* 30, 1867.

" *Padonia, Kansas, July* 8, 1867. — The prospects for crops here in north Kansas are very good now, notwithstanding the armies of Grasshoppers that were hatched here. Winter wheat that was not eaten up last fall is ready to cut. Spring wheat looks well ; the Grasshoppers have injured it but little here. Corn also looks well, and, if the ' varmints ' will only leave soon, will come out all right. Some think the Grasshoppers are leaving the country; there are not nearly as many now, as were hatched out last spring." — " *Young Farmer* " *in Prairie Farmer*, July 20, 1867.

" *Missouri, about July* 14, 1867. — Near St. Joseph the Grasshoppers have done some damage to the wheat, still the breadth sown was large and there will be an average crop. In the Phille Purchase, on the Western Border, the Grasshoppers have done great damage to everything but hemp." — *N. Y. Sem. Tribune, July* 19, 1867.

" *Nebraska City, Nebraska, about July* 14, 1867.* — In some localities the Grasshoppers have destroyed wheat, corn and garden vegetables clean. They have now finally left the State ; gardens have been replanted and are doing well. Only the sandy portions of Kansas have been visited by this insect. In Otoe Co., Nebraska, the Grasshoppers have commenced their ravages on wheat, and it is suffering. Many fields will not be worth cutting, while corn is badly thinned. In some places potatoes are completely stripped. Sorghum has suffered much. Our gardens are eaten through and through. South of us we hear much complaint, while a few miles west there is little damage

* In the original this item is not locally dated, further than as being intelligence from Kansas and Nebraska; but as it manifestly proceeds from the same pen as the third item which follows it here, I have given it the same local date. Without that local date, it is measurably unintelligible.

done, and in Cass Co., Nebraska the crops are very heavy." — *N. Y. Sem. Tribune*, July 19, 1867.

"*Omaha, Nebraska, July* 16, 1867. — The Grasshoppers have not done as much damage in this State as was expected. Their ravages are most extensive along the Huerlano and Arkansas." — *Prairie Farmer*, July 20th, 1867.

"*Ottawa, Kansas, July* 22, 1867. — The Grasshoppers, what was left of them — perhaps one for every fifty that we had last autumn — staid here till their wings attained full size, and then got up and left. The damage they have done to this part of the country amounts to nothing. I am told that in some of the counties north of us they destroyed a little grain before they left." — "*S. T. K.*," *in Prairie Farmer Aug.* 3, 1867.

"*Nebraska City, Nebraska, July*, 1867. — The season has been cold and backward, yet favorable for small grains, until the Grasshoppers hatched and commenced depredations upon our wheat, which has suffered tremendously. Many fields will not be worth cutting. Some fields of corn are badly thinned. Potatoes in some places are completely stripped, and our gardens are eaten through and through." — *Monthly Rep. Agr. Dep.*, 1867, pp. 244-5.

"*Richardson Co., Nebraska, July*, 1867. — The Grasshoppers have destroyed nearly all the crops in this county, and are still at work." — *Ibid.*, p. 245.

"*Douglas Co., Kansas, July*, 1867. — The Grasshoppers have been doing much damage in this vicinity, to all kinds of vegetation." — *Ibid.*, p. 245.

"*Cass Co., Nebraska, Aug.* 5, 1867. — The Grasshoppers have done no damage of any account." — "*A. G. B.*," *in Prairie Farmer Aug.* 10, 1867.

The migratory propensity is developed, from time to time, in the mature or winged Hateful Grasshopper in its native alpine home, whenever it has increased in numbers so greatly as to become instinctively aware that, if it deposits its eggs in the same district in which it was itself raised, its future offspring will starve. In the immature or wingless Hateful Grasshopper, *so long as it remains in a healthy state and finds plenty of suitable food at hand*, no such propensity would, I think, ever be developed, because it has not yet arrived at the time of life, when the feelings connected with the reproduction of the species are called into play. Hence the fact, so often set forth in the preceding extracts, as well as elsewhere, namely, that the larvæ of those Grasshoppers, which had hatched out in the lowlands, in the spring of 1867, had already shown a premature propensity for migration, though they had plenty of good food at hand, seems to prove that they were in a diseased and unnatural condition. I feel confident, at all events, that no *healthy* grasshopper-larvæ would ever pass straight through a field of green grain, without stopping some considerable time to take toll of it, as is reported above by the *Leavenworth Tribune*. (Page 87.) Hence, I infer that the whole brood of Hateful Grasshoppers, both young and old, throughout Kansas, Nebraska and Missouri, were, in the spring and summer of 1867, in a more or less diseased and abnormal state, in consequence of the great change in the "Conditions of Life" previously referred to. (Page 83.) This accounts for the fact that, comparatively, so little damage was done by them, when we take into consideration the enormous numbers that hatched out. Likely enough, a very large proportion of them died a natural death, before they arrived at years of discretion, as indicated in some of the above reports, and in others that will be given hereafter.

The following execllent history of this pernicious insect appears to have been written about the middle of July, 1867, and is from the pen of Mr. W. F. Goble, of Pleasant Ridge, Kansas. It first appeared in the *Monthly Reports of the Agricultural Department* for 1867, (pp. 290–1.)

"These Grasshoppers, or Mountain Locusts as many call them, made their appearance in the western part of Kansas late in August, or about the beginning of September, 1866. The first intimation had here of their approach was the delay of the eastward-bound train, from Fort Riley and Manhattan, on account of the immense numbers of insects crushed on the track, thereby destroying the friction of the driving-wheels. About the 27th of the same month they made their appearance in Eastern Kansas, progressing at the rate of from 5 to 10 miles a day, or according to the velocity of the wind in the direction they travel. Their general course seemed to be from the north-west to the south-east. A contrary wind greatly impeded their progress, and when a strong breeze had to be overcome, they could not make any progress at all in their favorite direction, but generally remained on the ground rather than attempt to proceed, and spent their time in consuming everything accessible in the vegetable line.

"They travel in the air like bees, some flying at an immense height, as can be seen on a clear day by looking toward the sun. When first appearing in any particular locality it is in the manner of a cloud, the insects descending to the earth like dropping rain. They commence at once devouring all vegetable substances in their way, showing, of course, a preference at first. Vegetables possessing the property of sweetness in any degree, as green corn, sorghum, etc., escape till all others in the vicinity are consumed. But everything of an acid or sour taste, as cabbage, [?] or rhubarb, (pie-plant,) as well as bitter and even hot substances, such as tobacco and red or Cayenne pepper, are especial favorites. The tenderest vegetation is always destroyed first. Our fine crops of autumn wheat were completely eaten up in the space of two hours. They are known to eat nearly everything of the vegetable kind, even to the dry bark on trees, and dry lint of seasoned fencing plank, as well as dry leaves and paper and all kinds of cotton goods and woollen clothing; *and I have even seen a flock of sheep literally covered with them devouring the wool.*

"Soon after these insects came upon the ground, they concentrated along the roads and upon any bare earth they could find, preferring the short vegetation common in such places to the hard prairie grass. In such situations and in cultivated fields, the most of their myriads of eggs were deposited. They continued laying till the severe winter weather killed them. The eggs were deposited to the depth, generally, of one inch; although, in loose earth where vegetable roots were found, some were placed as far down as ten or twelve inches, according to the length of the root, which was followed down and devoured, the grasshopper emerging after having laid its eggs.

"On north hill-slopes the process of hatching was much retarded. It was supposed by the people generally, that the severe winter would utterly destroy the posterity of these creatures in this vicinity; but it did not, as the developments of spring fully testified, though perhaps not more than one-fourth of the eggs withstood the weather and produced grasshoppers. Some of them commenced hatching as early as the last of February, when there were a few warm days, which brought forth those lying on the top of the ground. In March the weather was so severe, that a large proportion of the remaining eggs perished, the thermometer frequently indicating 18° below zero. Judging from the voraciousness of those that did appear, *I doubt not Kansas would have been made a perfect desert if all had lived.*

"About the 10th of April the young grasshoppers began to appear in myriads, and farmers grew alarmed. In Salt Creek Valley, where the best farms of the State are located, not only are the ordinary grains devoured, but the finest timothy and blue-grass meadows are ENTIRELY KILLED OUT. Farms however, lying next to timber and brush, fairly escaped, owing to the supply of vegetation thus afforded, and the constant fright given to the insects by workmen. When once driven from a place, they scarcely ever voluntarily return, as I demonstrated this spring in saving a garden and potato patch. This was done by taking bushes and driving the grasshoppers out at about 11 o'clock A. M., and again near sunset. They are very destructive during the night, and should always be driven off before sunset.

"I first noticed these insects on the wing this season on the 27th of June at Fort Leavenworth, when I saw a large number above the tops of the trees flying off in a south-easterly direction. Upon leaving the egg, they are of a milky white color and very tender. When they first began to appear in the spring, the cool nights destroyed many. *Indeed during the entire time they have been constantly dying by millions;* those that remained alive devouring the dead carcases with the utmost avidity.

"No general damage has been done in the State this year by the grasshoppers, but some localities have suffered extensively. As before remarked, as soon as they had developed wings, they left us, apparently governed in their course by the wind. We are now quite free of them, and nearly as good crops will be raised as usual."

While passing down the Mississippi River by steamboat in the middle of August, 1867, I fell in with Mr. Fowler, a very intelligent farmer from the neighborhood of Chillicothe, Ohio, who, as he told me, had been travelling extensively through Kansas with the view of locating there, and, with business-like forethought, had been making particular inquiries everywhere about this Grasshopper-pest. According to my usual practice under such circumstances, I took down from his mouth the following very valuable information respecting the spring hatch of Grasshoppers in Kansas A. D. 1867.

"When the Grasshoppers hatched out in Kansas in the spring of 1867, they always, even before they acquired wings, kept working gradually in a south-east direction. After their wings had become fully developed, whenever the wind permitted, they took flight and flew in the same south-east direction; and if the wind changed, when they were already in the air, so as to prevent them from travelling south-east, they would immediately descend to the earth and wait for a change of wind. Swallows [thought to be Bank Swallows, *Hirundo riparia*] preyed very extensively on them, and so did the Blackbirds [*Icterus phœniceus* Linnæus]; and a bird like a Night-hawk, usually found on the barren Plains to the west, followed them up and consumed numbers of them. After they had all disappeared, this last bird disappeared also. It was the general opinion of the farmers with whom I conversed, that, but for a six-weeks spell of cold and wet weather in the spring of 1867, which benumbed the young Grasshoppers after they had hatched out, and probably destroyed many of them, *the entire crops of the country would have been ruined by them.* As it was, according to the closest estimate I can make, which however must only be considered an approximation to the truth, the Grasshoppers took, on the average, during the summer of 1867, in the parts of Kansas which I visited, ⅛th of the field-crops and ⅞ths of the garden-crops. The Dog-fennel [*Maruta cotula*, D C.?] they swept clean off everywhere; but that the farmers could very conveniently spare."

VARIOUS IRRUPTIONS OF THE HATEFUL GRASSHOPPER IN BYGONE YEARS.

Usually — as is also the case with the Migratory Locusts, (or, as we Americans should call them, "Migratory Grasshoppers,") of the Old World and of Scripture — these Grasshopper invasions only take place at distant intervals of time. For example, 46 years before the invasion of 1866, there was a swarm descended from the Rocky Mountains A. D. 1820 upon Western Missouri, doubtless stopping by the way in Kansas, though, as that State was then uninhabited save by the Red Indians, we have no record of the fact. The following paragraphs afford all the information that I have been able to glean on this very interesting subject.

"We were informed by old residents of West Missouri and some of the Indians, that long ago, I think it was in the year 1820, there was just such a visitation of Grasshoppers as is now afflicting us. They came in the autumn by millions, devouring every green thing, but too late to do much harm. They literally filled the earth with their eggs, and then died. The next spring they hatched out, *did but little harm* (?), and when full-fledged left for parts unknown. Other districts of country have been visited by them; but, so far as I could learn, they have done but little harm after the first year." — *S. T. Kelsey, of Ottawa, Kansas, in Prairie Farmer, June* 15, 1867, p. 395.

"A Missouri Paper publishes a statement by an old settler, that great numbers of Grasshoppers appeared in September, 1820, doing much damage. The next spring they hatched out, *destroying the cotton, flax, hemp, wheat and tobacco crops;* but the corn escaped uninjured. About the middle of June they all disappeared, flying off in a southeast direction." — *Western Rural*, 1867.

Again: In the year 1856, or ten years before the invasion of 1866, and thirty-six years after the invasion just referred to, there descended from the Rocky Mountains another swarm, apparently of these same Hateful Grasshoppers, which — perhaps owing to the more northerly direction of the prevalent winds — took a more northerly course than the invading army of 1866 did, and swooped down upon Minnesota. In the *Practical Entomologist*, (II., p. 3,) I have printed all that I have been able to collect on this subject. Whether the damage said by the writer of that article to have been done by these insects in Minnesota in the following year, 1857, was done by a fresh swarm descending from the Rocky Mountains, or by the individuals that hatched out from the eggs deposited in the earth by the swarm of 1856, is left uncertain. But I incline to believe in the latter alternative, because it seems improbable that, for two successive years, two successive swarms of Grasshoppers descending from the Rocky Mountains, should have been deflected so unusually far to the north of their customary line of flight as Anoka Co., in Minnesota. Besides, I see that W. E. Watt, of Minnesota, says that "the year after the Grasshoppers invaded Minnesota they did but little harm," thus evidently implying that there were not two successive years of invasion. (*N. Y. Sem. Tribune*, Feb. 1, 1867.)

Eight years afterwards, or A. D. 1864, there seems to have been another Grasshopper invasion of Minnesota, but only over a comparatively small region of country, and probably by some species distinct from the true Hateful Grasshopper. At all events, instead of appearing in September, they appeared in July; whereas, as Minnesota lies to the north of the districts usually invaded by the Hateful Grasshopper, we should expect that species to appear, if anything, rather later instead of considerably earlier than it alway appears in more southerly latitudes. To whatever species these Grass-

hoppers belonged, they seem to have laid eggs, which hatched out the next spring in the invaded district, as the following extracts show :

"*Minnesota, July* 19, 1864. — A correspondent of the *St. Paul Press* speaks very alarmingly of the great Grasshopper raid now in progress down the Minnesota valley. They take every green thing in their course. We have no later news of the pests." — *Prairie Farmer, Aug.* 6, 1864.

"*Fort Ridgely, (on the Minnesota River) Minnesota May* 24, 1865. — Our bright prospects are blighted by the belief that the crops will be destroyed by the ravages of the Grasshoppers. In many localities, the ground is completely covered with these little insects, and as small as they neeessarily are at this early day, they have begun their work of destruction. I have seen small fields entirely ruined by them. Last spring (summer ?) large armies of Grasshoppers started down from a point west and northwest of this, near the British Possessions, and in the autumn the frost found them in this section of country." — *Ibid., June* 3, 1865.

Whether the following extract refers to the winged grasshoppers developed in 1865, from the eggs laid in the Minnesota Valley in the summer and autumn of 1864, or to a fresh swarm winging its way into the State in 1865, from the west and northwest, I am unable to decide; but I rather incline to the former alternative. Clearly, this entire Grasshopper-visitation must have been quite local; for, in the *Prairie Farmer* for 1865, may be found sundry "Records of the Season" from sundry parts of Minnesota, namely, Rice Co., Anoka Co., Ramsey Co., Goodhue Co., Blue Earth Co., Wabasha Co., Martin Co., Elgin and St. Paul, and dated from June 19th to October 7th, 1865, which say nothing whatever on this subject.

"*St. Peter, Minnesota, July*, 1865. — The Grasshoppers have been flying over this place in countless myriads. The air, for a quarter of a mile high, was filled with them, and their speed was four to five miles an hour. In every town or farm through which they pass, they leave a strong guard, and the destruction of crops is sure to follow." — *Prairie Farmer, July* 22, 1865.

Lastly, in 1857, as appears from the following extract, or one year after the first Minnesota invasion, and nine years before the great invasion of 1866, there was an irruption of some kind or other of Grasshoppers — perhaps our Hateful species, perhaps a different one — into the dominions of that High and Mighty Autocrat of a vast portion of the soil of Republican America, whom the vulgar herd of Gentiles designate as Brigham Young.

"In 1857, the Grasshoppers ate everything green in Salt Lake Valley, and came near starving the Mormons out, since which time old Brigham keeps one year's supplies on hand, knowing that they would not come the second year." — *Iowa Homestead, May* 8, 1867.

Ten years afterwards, as is shown below, there was still another irruption of the same insect, but apparently in greatly diminished numbers, into the same territory.

"*Great Salt Lake City, Utah, about July* 31, 1867. — The season has been very fine for farming, but on the last day of the month the Grasshoppers came by millions." — *Monthly Rep. Agr. Dep.*, 1867, p. 306.

"*Wanship, Utah, July* 31, 1867. — First appearance of a cloud of Grasshoppers over Wanship. They have destroyed one-half of the grain in Cache Valley, and all the fruit and a great amount of the grain in Davis Co. They are swarming on the lower part of Weber River." — *Ibid.*

"*Great Salt Lake City, Utah, about November*, 1867. — In a field that was being planted in the north-east portion of this City, last Monday, numbers of young Grasshoppers (the size of House-flies) were turned up by the plow, all alive and *green*, and quite recently hatched." — *Ibid.*, p. 365.

It is by no means certain, that the insect referred to in the above six paragraphs is the same species as the Hateful Grasshopper of the other side of the Rocky Mountains. Indeed, as the young ones that hatched out *underground* from the eggs in November, 1867, are said to have been "green," while those that hatched out in Kansas from the eggs of the true Hateful Grasshopper in the spring of 1867, are said by Mr. Goble to have been "milky-white upon leaving the egg," (above p. 91,) I should rather infer that it belonged to a different species, peculiar to the western slopes of the Rocky Mountains. If it be the same, its appearing in the winged state in Utah, A. D. 1867, nearly a month sooner than it appeared in the Valley of the Mississippi, A. D. 1866, may be accounted for, partly by the western exposure of the Rocky Mountains being perhaps warmer than the eastern exposure, which would, of course, have a tendency to accelerate the transformations of the insect, and partly by the invading army not having to march so far in this case to reach its "objective point." In the lowlands on this side of the Rocky Mountains, the average daily progress of the Hateful Grasshopper, when full fledged, in 1866, was only, as we have seen, from five to ten miles. (Above p. 90.)

THE LAST INVASION OF THE HATEFUL GRASSHOPPER IN THE AUTUMN OF 1867.

From the following extracts, which I have laboriously gleaned from various sources, it appears that, contemporaneously with the above invasion of Utah and just one year after the Grasshopper-invasion of Kansas, Nebraska and Missouri in 1866, and at least 42 days* after the last remnants of the descendants of that great army had finally wasted away and disappeared from the invaded territory, a fresh host of invaders descended upon the fertile plains of the Mississippi from the barren canons (kanyons) of the Rocky Mountains, and at precisely the same period of the year. This time, however, they took a rather more northerly course, the main body descending through Nebraska upon Iowa, instead of through Kansas upon Missouri. Still, in both years there were flying columns of the enemy, that deviated a little from the general line of march either to the right or to the left. For, as will be seen hereafter, some of the more northerly parts of Kansas and the extreme north-west corner of Missouri were invaded by the army of 1867; and, as I have shown in the *Practical Entomologist*, the southern parts of Nebraska were very generally invaded by the army of 1866. This second invading army, however, does not seem to have been quite as numerous as that of the preceding year.

It has been erroneously supposed by many, that this swarm of winged Grasshoppers, which made its appearance in Kansas, Nebraska and Iowa from Aug. 25th to Sept. 30th, 1867, was not a fresh importation from the Rocky Mountains, but simply the individuals that hatched out in the spring of 1867 from the eggs laid in the autumn of 1866 by the

* As may be seen by the accounts collected from various sources and printed above, the departure of the Grasshoppers that hatched out in the spring of 1867, in Kansas, Nebraska and Missouri, from eggs laid in the preceding autumn, is variously dated in various localities from June 25th on to July 14th; while the earliest invaders in the autumn of 1867, as will be immediately shown, appeared August 25th, and the latest September 30th.

invading army of that year. But, in the first plaee, as I have already shown, there was an interval of, at the very least, 42 days, during which no ravages by Grasshoppers are recorded anywhere in the afflicted region — whieh pretty effeetually demolishes the above supposition; secondly, one of the reports printed below expressly says that, for a period of 2½ days, there was a eonstant influx of Grasshoppers into Riehland, Nebraska, FROM THE NORTH-WEST; and thirdly, although south-western Iowa was really invaded 1867 by some of the unfledged Grasshoppers from Missouri, yet this took place, not in the autumn, but early in June as the following paragraph shows: —

"The grasshoppers are making sad ravages upon the erops of south-western Iowa. Whole fields of grain disappear in a single night. They go in large droves, and keep straight onward, no impediment whatever turning them from their eourse." — *Rock Island (Ill.) Union, June* 17, 1867.

Now, if the swarms that invaded Iowa in September sprang from the same source as those that invaded that State in June, why do we hear nothing of any Grasshoppers there from the forepart of June to the latter end of August? The truth of the matter seems to be, that the Hateful Grasshopper, in its native Alpine home in the Roeky Mountains, attains maturity in August, and then, aeeording to the mysterious promptings of its peeuliar instinet, often takes wing for the far-distant lowlands towards the East; while the very same speeies, when hatched out in warmer elimates, that is, in the lowlands of the Mississippi Valley, attains maturity towards the end of June, or fully one month earlier, and then, prompted by the same instinet that governed it in its native home, immediately takes wing, and usually flies off in a south-east direetion; after whieh it perishes in some unknown manner.

"*De Soto, Nebraska, Aug.* 29, 1867. — Invasion of Grasshoppers, looking like a snow-storm. They show a preferenee for eorn and potatoes." — *Monthly Rep. Agr. Dep.*. 1867, *p.* 311.

"*Glendale, Nebraska, Aug.* 31, 1867. — Grasshoppers now at work on the eorn-fields; the blades and tops mostly gone; many stalks, three-quarters of an ineh in diameter, eut off, and many ears just glazing eaten down, eob and eorn, from one to two inehes." — *Ibid.*

"*Richland, Nebraska, Aug.* 31, 1867. — At noon on August 27th large numbers of loeusts [grasshoppers] appeared, and eontinued to eome FROM THE NORTH-WEST until the evening of the 29th. They still (Aug. 31st) remain, and it is probable that the eorn will be almost or entirely lost." — *Ibid.*

"*Algona, Iowa, Sept.* 20, 1867. — Grasshoppers made their appearanee in large numbers, and by the 30th had stripped gardens and tender herbage. Corn was too far advaneed towards ripening to be mueh damaged. They seemed to eome FROM THE WEST OR SOUTHWEST." — *Ibid. p.* 352.

"*Council Grove, Kansas, Sept.* 26, 1867. — Sept. 20th, Grasshoppers passing SOUTH-EAST in great numbers, dropping heavily of their numbers on farms and woodland. *All seem to be of spring hatching.* Sept. 26th, laying eggs same as last autumn, and eating everything in their reaeh." — *Ibid. p.* 352.

"*Fort Dodge, Iowa, Sept.* 30, 1867. — A swarm of Grasshoppers arrived at 1 P. M. Sept. 10th, and eommeneed work immediately upon vegetables, leaving hardly any buckwheat worth eutting, and stripping the leaves entirely from the eorn, so that it looks like stieks stuek in the ground. They eame again in additional numbers on the

20th, but are now (at the end of the month) gradually decreasing. They have laid their eggs by millions." — *Ibid. p.* 352.

"*Holton, Kansas, Sept.* 30, 1867. — Grasshoppers eating some early-sown wheat. They can be seen by millions passing to the SOUTH-WEST. They have done but little injury here thus far." — *Ibid. p.* 352.

"*Greenwood, Iowa, Oct.* 6, 1867. — Grasshoppers pretty thick, but came too late in the season to injure anything except autumn-grain, of which there is very little." — "*Justice*," *in Prairie Farmer, Oct.* 12, 1867.

"*Ottoe Co., Nebraska, Oct.*, 1867. — Of late, the Grasshoppers have again visited our section, and are depositing their eggs in vast numbers. We begin to fear that they may prove to be an annual pest to our River towns, and in fact to the entire Missouri valley." — *Monthly Rep. Agr. Dep.*, 1867, p. 327.

"*Osceola, Clarke Co., Iowa, Oct.* 20, 1867. — The Kansas Grasshoppers, which for six weeks past have gradually made their way EASTWARD, appeared here in comparatively small numbers about two weeks since. They are rather small brown insects, with red legs and white wings, to the general observer differing from the ordinary grasshopper in nothing except their power of continued flight. A gentleman from the upper part of this county reports that, on a road running through his place, the Grasshoppers would be found, morning and evening, *six inches deep*, [in the ground? — B. D. W?] He stated that their eggs were hatched after an incubation of several days, and that a few days' growth gave distinct form to the young. The female may be seen in large numbers on our roadsides in the act of 'setting.' The tail of the insect, projecting downward and backward, is found to enter a tubule in the sod, about ¾ of an inch in depth and 3-10ths in diameter. Into this nest is deposited an egg-sack of mucus, containing in uniform order 16 minute eggs of the shape of an elongated bean. I send a pair of insects and several nests of eggs." — *Corresp. of Keokuk (Iowa) Constitution.*

"*DesMoines, Polk Co., Iowa, Oct.* 30, 1867. — Myriads of young Grasshoppers have been observed in the fields about here of late, which of course must be the progeny of the flood of insects, which first made their appearance here the latter part of September." — *Iowa Homestead.*

"*Fort Calhoun, Nebraska, Dec.* 6, 1867. — Corn is about all in crib and not very good. The Grasshoppers took the leaves about 3 or 4 weeks too early, which affected it about the same as an early frost does." — "*C. R.*," *in Prairie Farmer, Dec.* 21, 1867.

"*Nodoway Co., N. W. Missouri, about Nov.* 1867. — The Grasshoppers made a raid upon us this autumn, but too late to do much injury. We look for their appearance in the spring, when the eggs deposited will hatch." — *Monthly Rep. Agr. Dep.*, 1867, p. 365.

"*Woodson Co., Kansas, about Nov.* 1867. — The 'Mormon locusts' [Hateful Grasshoppers] made their appearance in this county on the 25th of September, and there was not sufficient cold weather to stop their ravages upon the crops until the 29th of October, when the thermometer fell to 24° above zero. The consequence is that they have destroyed all the wheat sown prior to their arrival." — *Ibid.*

"*Dakota Co., Nebraska, about Nov.* 1867. — The Grasshoppers have left us, but their eggs have been deposited to be hatched out in the spring." — *Ibid.*

"*Hall Co., Nebraska, about Nov.*, 1867. — Grasshoppers have been very thick again this

season, but have done little damage. They have deposited few eggs compared with the preceding year." — *Ibid.*

"*Page Co., Iowa, about Nov.* 1867. — We have been visited this autumn by the Grasshoppers, which have devastated gardens to considerable extent, and even eaten the fruit from the trees. They were particularly fond of peaches, in many instances eating the fruit entire, leaving the pit [stone] on the tree. Nearly all the cabbage in the county has been devoured by them, and the autumn wheat entirely eaten up, my own being the only piece left in this section. The earth is filled with their eggs."— *Ibid.*

"*DesMoines, Polk Co., Iowa, Jan.* 8, 1868. — There come to us from every direction expressions of great apprehension, about the devastations of the Grasshoppers the coming season." — *Iowa Homestead.*

When I was attending the Fair of our State Agricultural Society in October, 1867, I got into conversation at my Hotel with Mr. C. McKee, of Cass Co., Illinois, who, as he informed me, had just returned from a business tour through a great part of Iowa. From this gentleman I learned that the Grasshoppers first invaded Iowa about August 25th, and that they continued arriving till about the end of September. "They came," he told me, "with a westerly wind, and were generally believed by the Iowa farmers to have originated in Dacotah." He had met with them, or heard of them in the following counties of Iowa, and from the above Reports of the Agricultural Department we may add Adams and Page counties to the list; all of which, as will be seen by the geographical student, lie in the western half of the State, the most easterly point in the most easterly counties (Polk and Warren) being no less than 115 miles from the nearest point on the Mississippi River: — Cherokee (also reported by the Agricultural Department,) Woodbury, Ida, Sac, Calhoun, Greene, Dallas, Guthrie, Adair, Madison, Warren, Clarke, Ringgold, Carroll and Polk (Des Moines.) I may add that the Editor of the *Iowa Homestead*, to whom I had forwarded a list of the above 17 counties in Iowa, says in his issue of Jan. 15, 1868, that he "thinks that the territory named covers the extent of the Grasshopper-raid into Iowa in the summer and fall of 1867."

Of course, throughout the districts in Kansas, Missouri, Nebraska and Iowa, which have thus been invaded by the Hateful Grasshopper in the autumn of 1867, the eggs laid by the females, except the few that hatch out the same autumn, will mostly live through the winter and hatch out in the spring of 1868; when, in all human probability, the same partial destruction of the crops will take place, that was experienced in the spring and summer of 1867 throughout the districts invaded in the autumn of 1866. But there is not the least reason to anticipate, as the writers of many of the above extracts evidently do, that these Grasshoppers have become a permanent institution in that section of country. Likely enough, these districts may not be again invaded by their little foes from the Rocky Mountains for the next ten or twenty years. When in October, 1866, in the columns of the *Practical Entomologist*, I stated that it was not at all probable that the Grasshopper plague would be continued in Kansas and Nebraska beyond the summer of 1867, I did so with the distinct proviso, "unless fresh swarms should descend upon those countries from Colorado." (Vol. II., p. 5.) Since, however, I am now writing more especially for the citizens of Illinois, it is not necessary to dwell further upon this subject.

But Kansas, Missouri, Nebraska and Iowa were not the only States on this side of the Rocky Mountains, that were invaded by Grasshoppers in the autumn of 1867. Nearly a dozen counties in Texas have suffered in the same manner and at the same

time, and probably from the same species of Grasshopper, the portions of the State that lie at the greatest distance from the Rocky Mountains having been apparently not infested by these insects. I give below all that I have been able to collect on the subject.

"*Greenville, Hunt Co., N. E. Texas, about Dec.* 24, 1867. — Since the departure of those few dozen Grasshoppers, our farmers have begun to sow wheat in real earnest. The damage done by that same set of Radical bugs is not so great as was anticipated." — *Greenville Independent.*

"*Dallas Co., N. E. Texas, about Nov.*, 1867. — The Grasshoppers made their appearance here on October 17th, the air being filled with them. They appeared to be coming from the west, and traveling east. They have literally eaten every green thing, and in places where they got to the wheat that was being sown, they devoured the grain. About two-thirds of them have disappeared, and I think all will leave in a few days." — *Monthly Rep. Agr. Dep.*, 1867, p. 364.

"*Fannin Co., N. E. Texas, about Nov.*, 1867. — The Grasshoppers made their appearance about two weeks ago, but have done little or no injury yet. There is a general disposition to withhold seeding until they entirely disappear." — *Ibid.*, p. 365.

"*Red River Co., N. E. Texas, about Oct.*, 1867. — We have now in this county, for the first time in my recollection, a visitation of Grasshoppers, which are devouring everything they can make food of, and I fear they will destroy all the wheat put into the ground. Sowing will be suspended until they disappear." — *Ibid.*, p. 365.

"*Lampasas Co., Central Texas, about Oct.*, 1867. — Since my last report, Grasshoppers have come upon us, though not very numerous, but sufficient to deter farmers from putting in wheat and other small grains." — *Ibid.*, p. 365.

"*Lampasas Co., Central Texas, about Nov.*, 1867. — Grasshoppers made their appearance here in immense numbers about the 1st of October, and completely destroyed the autumn and winter gardens, and injured the stock range materially. They continued with us until the 20th, when they moved on their journey in a south-easterly direction. Many are deterred from sowing wheat by apprehension of the re-appearance of the destroyer in the spring." — *Ibid.*, p. 364.

"*Bell Co., Central Texas, about Nov.* 1867. — We have had Grasshoppers in considerable numbers since the 15th of October, but too late to do any harm except to gardens, which they have entirely destroyed." — *Ibid.*, p. 364.

"*Coryelle Co., Central Texas, about Nov.* 12th, 1867. — The Grasshoppers made their appearance in this county on the 12th of October, coming in vast quantities from the north. They have been with us a month and done much injury. All the autumn gardens were destroyed; and though wheat-sowing is past, little has been sown, as the Grasshoppers eat the grain before it can be covered." — *Ibid.*, p. 365.

"*Lavaca Co., Central Texas, about Nov.* 1867. — The Grasshoppers are already, in the western part of the county, depositing their eggs by the million, which, if not destroyed by storm or severe winter, will hatch out in the spring and do a great deal of damage." — *Ibid.*, p. 361.

"*Burleson Co., Central Texas, about Nov.*, 1867. — We have the Grasshoppers with us, and they cover the ground, and are depositing their eggs." — *Ibid.*, p. 364.

"*Fayette Co., Central Texas, about Oct.*, 1867. —Grasshoppers appeared in this neighborhood on the 3rd instant in great numbers." —*Ibid.*, p. 365.

"*Austin Co., Central Texas, about Nov.*, 1867. —Grasshoppers, hitherto unknown in this locality, have appeared in countless numbers." —*Ibid.*, p. 365.

In the following Table will be found a chronological synopsis of the various Grasshopper-invasions, of which the details have been given above. In every case eggs were deposited in the ground in great numbers, which, so far as can be ascertained, hatched out in the following spring, so as to cause considerable damage to the crops.

A. D.	Districts Invaded.	Species of Grasshopp'r
1820	Western Missouri (and Kansas?)	Hateful Grasshopper.
1856	Minnesota	Hateful Grasshopper?
1857	Utah	Unknown species?
1864	Minnesota River Valley in Minnesota	Unknown species?
1866	Kansas, South Nebraska, West Missouri and N. E. Texas	Hateful Grasshopper.
1867	Utah	Unknown species?
1867	Texas (North-eastern and central counties.)	Hateful Grasshopper?
1867	Nebraska, North Kansas, N. W. Missouri and Western Iowa	Hateful Grasshopper.

The true Hateful Grasshopper must be carefully distinguished from the common Red-legged Grasshopper (*Caloptenus femur-rubrum*, DeGeer,) which swarms everywhere from Massachusetts to Minnesota, and from Pennsylvania to Illinois. The unpractised observer, indeed, would very readily confound the two species; for in reality they differ in nothing but the comparatively much longer wings of the former, which enable it to fly vast distances; whereas the latter does not usually fly more than a few yards at a stretch. Harris reports of the Red-legged Grasshopper, (or, as he prefers to call it, "the Red-legged Locust,") that in certain seasons it almost entirely consumes the grass of the New England salt-marshes, and then emigrates on to the uplands, devouring on its way grass, maize, garden-vegetables, potato-tops, clover and tobacco-plants. "These insects," he continues, "will even destroy in a few hours the garments of laborers, hung up in the field while they are at work; and, with the same voracity, they devour the loose particles which the saw leaves upon the surface of pine-boards, and which, when separated, are termed saw-dust." (*Inj. Ins.*, pp. 168–170.) As the reader will have noticed, the Rocky Mountain species has the same omnivorous propensities. It is probably to this Red-legged Grasshopper that Mr. S. T. Kelsey, of Kansas, refers, when he says that he "has known Grasshoppers in western New York to destroy a large proportion of the growing crops, and then deposit their eggs," as the other species did in Kansas in 1866. (*Prairie Farmer*, June 15, 1867.) While I was attending the State Fair held at Freeport in North Illinois in the year 1859, I heard (as I have already recorded elsewhere) from the farmers of that neighborhood great complaints of the damage done them that year by Grasshoppers. And Mr. Arnold, of DeKalb County, which also lies near the northern boundary of this State, says that his oat-crop in 1861 "was diminished at least 10 bushels per acre by the Grasshoppers, who ate off the heads, the ground being literally covered with grain."* In Fulton Co., Central Illinois, "myriads of young grasshoppers" are reported to have appeared "in the meadows, so as to be likely to destroy the crop of clover seed," on June 23, 1860. (*Prairie Farmer*, *July* 5, 1860.) And in Champaign Co., Central Illinois, young grasshoppers are said to have swarmed "in countless multitudes" in the middle of June, 1861. (*Ibid*, *June* 20, 1861.) All these grasshoppers in North and Central Illinois were also, in all likelihood, the common

* See, on these two points, *Trans. Ill. State Agr. Soc.* V. p. 497.

Red-legged species; and it is to that species that I should likewise refer the following observations, which, as well as many others that the reader has already perused, have been gleaned from the very valuable "Records of the Season," that enrich the pages of the *Prairie Farmer*.

"*Morgan Co., Illinois, Sept.* 7, 1867.—Some grasshoppers are eating on the leaves of the corn, but not enough to do any damage."—*Prairie Farmer, Sept.* 14, 1867.

"*Stark Co., Illinois, Aug.* 27, 1867.—Some grasshoppers are eating on the leaves of the corn, but not enough to do any harm."—"*W. N.*" *in Prairie Farmer, Sept.* 7, 1867.

"*Marshall Co., Illinois, Sept.* 27, 1867.—Corn was doing well until the 27th of August, when THE GRASSHOPPERS made their appearance, eating off all the corn-blades and all our vegetables that grow above-ground."—"*E. S. H.*" *in Prairie Farmer Oct.* 12, 1867.

"*Washington Co., Illinois, Sept.* 3, 1867.—THE FLYING GRASSHOPPERS are here by the bushel; voracious eaters, they make fruit-trees, groves, currant and gooseberry bushes, and potato vines look bad indeed. Corn-fields look like fields of bean-poles with ears on them."—"*O. C.*" *in Prairie Farmer, Sept.* 7, 1867.

Washington county, it will be observed, is in South Illinois, Morgan county in Central Illinois, Marshall and Stark counties in North Illinois; and all four of them are removed by the width of at least two counties from the Mississippi River. Consequently, it is unreasonable to suppose, knowing what we do of the habits of the Hateful Grasshopper, that that insect could have flown from the very centre of Iowa—the nearest point to Illinois where it is known to have occurred in the autumn of 1867—over the whole of the eastern half of Iowa and at least two counties in Illinois, without leaving any signs of its journey on the road, and have subsequently appeared in one or more of the interior counties of Illinois in September, 1867. Hence, so far as *indirect* evidence goes, it is utterly improbable that the Grasshoppers referred to in the above extracts could have belonged to the Rocky Mountain species. It is very true that there is no *direct* evidence, that the Grasshoppers found in Illinois in Marshall and Washington counties during September, 1867, by "E. S. H" and "O. C.," were not the veritable Hateful Grasshoppers of Kansas, and Nebraska, and Western Missouri, and Western Iowa; and certainly their habits, as stated in the above two extracts, agree very remarkably with those of the Rocky Mountain insect. But who is to blame for this missing link in the chain of evidence? Not the editors of the *Prairie Farmer;* for no doubt they printed faithfully all the intelligence that their correspondents sent them. Not "E. S. H." and "O. C."; for they spoke according to the lights that had been vouchsafed to them. Not the Entomologists; for we have been preaching for the last ten years on the practical importance of our favorite branch of Science. The blame, in reality, lies with our wretchedly defective School System, which persists in tearing the brains of young children to pieces with such useless acrobat-feats of the intellect, as are dignified by the name of "Mental Arithmetic," while it utterly neglects to instill into their minds the commonest rudiments of Natural History. Hence we are perpetually dinned with nonsensical theories about "THE borer," "THE fly," "THE bug," "THE grasshopper," &c., &c., as if there was respectively but ONE species of borers, of flies, of bugs and of grasshoppers within the limits of the United States! Whereas in reality there are hundreds of distinct species of each of them, differing one from the other as widely as a sheep from a goat, or a cow from a deer, or a horse from a hog. Had but

"O. C." of Washington county and "E. S. H." of Marshall county been familiarized in their school-days with these simple truths, they would not have thought it sufficient merely to chronicle the fact, that "THE grasshoppers" had done so and so in their respective neighborhoods; but they would, in addition, have sent specimens of the culprit insects to some competent entomologist — Mr. C. V. Riley, for example, who at that very time was conducting the entomological department of the *Prairie Farmer* — and thus it could have been decided with scientific certainty, to what particular species their grasshoppers really belonged. Would farmers but make it a rule to adopt this course, whenever they notice any unusual occurrence in the little World of Insects, they would not only put money into their own pockets by furthering our knowledge of Economic Entomology, but they might, in addition, often subserve the interests of pure theoretical science, by adding new facts to the great store which has been already accumulated. When the scientific name of an Insect has been once, no matter how, determined, the Farmer can record for all future ages with scientific precision whatever he knows about it; and the Farmer, be it remembered, is just as capable as the Philosopher of observing the peculiar habits of any particular species of Insects, and ordinarily he has much better and more frequent opportunities for so doing than any Philosopher has. On the other hand, until the name of an insect is scientifically ascertained, everything that is said about it amounts to little more than guess-work, and groping round in the dark, and the balance of probabilities. We may, it is true, sometimes solve the scientific conundrum, as I have myself attempted to do in the present case, and *believe* that we have found the correct solution. But it cannot be too often repeated that, "*Believing* is not *knowing*, and *faith* is not *science*."

The practical man will, perhaps, think that, of whatever *theoretical* interest these long-winded discussions on the nativity of certain broods of Grasshoppers may be, they are of no manner of *practical* importance. But the practical man, if he so think, will be, for once in his life, mistaken. Let it only be conceded that Hateful Grasshoppers, after being raised from the egg in 1867 in the lowlands of Kansas and Missouri, can generate freely the same year in the lowlands of Nebraska and Iowa — for it must be remembered that the Grasshoppers that afflicted the two last-named countries in the autumn of 1867 are said to have laid millions of eggs — and no good reason can be given, why Hateful Grasshoppers, raised from the egg in 1868 in Nebraska and Iowa, should not generate freely in Illinois in the autumn of that year; and so on indefinitely for a long series of years. In other words, upon this seemingly mere theoretical question, that has been discussed at such tedious length, hangs the purely practical and highly important question, whether or not we folks in Illinois, and in other States still further to the east, are likely to be afflicted in the future by the Hateful Grasshopper for nobody knows how many years. If, on the contrary, every swarm of Hateful Grasshoppers raised in the lowlands is always barren, and if every swarm of them that is capable of laying fertile eggs must necessarily, as I firmly believe, have been raised from the egg in its native alpine home, away up in the canons (kanyons) of the Rocky Mountains, then there MUST be some geographical limit or other to the region of lowland country, which they are physically capable of reaching. It would be absurd, for example, to imagine for one instant that a Grasshopper-army, starting from the Rocky Mountains, could in one season fly all the way to France or England, or even as far as the Atlantic seabord of the United States. Hence, allowing that there is some geographical limit to the flight of such an army, we have but to recur to historical facts to find what that limit has hitherto been; and we may then infer with moral

certainty, that for the future—all other influencing circumstances continuing the same—the geographical range of a swarm of Hateful Grasshoppers, descending from the Rocky Mountains, will always continue to be the same or nearly the same.

It may perhaps be thought, by those who have not carefully studied the difference between the two cases, that, if the Colorado Potato-bug could descend from the Rocky Mountains into Nebraska and Iowa, and then pass onwards into Illinois, and so indefinitely forwards in its grand march to the Atlantic Ocean, the Hateful Grasshopper may do the very same thing. But the two cases are not parallel. The Colorado Potato-bug, as we all of us in northern and central Illinois know from woful experience, propagates freely and rapidly, generation after generation, in the northern lowlands of the Mississippi Valley, and spreads by this means every year further and further to the eastward; although it is very true that in the more southerly lowlands of that Valley—such as Kansas, and Missouri and South Illinois—it propagates much less freely and rapidly, and consequently spreads but very slowly indeed towards the east. On the other hand, superabundant evidence has been detailed in this chapter, to prove that the Hateful Grasshopper does NOT breed any where in the lowlands of the Mississippi Valley, but, on the contrary, gradually wastes away and disappears from off the face of the earth, when raised there from the egg, without itself laying any eggs at all. Therefore it is utterly improbable that this insect should, at any future period, breed freely in the country immediately to the west of the Mississippi, and thus pass gradually eastward into Illinois, and after breeding there pass on still further eastward. And in point of fact we know that the true Hateful Grasshopper has never been found by any entomologists, even in very small numbers, from one end of Illinois to the other. Moreover, the Colorado Potato-bug is a slow-flying insect, physically unable to fly across the vast Plains of the Western Desert at one fell swoop. Hence, until the distance between Colorado and eastern Kansas and Nebraska was bridged by settlements where potatoes were grown, it was incapable of passing into Kansas and Nebraska, and thence through Iowa into Illinois; and we know that history proves to us, so far as any negative fact can be historically proved, that it never did so. On the other hand, the Hateful Grasshopper is a rapid-flying insect, capable of flying hundreds of miles at a stretch, when caught up by a strong westerly wind; and there is historical evidence that it crossed the Plains, that intervene between Colorado and the inhabitable or eastern parts of Kansas, in 1820, or long before any white man had thrust his plow into the virgin soil of those two districts. Therefore, if this Grasshopper is going at some future period to make its way into Illinois, not by successive broods being raised one from the other on the route, but by one single uninterrupted flight from the Rocky Mountains, we have a right to ask, why it has never done so at some previous period?

Our State has now been organized for about 50 years, and for many preceding years it was sparsely inhabited both by the French and by the English. Yet, in all that long period of time, no record of any such Grasshopper-invasion of our State, as history shows to have repeatedly taken place in various States to the west of us, and in various years from A. D. 1820 up to the present year, 1867, can be met with in any printed document, or gleaned from the trusty memory of the "oldest inhabitant." Why is this? What possible cause can be assigned, why, up to the year 1870, for example, the Hateful Grasshopper should never have flown eastward from the Rocky Mountains within 115 miles of Illinois, and in that particular year should fly so many miles further east as to touch the sacred soil of Illinois? The distance from the alpine regions of the Rocky Mountains to the most easterly point that this insect has ever hitherto reached,

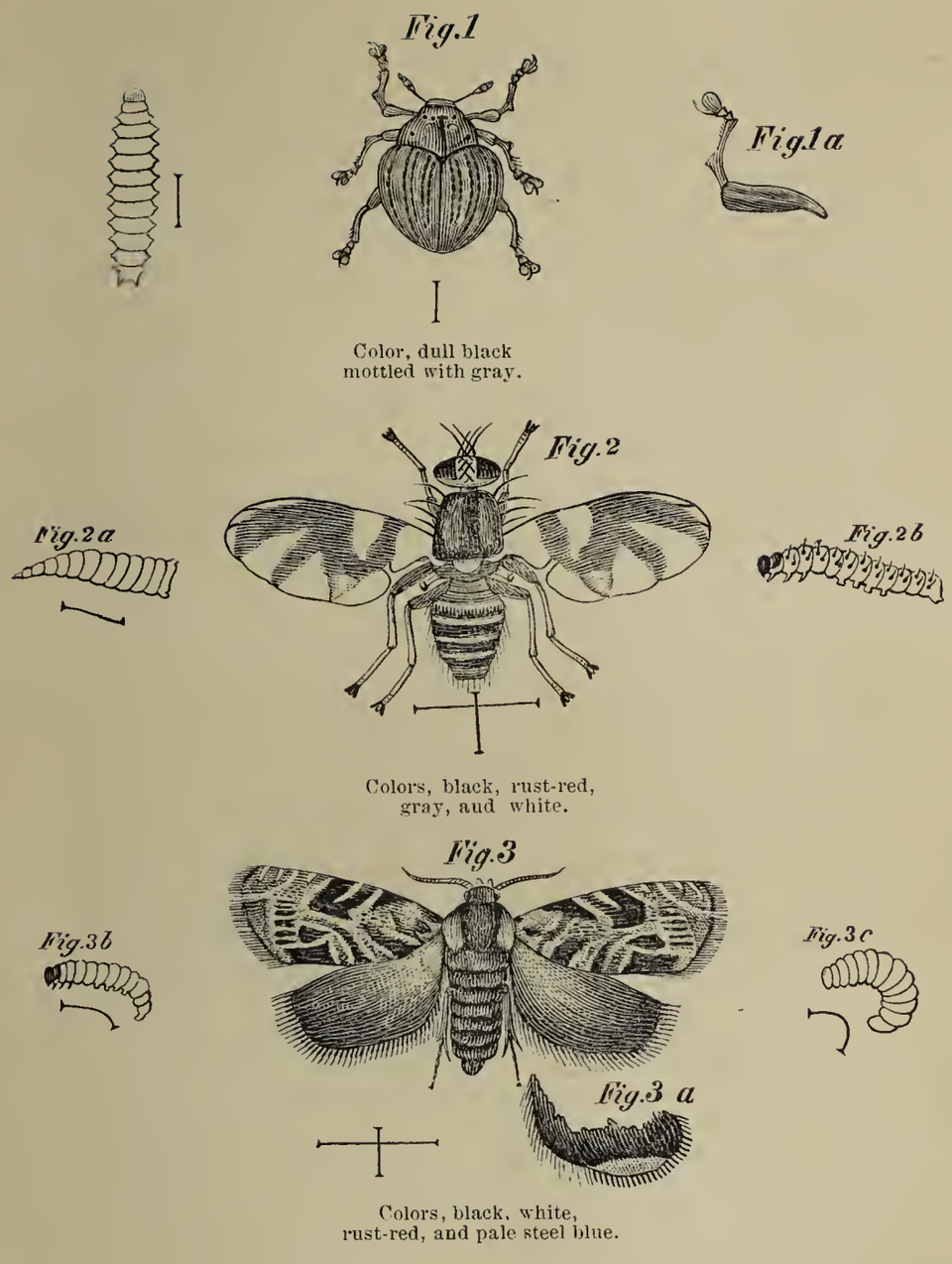
namely, the eentre of Iowa, is about 550 miles. What is to enable it at some future period to fly 150 miles further, or a total distance of 700 miles, which it must do if it is ever going to swoop down upon any considerable portion of Illinois from its present alpine home? It surely cannot be the settlement of some portion of the intervening eountry, that will enable it to do so. This cause, if it had any influenee at all upon the length of its flight, would rather have a tendeney to diminish that length; for there is abundant evidence that every invading army, eomposed of these Grasshoppers, drops a portion of its numbers, as it goes along, wherever it finds abundanee of suitable crops to prey upon; so that, the wider the extent of settled country that it passed through, the sooner would such an army be reduced to nothing. The only physical change that I can conceive of, as likely to cause such an invading army to penetrate into Illinois, is a sudden upheaval, to the amount of many hundred feet, of the whole chain of the Rocky Mountains that lies to the westward of us, so as to bring the native alpine home of this insect full 115 miles nearer to Illinois. But modern geology teaehes us that, although sueh an upheaval may very probably take place by slow and gradual steps in the course of the next 10,000 or 20,000 years, yet it can never come to pass in our time, or in the times of our grandchildren, or even in the times of our great-grandehildren twenty times removed. Therefore we may infer, with moral certainty, that no swarm of Hateful Grasshopers ean swoop down from the Rocky Mountains upon Illinois, within the only future that practically coneerns us. But it was demonstrated before, that this insect could not pass into Illinois in the same mode as the Colorado potato-bug has done, namely, by breeding at various way-stations on the road. Therefore, as there are but two eonceivable modes by which the Hateful Grasshopper ean reach Illinois, namely, 1st, at a single flight, or 2d, by breeding on the road, and as it has been shown that both modes are utterly improbable in the ease of this species for hundreds of years to eome, it necessarily follows that, in all human probability, it it will not pass into Illinois at all for hundreds of years to come.

Every man — except, perhaps, some crazy Millerite — believes firmly that, in all human probability, the sun will rise in Illinois every morning for hundreds of years to come. Yet he has no better kind of evidence to justify sueh a belief, than I have to justify the truth of my theory, namely, that, in all human probability, we shall never for hundreds of years to come, be afflicted with the Hateful Grasshopper in Illinois. Both the inorganic and the organic worlds are governed by certain fixed laws; and whether it be a vast fiery globe of liquid lava, revolving slowly upon its axis in the midst of the attendant worlds, that have been circling around it, each in its own peculiarly prescribed path, for indefinite ages; or whether it be some infinitesimally minute insect, winging its way from the alpine heights of the Rocky Mountains over the Desert Plains of the West; we have but to ascertain by what laws eaeh of them is governed, in order to be able to predict, in the case of eaeh of them, what is, and what is not, morally certain to happen in the future.

THE END.

THE PRACTICAL ENTOMOLOGIST.

THIS WORK, of which, for the first year, BENJ. D. WALSH was Associate Editor, and for the second year Sole Editor, was discontinued in October, 1867. Copies of Volumes I. and II., together with indexes, containing in all 258 pages of double-column small-quarto size, will be sent, postage paid, to any address, on remitting the following amounts to "E. T. Cresson, Secretary of the American Entomological Society, P. O. Box 2056, Philadelphia:" For one unbound copy, $1.25; for one copy, two volumes in one, neatly bound in cloth, $2.25.



Drawn by Benj. D. Walsh. Engraved by Wm. Mackwitz.

Fig. 1. The Grape Curculio, (*Cœliodes inæqualis*, Say).

Fig. 1a. Its front leg highly magnified.

Fig. 1b. Its larva.

Fig. 2. The Apple-maggot Fly, (*Trypeta pomonella*, Walsh).

Fig. 2a. Its larva, the Apple-maggot.

Fig. 2b. The Apple-worm, (larva of *Carpocapsa pomonella*, Linn.)

Fig. 3. The Plum Moth, (*Semasia prunivora*, Walsh), female.

Fig. 3a. Part of the hind wing of the male Plum Moth.

Fig. 3b. Larva of the Plum Moth.

Fig. 3c. Larva of the Plum Curculio, (*Conotrachelus nenuphar*, Hbst.)

N. B. *The hair-lines show the size of the insect, when not magnified.*

FIRST ANNUAL REPORT

ON THE

NOXIOUS INSECTS.

BY WILLIAM LEBARON, M. D.,
STATE ENTOMOLOGIST.

Pub. in August 1871 { among reports to Gen. Assembly and reprinted also as a separate pamphlet (see copy in library.)

TABLE OF CONTENTS.

INTRODUTCION.

To His Excellency, John M. Palmer,
Governor of the State of Illinois:

Sir—Having been called by your appointment to fill the vacancy in the office of State Entomologist, caused by the sudden and accidental death of Benjamin D. Walsh, whose untimely loss scientific and economic entomology equally deplore, I herewith present my first annual report, in compliance with the requirement of the law by which this office was established, and in furtherance of the objects which my lamented predecessor had so much at heart.

My attention has been so much diverted, for several years past, from the study of insects, by the pressure of professional and other duties, that I have not been able, in most instances, to make those continuous observations which are essential to the complete elucidation of the history of species. The present publication, therefore, will be in the main, what its title implies, a report of my observations in practical entomology for the season just past.

The history of many of our noxious insects, and especially the most notorious of them, has been pretty thoroughly traced, not only by the entomologists expressly employed by several of the States for this purpose, but also by many other active gleaners in this field. Still, any one who enters upon the study of this extensive subject, soon finds work enough upon his hands. It cannot be said that the history of any insect is perfectly and absolutely known, and it is a notorious fact that some of the insects which have been longest known and studied, such as the Plum Curculio and the Apple Worm, are the very ones which are caus

ing the most damage to the horticulturist at the present day ; a
if we take into account the multitude of insects which are prey
upon our shade and ornamental trees and shrubs, which, in
estimation of many, are scarcely inferior in value to the fruit be
ing trees, we may safely conclude that the prospect is very rem
when the work of the practical entomologist will cease or ma
rially diminish. And the force of this view is greatly enhan
by the occurance, every year, to a greater or less extent, of n
species of noxious insects, or rather of insects which, having
isted here or elsewhere in moderate numbers, from time imm
morial, have suddenly sprung into destructive profusion in con
quence of an abundant supply of congenial food, or the absence
their natural enemies, or other conditions favorable to life, so
of which are known, and some of which are obscure or inscrutab
The Colorado Potato-beetle, the Currant Saw-fly, the Asparag
beetle, and the *Bruchus granarius;* to which we might add
Pear-caterpillar (*Callimorpha Lecontei*), and the Lesser App
leaf folder (*Tortrix malivorana*,) treated of in the following
port, were all unknown here as noxious insects until within
last few years. It is true that some noxious insects, on the oth
hand, have greatly diminished, and some, which have been
sorest scourges of the orchardist, such for example, as the not
ous Bark-louse of the apple tree, seem to be in the process of
tinction. But we must not draw too much encouragement fr
this state of things, since it is also true that noxious insects
sometimes known to disappear from one section of the count
only to break forth in greater number and virulence in anoth
The Chinch-bug, which at one time rendered the raising of spr
wheat an impossibility in Northern Illinois for several years
succession, has, for many years, been wholly unknown in this s
tion. And yet this very year it has again made its appearance
considerable profusion in a few localities, and I have recen
heard of its having been found hybernating under the sheath
corn-stalks in my own county of Kane; not in great numbers
is true, but sufficiently numerous, I fear, to start a colony for
succeeding year.

Whilst it is the business of the scientific entomologist, in app
ing his knowledge to economic purposes, to test the value of
various antidotes which have been recommended against our

ct enemies, and if possible, suggest new ones, it is more espe-ally his province to thoroughly study the habits and trace the evelopment of the noxious species, so as to determine at what eriod of their existence, and at what time of the year, and to hat part of the infested plant, the proper applications can be ade with the most effect. For there is a period in the lives of ost of our noxious insects, and that is usually, of course, the me of their tender infancy, when some one or other of the com-on remedies, such as soap, tobacco, lime or ashes, is effective in estroying them, provided only that it can be made to reach them.

In illustration of *the time when* such applications should be ade, we may take two of the most destructive foes of the apple ee, the Round-headed borer and the Oyster-shell bark-louse. single application of soap in the one case, and of soap diluted ith water in the other, about the last week of May, or the first eek of June, will be fatal to every insect which it reaches; hereas the same applications are utterly useless if made at any ther time of the year.

In illustration of the importance of observing, in some cases, *he time of day* also, in which to make remedial applications, a ood example is furnished by the Rose-slug, which hides under he leaves in the day time, and thus escapes our ordinary applica-ions, but comes upon the upper surface to feed in the evening, nd is therefore entirely exposed.

As regards the particular *part of the tree* to which to direct our emedies, a very good example is furnished by some observations which I have been making the past summer, upon the Bark-louse, r more correctly, the *Coccus* (*Mytilaspis*) of the pine, which, in his instance, stations itself upon the leaf. It is the habit of this nsect, like most others of its family, to become stationary for life fter the first few days succeeding its hatching; and it is the sin-gular instinct of this species for the two sexes to fix themselves upon different parts of the tree, the males remaining upon the same leaves upon which they hatched, whilst the egg-laying fe-males, which alone demand our attention, for the most part spread themselves upon the new and terminal foliage.

These, and many other examples of the above general proposi-tions, will be found more fully elucidated in their proper places, in the following report.

In order to be able to avail ourselves of the knowledge accun lated by others, concerning the habits of our noxious insects, a the methods of counteracting their ravages, the first step is identify with certainty, the species which we may have in han For this purpose, it is necessary to refer to some living authorit or to a correctly named cabinet, or to plates, or to well writt descriptions.

Next to consulting some well informed entomologist, the sure way to identify an insect, is to compare it with the specimens a well preserved and correctly named cabinet. With this end view, it would be well for those whose pursuits render son knowledge of noxious insects especially important, to make p vate collections of their own. But as this is hardly to be expecte except in a few isolated cases, it becomes the more important th every horticultural society should have a well arranged collecti of noxious insects, both in larva and perfect states, located some central point where it would be easily accessible to its mem bers, and others interested. But as such collections, also, will most likely to be either wholly neglected or imperfectly prepare we can understand the paramount necessity of having, at leas one if not more large cabinets in the State which may serve the pu poses of ultimate resort. It was a pervading consciousness of th kind, no doubt, which produced so general a desire, on the pa of intelligent men throughout the State, that the large and va uable collection of insects left by my predecessor in office, M B. D. Walsh, of Rock Island, should be secured as the perm nent property of the State. Soon after my appointment to th office of State Entomologist was publicly announced, I receive communications from several persons of influence, and among others, Mr. W. C. Flagg, President of the Illinois Horticultura Society, calling my attention to this matter, and expressing th wish that this cabinet might be secured to the State. Mr. Flag stated that he had already had two interviews with Gov. Palme in which this matter formed a principal topic of discussion, an that the Governor expressed his willingness to take any step which might be necessary for the attainment of this end. Ac cordingly, as soon as it was determined that there would be a ba ance of the contingent fund at his disposal sufficient for the pu

ose, Gov. Palmer authorized me to visit Rock Island and effect ne purchase. Some of the details of this transaction were pub- shed in the newspapers at the time, and need not be here re- eated. It may be stated in a few words, that this collection em- races all the orders of insects, that it is estimated to contain about hirty thousand specimens, well preserved and admirably mounted, nd most of the species scientifically named; and that it was the esult of ten years' assiduous labor by this able and enthusiastic en- omologist. The price paid for it was twenty-five hundred dollars, vhich sum also covered a considerable balance of salary due to Mr. Walsh at the time of his death. I may here add that I have been both surprised and gratified at the universal expression of atisfaction by men of intelligence, wherever my official travels nave carried me, at the accomplishment of this purchase, and I nave heard no intimation that the sum paid for this cabinet was njudiciously expended. The cabinet is deposited, for the present, n the fire-proof building of the Chicago Academy of Sciences.

Next in value to a collection of the insects themselves, are cor- ectly drawn figures. With respect to availability, a well illus- rated book must even take the precedence of a cabinet, since the book can be obtained at a comparatively trifling cost, and may be always at hand. It is in this way that Mr. C. V. Riley, State En- tomologist of Missouri, has done an excellent work in the cause of Western economic entomology. The figures with which his val- uable Reports are illustrated, are remarkable for their accuracy, and one can never be at a loss, in referring to them, to identify any of the species illustrated.

And in this connection, I cannot help referring to the extensive and valuable series of plates illustrative of the entomology of the United States, and with special reference to the injurious species, in all their stages, in the course of preparation by Mr. Townend Glover, Entomologist to the Department of Agriculture at Wash- ington.

The work consists of a great number of figures etched upon copper, many figures upon the same plate so as to economize space and material, and thus reduce the cost and price of the pub- lication. The plates have already reached the following num- bers: forty-five plates of Coleoptera, six of Orthoptera, seven of Neuroptera, ten of Hymenoptera, one hundred and nineteen of

Lepidoptera, six of Homoptera, five of Heteroptera, and eight Diptera. Mr. Glover contemplates adding six or eight more pla of Coleoptera, and ten or twelve of Lepidoptera, to make the w as complete as possible. These will make, at least, two hund and twenty-two plates, and as each plate contains twenty-five more figures, we shall have here exhibited, at the lowest estima six thousand, five hundred and fifty illustrations of our No American insects. In addition to these, there are already co pleted, twenty-two plates of the cotton plant and the insects jurious to it. The drawing and etching have both been perform by Mr. Glover himself, and the whole work, as I understand, been performed wholly outside of his regular office hours; a markable monument, certainly, to the zeal and industry of author. This work, having been performed under such disadv tageous circumstances, the figures necessarily exhibit considera inequality, in point of excellence, and many of them will have be retouched before they are ultimately submitted for publicati but the author informs me that the whole work could be finis in a few months if he could devote his time exclusively to it.

The clause in the law by which the office of State Entomolog was established, which makes it a part of his duty to prepar cabinet of the insects of the State for the Illinois Industrial U versity, has never yet been carried out. Mr. Walsh had accu lated valuable materials for this purpose, but no suitable provis has yet been made at the University to receive them. It is intention, as soon as the work of preparing this Report is co pleted, to commence making up a collection, systematically ranged and named, both from Mr. Walsh's collection and my ov to be placed in temporary boxes, ready to be transferred to museum of the Industrial University, whenever it shall be desir and when suitable provision shall be made for their reception.

Most of the figures accompanying this report are reprints figures prepared by Mr. C. V. Riley, for the illustration of own Reports, or the pages of the American Entomologist. So as I could avail myself of these figures, it answered my purp as well as new engravings could have done, and they were tained at considerably less than the original cost.

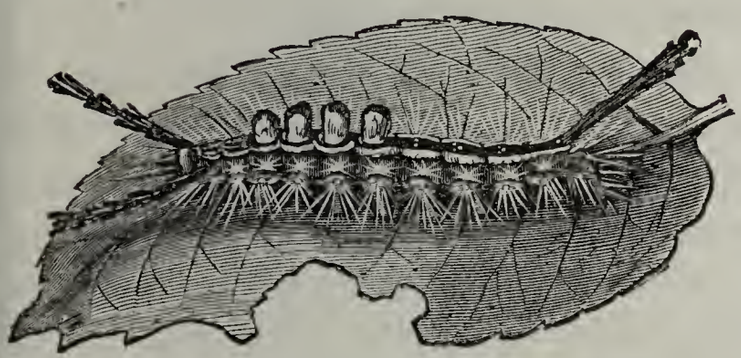
I take this opportunity to express my thanks to the officers of ıe great railroad lines throughout the State—the Illinois Central; ıe Chicago, Alton and St. Louis; the Chicago and Rock Island; ıe Chicago, Quincy and Burlington; and the Chicago and North-vestern railroads—for the annual passes over their respective outes, which they have freely presented to me.

All which is respectfully submitted, by

WILLIAM LEBARON,

GENEVA, *Dec.* 15. 1870 *State Entomologist.*

INSECTS INJURIOUS TO THE APPLE TREE.



THE WHITE-MARKED TUSSOCK-MOTH.

(*Orgyia leucostigma*, Smith and Abbott.)

Order of LEPIDOPTERA. Family of ARCTIIDÆ.

Harris's Treatise, State Ed., page 366 ; Fitch's 1st and 2d New York Reports, p. 209 ; Riley's 1st Missouri Rep., p. 144.

There is no noxious insect which I have received from so many different localities during the past summer, as the pretty caterpillar, which is the larva of the above-named moth. It is easily recognized by its coral red head and neck, and two tubercles of the same color, on the ninth and tenth rings. There are four short, thick, brush-like tufts on the fourth and three following rings, varying in color from cream color to yellow, and three long pencils of black hairs projecting one on each side of the neck, and the other from the top of the eleventh ring. It is figured on plate seven, of Harris's Treatise, fig. one; and there is a better figure on the 145th page of Mr. Riley's first Missouri Report, a copy of which is given at the head of this article, and also a figure of the male of the moth which proceeds from it. This insect has always been described as an exclusively leaf-eating caterpillar, but in

almost every instance in which I have received specimens, complaint has been made of their gnawing the young apples, and examples of the fruit thus corroded have generally been sent in the packages with the caterpillars. The effect is either to destroy the fruit, or, where the corrosion is less in extent, to induce a deformity in its future growth. This kind of injury can only be done by the first or spring brood of caterpillars. The later brood will sometimes strip the tree of its foliage after the apples are nearly grown, and I have this year seen the curious spectacle of an orchard loaded with apples with scarcely a leaf to be seen upon any of the trees. The only injurious effect in this case seemed to be the diminishing somewhat the size of the fruit.

This is one of our most widely distributed insects, having been noticed in most of the States east of the Mississippi River. The female is wingless, and it could have obtained this wide geographic range only by being transported upon nursery trees from one locality to another. This is sufficiently explained by the fact that the female moth lays her eggs upon her cocoon, which is attached sometimes to fences or other objects, but usually to the twigs of the tree upon which she has fed. If left to themselves, therefore, these insects would migrate very slowly, and in point of fact, are remarkable for committing their ravages within very limited ranges. For this reason they have never been regarded as noxious insects of a very serious character.

The Tussock-moth caterpillars are solitary in their habits; that is, they do not live together in families like the Tent-caterpillar and many others. This would render them very difficult to eradicate, were not their distribution limited by the wingless and stationary character of the female moths. They do not cover themselves with a web, but they have the power of letting themselves down from the tree by a thread, when disturbed.

These insects are remarkable for the great variety of foliage upon which they can subsist. Though they seem to prefer the apple, yet they feed freely upon the oak, maple, elm, plum, pear, horse-chestnut, black-walnut, larch, and rose-bush.

They pass the winter in the egg state, attached for the most part to the twigs and branches of trees, and as the egg masses are fastened to the outside of the cocoon from which the female has emerged, they form very conspicuous objects upon the leafless

limbs, and can therefore be easily seen and removed. Every orchardist and nurseryman should look over his trees in the course of the winter or early spring, and remove all the tufts of web or crumpled leaves which he may find adhering to their branches. In this way he will save himself from much loss, and also a great deal of labor in the subsequent and more busy seasons. He will thus remove at least two kinds of insects which are liable to become quite troublesome: the Tussock-moth caterpillar, now under consideration, and the Leaf-crumpler, often found disfiguring our apple and plum trees, and which is the larva of the *Phycita nebulo*. If this be neglected, the only way to get rid of them in the summer time, is to shake them from the trees. The foliage might also be made distasteful to them, by dusting it with lime when the dew is on.

Dr. Hull, of Alton, who has had much experience in the treatment of noxious insects, informs me that he has found the lime a very effective remedy, especially for the Leaf-crumpler. Indeed, the lime-dusting process is a sort of panacea, with the doctor, for destroying many of the foliage insects by which horticulturists are molested.

Another reason why the Tussock-moth larva has not been so destructive as many others, is that it is extremely subject to the attacks of parasites. Dr. Fitch describes two kinds of Chalcides which infest it, and Mr. Riley says he knows of seven others. And I have myself witnessed, this season, the most wholesale destruction of this insect, by parasites, that I have ever known in the case of any species. On the second of September my attention was called to an orchard a few miles from my residence, in which all the trees in one corner of the inclosure, to the number of fifteen or more, had been entirely stripped of their foliage by these caterpillars, whilst they were at the same time well loaded with fruit. The remaining trees, at least four times the number, were scarcely touched, illustrating, in a remarkable manner, the local restriction of the species. They had nearly all inclosed themselves in their cocoons, and were attached everywhere: on the twigs, branches and trunks, lying in masses in the crotches, and even on the sides of the trunk wherever there happened to be a little depression. In these cases, a number of cocoons, lying side by side, would sometimes have a sheet of web spread in com-

mon over the whole. Upon opening the cocoons, I found, with very few exceptions, not pupæ, but partly changed caterpillars dead and dry, and in each of these two or three, and sometimes four coarctate pupæ, of a regular oval form and mahogany color evidently belonging to some parasitic two-winged fly. In some were found the larvæ or maggots, not yet changed to pupæ.

They are from three to four-tenths of an inch in length, and present the ordinary characters of the larvæ of the Muscidæ or fly family. The body is somewhat tapering anteriorly, and capable of considerable extension. The only parts of the mouth visible are two minute, curved, black mandibles or teeth. The body is rounded, posteriorly with a shallow depression, in which are situated two conspicuous spiracles or breathing pores. On all the rings, but mostly on those nearest the extremities, are numerous microscopically minute, black, spinous points. These points extend all around the body beneath, as well as above, and probably assist the larvæ in the slight locomotion which it requires. The pupa is a quarter of an inch long, with slight, but distinct segmental incisions, and even with vestiges of the spinous points of the larva, proving that the covering or case of what are known as coarctate pupæ is really only the skin of the larva contracted and hardened.

The parasitic flies began to emerge from their pupal cases during the first week of September, and proved to belong to the genus Tachina, proper, as restricted by Macquart, and to section A A A, distinguished by having the third joint of the antennæ a little more than twice the length of the second. They resemble the common house-fly but are somewhat larger and have more bristly bodies. Many of the *Tachinæ* bear a close resemblance to each other, and are therefore difficult to distinguish from each other by merely verbal descriptions. This species may be appropriately named the *Tachina orgyiæ*. Length about one-third of an inch; sides of front, pale golden; middle space, velvet black; face, silver-ash; fascial bristles, reaching nearly to the middle of the face; eyes, bare; third joint of antennæ, a little more than twice as long as the second; second joint of the seta, well developed; third joint of seta, thickened for half its length; palpi, brownish; thorax, with alternate stripes of black and dusky cinereous. First longitudinal vein of the wings, after the auxillary, reaching the middle of the costa. Third and fourth veins, almost meeting, some way before the tip of the wing. Fourth vein, prolonged beyond the curve, half way to the border. Discal cross vein removed its own length from the border, and more than half its length from the flexure of the fourth vein. Abdomen black with cinereous reflections at the incisions and on the basal half of the segments, except the first. Two bristles on the hind margin of the first and second segments. Terminal segments many bristled.

Of the myriads of cocoons here accumulated, it appeared that scarcely one out of a hundred had escaped the fatal visitation of these parasites. So that the race of caterpillars, so abundant and destructive this year, may be considered as practically exterminated in this locality.

It might seem, at first sight, that a knowledge of parasitic insects is of no practical importance, inasmuch as they carry on their beneficent work wholly irrespective of our cognizance or co-op

ration. But a moment's reflection will show the erroneousness of this conclusion, of which the case now before us furnishes a sufficient illustration. Here is an orchard, one-fourth part of which has been devasted by these destructive caterpillars. The presumption is that their progeny, next year, will sweep the field. It behooves the owner, therefore, to set to work in earnest to collect and destroy this almost countless number of cocoons, and from any ordinary degree of search it may be reasonably feared that many will escape detection. But if he, or any one whom he may have it in his power to consult, knows enough of entomology to understand that all this work has been done for him by his parasitic friends, and much more thoroughly than he could do it, he is at once relieved from all labor and anxiety.

It was in the case of the larva of the Tussock-moth that I made the interesting observation, last summer, of the manner in which such birds as the American cuckoo contrive to eat the hairy caterpillars without filling their stomachs with indigestible material. Whilst sitting in the porch of Mr. Jesse K. Fell's residence in Normal, where I was visiting, with the *ad interim* horticultural committee, my attention was attracted to a cuckoo regaling himself upon these caterpillars which were infesting, in considerable numbers, a kind of imported larch which was growing near the house. My curiosity was excited by seeing a little cloud of hair floating down upon the air from the place where the bird was standing. Upon approaching a little nearer I could see that he seized the worm by one extremity, and drawing it gradually into his mouth, shaved off, as he did so, with the sharp edges of his bill, the hairy coating of the caterpillar and scattered it upon the wind. It has been long known that the American cuckoo is one of the very few birds that will eat the hairy caterpillars, but I believe that it has not been before observed how it is that he performs this useful part, without at the same time disturbing his digestion.

THE FALL WEB-WORM.

(*Hyphantria* (*Spilosoma*) *textor*, Harris.)

Order of LEPIDOPTERA. Family of ARTIIDÆ.

Harris's Treatise, page 357 ; Fitch's Report, No. 88.

This is the caterpillar which disfigures with its web, often se
eral feet in extent, both garden and forest trees in the latter pa
of the summer and fall. Like other caterpillars of the family
Arctians, to which both this and the preceding species belor
they are very indiscriminate feeders. This is the more rema
able as the great majority of insects are very select in their di
generally confining themselves to a single species of plant, or
most to plants of the same natural family. The Web-worm flo
ishes equally well upon the apple, pear, cherry, both wild a
cultivated, shagbark and pignut hickory, black walnut, buttern
elm, ash, and willow, and they bear to be transferred from
kind of tree to another with impunity. I have, this summ
changed them from the apple tree to the black walnut, and *v*
versa, without their seeming to suffer any inconvenience. Th
range of diet however has its limits. I have tried the experim
of tying nests of these caterpillars upon the common locust, ma
currant and rose bushes, and grape vine. In all these cases
caterpillars extended their web a short distance, but ate but lit
and in no case came to maturity.

When young they eat only the upper surface of the leaves,
when more mature they devour the whole leaf except the lar
ribs. They are active caterpillars, and when disturbed, hav
habit, especially when young, of showing their dissatisfaction
snapping their heads from one side to another. They do not cr
upon the branches like the Tent-caterpillar, but travel along
threads of which their webs are composed. They inclose wit
their nests the leaves upon which they feed, extending their
from branch to branch as their necessities require. Late in
season these nests attain a great size, and where there happen
be a number of them on one tree, they will sometimes almost c
a tree of moderate dimensions. A nest of these insects upo
apple tree in my garden, the present season, which I left un
lested for the purpose of observing their habits, attained an ex

of seven feet by actual measurement. If a nest be torn open, the inmates in a short time repair the breach.

I have examined the nests upon different kinds of trees to see whether the difference of food produced any variation in the color of the caterpillars, but could discover none. This is the more remarkable as they are not a particularly uniform species, the insects in the same nest varying from a pale buff or brownish yellow to a dull green, but having in both cases somewhat of a grayish tint, produced by a dense sprinkling over the whole body of minute black points and lines. This intermixture of black is the densest on the upper side, so as to constitute a broad blackish dorsal stripe; but many individuals are scarcely darker on the back than on the sides. Drs. Harris and Fitch both describe the larva of *Hyphantria textor*, as having a black head. I have seen a few black-headed individuals in nests both on the apple and the hickory, but nearly all of them have heads of a clear amber-brown color. The upper lip and the basal joint of the small antennæ are pure white, constituting quite characteristic marks, irrespective of all other variations. There are five inconspicuous whitish lines extending the length of the body, one on the middle of the back and two on each side. The upper part of the neck is black or dark brown, divided through the middle by the white dorsal line. There are twelve pale orange or amber colored tubercles on each segment, the two middle dorsal and the lowest lateral ones being smaller than the others. The two larger dorsal tubercles are sometimes black, both in the darker and lighter colored individuals. Each tubercle emits a tuft of long hairs which are usually rusty-white, but in some specimens bright-ferruginous.

Many kinds of caterpillars conceal themselves, or at least remain stationary through the day and feed only in the evening or night. In this way, no doubt, they escape to some extent the notice of insectivorous birds, which are almost all diurnal in their habits. The caterpillars of which we are now treating are strictly nocturnal feeders. They remain in the oldest and densest part of their nests through the day, and notwithstanding their long fast, they do not venture out till it is quite dark. In order to witness them at their work I have been under the necessity of examining them by candle light.

The Fall Web-worms, as these caterpillars are usually called, have not heretofore been regarded as holding more than a third rate rank in the catalogue of noxious insects. Yet, judging from my observations the past season, I should suppose them to be upon the increase. I saw the apple trees much disfigured by them through the middle portions of the State, and also in my own neighborhood; and a correspondent of the American Entomologist, writing from Massachusetts, remarks that they have been unusually abundant in that part of the country. They appear so late in the season, not making much show till after the first of August,

that it is not probable that they will ever be very seriously injur ous to fruit trees. The greatest objection to them is the disfigure ment which their extensive webs produce both from fruit an ornamental trees. I do not know that any predaceous or parasiti insects prey upon them. Indeed they are so protected during th day, that it is not easy to comprehend how any insect enemie could get access to them.

An interesting question here presents itself, whether the para sitic insects are active in the night. We often see them plying their busy avocation in the day time, but the minute size of mos of them precludes the possibility of our detecting whether they extend their operations into the night.

These are gregarious insects and are therefore easily removed by hand, or, where they are out of reach, by thrusting a pole int their nests and turning it round and round so as to entangle them in their web. Shaking and lime-dusting are here of no avail One of my neighbors told me that he effectually removed them from his garden trees by tearing open their nests and sprinkling in some Paris Green with which he had been killing potato-bugs But such applications are unnecessary. The true remedy consist in removing the nests by hand as soon as they make their appear ance.

These insects pass the winter in the chrysalis state, and make their appearance in June and July in the form of white moths without spots, with tawny yellow fore thighs and blackish feet and measuring a little more than an inch across the expanded wings. A figure of the cocoon, and an imperfect one of the cat erpillar, may be seen on plate VII, figs. 10 and 12, of Dr. Harris' treatise on insects injurious to vegetation.

THE LESSER APPLE LEAF-FOLDER.

(*Tortrix malivorana*, N. sp.)

Order of LEPIDOPTERA. Family of TORTRICIDÆ.

A pretty little bright-orange, round-shouldered moth, the larva of which is a small, greenish, naked caterpillar, with a pale amber-brown head and whitish incisions. In some specimens the

whole caterpillar is of a pale brownish tint. Usually, one caterpillar, sometimes two or three, eats off the upper cuticle of the leaf, curling the two sides upwards till the edges nearly or quite meet, and tying them together with web. In this inclosure the little caterpillar goes through its transformations. It lines the opposite sides of the leaf where the pupa lies with fine white silk.

Pupa three-tenths of an inch long or a little less; terminating anteriorly in a little knob attached by a neck. There is a series of minute points upon the edge of some of the segments, and the posterior extremity is furnished with two hooks, bent downwards, by means of which the pupa works itself half way out of the closed edges of the leaf before the moth emerges.

Moth three-tenths of an inch long, average expanse of wings half an inch. Antennæ brown, annulated with whitish on each joint, most distinctly on the under side, first joint densely clothed with orange scales. Palpi, orange, horizontal; the scales project around and beyond the end of the pentultimate joint so as to form a little cup in which the small ultimate joint is inserted. Maxillary palpi rudimental. Tegulæ well developed, more than half as long as the thorax. Head, thorax and fore wings bright orange. The orange scales which cover the wings are observed when carefully examined, or seen through a lens, to be mixed with numerous whitish, almost silvery scales, so arranged as to form about ten indistinct, transverse sinuous or wavy lines. Hind wings, abdomen and legs whitish with silken lustre. There is a little plume of divergent scales at the end of the abdomen.

This little insect furnishes a very remarkable example of the sudden appearance and rapid multiplication of noxious species. The moth is so rare that I cannot learn that it has ever before been seen even by entomologists. There is not a specimen of it in the collections of either Mr. Walsh or Mr. Riley; and Mr. Glover, of Washington, who is himself an experienced lepidopterist and is familiar with most of the eastern collections, and to whom I had an opportunity of showing my specimens, said he had never seen it, and remarked that the species is so peculiar that he knew he should recollect it if he had ever met with it.* And yet this summer, in a single nursery of young apple trees, specimens enough could have been captured to supply all the cabinets in the world.

All I know of this insect I learned during a visit to the fruit farm of Mr. D. B. Wier, of Lacon, on the 22d of July. At some distance from the place my attention was arrested by the blasted

*Note.—Since writing the above Mr. Glover informs me by letter that he has recently had occasion to visit several of the large collections of insects in Philadelphia and Boston, and that he could find no specimen of this moth.

appearance of his apple nursery, the foliage looking, at a distan
as if it had been scorched by fire. Upon entering the inclosu
the authors of the mischief were readily detected. Upon putti
apart the two halves of the folded leaves, a little worm could oc
sionally be seen, but at this date most of them had passed in
the pupa state, and many of the moths had already emerged,
that a flock of them could be put to flight almost anywhere
brushing against the plants. Mr. Wier says that as little kno
as this insect seems to be, this is not the first year that they ha
injured his nursery.

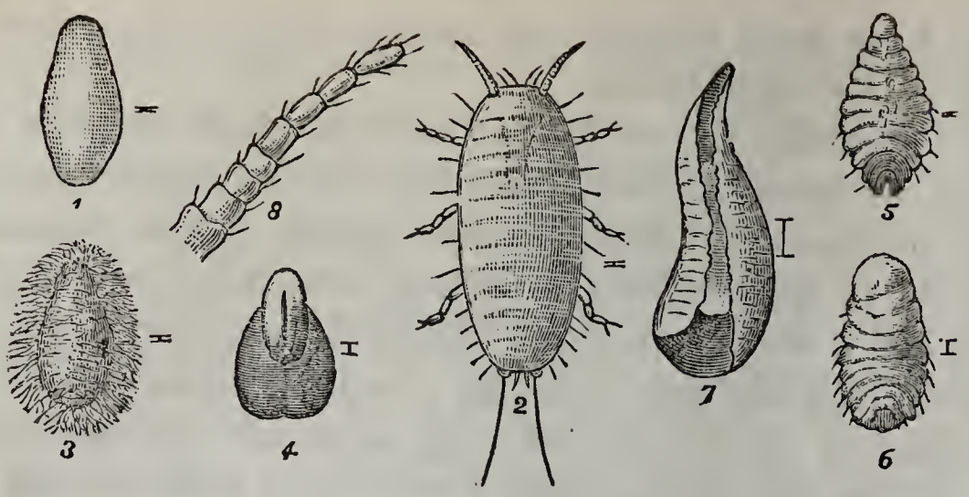
There are at least two broods of this insect in a season. T
first brood of moths, according to Mr. Wier, make their appe
ance early enough to deposit their eggs in the folds of the you
leaves just as they begin to open. Another brood was just eme
ing, as I have above stated, in the third week of July. This bro
as Mr. W. afterwards informed me, by letter, began at once
deposit their eggs upon such leaves as had not been injured. A
cording to my own observation, the caterpillars of the earl
brood draw the opposite edges of the leaf upwards, by means
their web, till they meet, thus forming a roof over the inse
which protects it from the weather, and must also serve to conce
it in a great measure from birds and other enemies. It must al
form a serious barrier to the effective use of any destructive a
plications on our own part. But Mr. Wier informs me that t
young of the last brood, hatching as they do on the surface of t
mature and rigid leaf, do not draw its edges together, but simp
protect themselves by constructing a web over the surface of t
leaf. From the above account, it is evident that this little ins
resembles, in most of its habits, the larger and more common T
trix of the apple and the rose. In what form they pass the wi
ter I believe has not yet been determined.

If this insect should spread so as to infest other nurseries, as
has that of Mr. Wier, it would prove itself a pest of the most s
rious character; and, as far as we can judge, from present appe
ances it will be a difficult matter to reach them with remedi
agencies, both on account of the closure of the leaf in which th
dwell, and their webby covering. Fortunately, as is the case wi
most other double-brooded insects, the first brood is comparative
limited in numbers; and Mr. Wier thinks it would have paid hi

well to have gone through his nursery early in the season and picked off the folded leaves.

The importance of combatting evils in their incipient stages can find no more apt illustrations than in the department of economic entomology. Many noxious insects can be substantially eradicated in their infancy, which, if permitted to attain a larger growth and a wider spread, are wholly beyond our control. This is emphatically the case with the present species. It is evident that whatever applications we may make use of here, must be made before the young insects have time to close the leaf above them, in the case of the first brood, and before they have covered themselves with web, in the second. These periods will probably be found to be about the first week of May and the third week of July. But the time will vary some with the character of the season, and must be determined by actual inspection. These little worms are so tender and so unprotected by any hairy covering, that I should expect them to be easily destroyed by any of the ordinary applications, such as lime, ashes or soap, provided we can find a time when the substance applied will really reach them. Mr. Wier informed me that he discovered a bug with many bright stripes, preying upon these caterpillars, which from his description, I suppose to be the *Harpactor cinctus;* but this tribe of predacious insects is not usually sufficiently numerous to make much headway against such a multitudinous species as the *Tortrix malivorana.*

Note—*Aug.* 15, 1870.—The delay in the re-publication of this Report enables me to add that I visited Mr. Wier's nursery at about the same time this year (1871) that I did the previous year, and though I am informed by Mr. Wier that these little leaf-worms were more numerous than ever, early in the season, yet at the time of my visit there were comparatively few to be seen, and the young apple-trees had made a good growth for the season. It is evident therefore that these insects are very susceptible to climatic or other and unknown influences, and there is reason to hope that they will not prove to be very permanent and serious pests.



Explanation of figures—1, egg, scarcely one hundredth of an inch in length ; 2, young larva i its active stage ; 3, its appearance soon after becoming fixed ; 4, appearance of scale after th second plate is formed ; 5 and 6, insect at different stages, as seen under the scale ; 7, fully forme scale with inclosed insects, as seen from below ; 8, antenna, highly magnified. The side figu shows the natural appearance of the scales on the tree.

THE OYSTER-SHELL BARK-LOUSE.

(*Mytilaspis conchiformis*, Gmelin.)

Order of HOMOPTERA. Family of COCCIDÆ.

Harris's Treatise, page 252 ; Fitch's 1st and 2d N. Y. Rep., p. 31; Walsh's 1st Il Rep., p. 34; Riley's 1st Mo. Rep., p. 7.

The common Apple-tree Bark-louse, obscure and un inviting as it at first sight appears, is, in many repects one of the most anomalous and interesting insects tha comes under the cognizance of either the scientific or the practical entomologist. How it is propagated, how it obtains its nutriment, and how it migrates from one tree to another ; whether it flourishes best on a healthy or a debilitated tree, whether it exercises any selection amongst the different varieties of apple, and whether, with respect to its prevalence, it is upon the increase or the decrease, are questions which have long been involved in much obscurity, and some of which are yet far from being satisfactorily solved. Yet it is an insect which has been long known, having been originally imported into this country from the other side of the Atlantic, and has been subjected to the prolonged scrutiny of some of the acutest entomologists that either Europe or this country has produced.

It is one of the opprobria of entomology that the male of the Oyster-shell Bark-louse has never been discovered. Judging from the analogy of other species of the same genus, the male, if ever discovered, will be found to be a very small two-winged insect, yet having no special affinity with the dipterous order of insects.

The parts of the mouth are undeveloped, so that it takes no food, his sole office being the propagation of the species.

The female, on the other hand, with which alone we are acquainted, and which has been, upon the whole, probably the worst enemy that the orchardist, in the Northern States, has had to contend with, is a wingless, footless, eyeless, grub-like creature, which never moves from the spot where she first fixes herself, and effectually excludes herself from the light of day, by inclosing herself in an impervious cell, as it were, in a living sepulchre. And yet, though destitute both of the organs of vision and locomotion, these insects have passed from one continent to another, spread over vast States and Territories, crippled or destroyed thousands of orchards, and impoverished their owners, in spite of all the efforts and appliances which human ingenuity could devise. And the difficulty is increased when we consider that, with the exception of the first three or four days of their lives, they are immovably fixed to the bark of the tree. Can the mystery be solved?

In the first place, it is evident that this insect, if indeed it be identical with the European species, must have been brought across the ocean, attached to the bark of nursery trees. But it is far from being so easy to explain how it has been carried from one tree, and from one orchard to another, often at great distances apart.

Three theories have been suggested upon this subject; first, that the insects transport themselves during the short active period of their lives, by crawling from one tree to another. It seems to me that a very little observation must convince us that this theory is wholly untenable. If we compare the roughness of a piece of plowed ground, or the inequalities of sod land, with its growing grass and its complicated matting of last year's growth, with the microscopic minuteness of these insects, during the short active period of their existence, it will be obvious that they never could migrate more than two or three feet, at most, from the tree on which they grew, by any locomotive powers of their own.

Another theory is that they are carried from one place to another by adhering to the feet of birds, and possibly also to the feet and legs of larger insects. This was Mr. Walsh's theory, and it seems to be the only way in which we can account for their being carried to any considerable distance, such for instance as a mile

or more; and we often find them in isolated situations and unde
circumstances which preclude the idea that they could have bee
brought hither by human agency. For example, the Oyster-she
Bark-louse, being an imported insect, is never found, in a state o
nature, upon our native crabs, and when they accidentally get
foothold upon them they do not multiply much, the crab tree be
ing evidently uncongenial to their tastes. Yet I have seen ther
in small numbers upon every tree of a small grove of crab-appl
which I have known for twenty-five years, standing upon th
prairie, nearly a quarter of a mile from any apple orchard; and
have found a few scales on another crab-apple tree standing
the edge of the timber, more than half a mile from any cultivat
trees. The bird theory, however, is a very inadequate one to e
plain the general diffusion of the Bark-louse. The most we cou
expect would be that a few of the insects might possibly be th
transported during the short time when they are not attached
the tree; and a series of experiments which I made, the past se
son, with the view of testing this theory, go to disprove the su
position that they are ever disseminated in this way. I wish
to see whether these minute insects would readily crawl on to a
obstruction like the toes of a bird. I experimented for hours
putting little slivers of wood about as large as a bird's claw in t
way of the crawling Coccids, but in no instance would they cra
on to them. If the stick were put down abruptly before them,
a short distance, say one-tenth of an inch, they would usually st
and turn off in another direction, showing that they have t
sense of sight. If it were put a little further off, so that th
would approach it gradually, they would sometimes turn aw
before reaching it, and at other times they would come up to
run along parallel to it, and if they could not find a place to
under it, they would turn away. I then beveled off the stick
a sharp edge, so as to present the least obstruction, and at
same time offer an inclined plane up which they could easily cra
but they would not go on to it. It is pretty evident, therefore, t
these creatures have no instinct which leads them to avail the
selves of such means of transportation.

The third theory is that they are blown from place to place
the wind. That they are carried by a moderate breeze, duri
their hatching period, to a distance of several rods, has be
abundantly proved by myself and by others. If you suspend

inverted umbrella under an infested apple tree, at this period, you will soon see the little white crawling points upon it, being the more easily detected from their contrast with the black back ground. They can also be seen upon the grass or other objects under the tree by examining with a lens. They will uniformly be found further from the tree on the side towards which the wind is blowing than on the other. I have also found them thickly sprinkled upon the upper surface of cob-webs which happened to be spread over the grass at the distance of two or three rods from the tree. Being caught on the web, it was evident they could not have crawled there, but that they must have fallen there from above.

An interesting query here suggested itself as to the degree of tenacity with which these insects adhere to the tree at this period, and how strong a wind it requires to remove them. To determine this point I experimented by blowing upon them with my mouth, with different degrees of intensity. I found that a pretty strong current of wind did not disturb them, provided it was steady and uniform, but that a short, sharp puff readily dislodged them. At one time, during my examination, the wind arose and blew a pretty stiff breeze, and I could feel it sweep over the surface I was examining with considerable force; yet in only a very few instances could I perceive that any of the Coccids were blown off; and yet actual observation showed that the ground beneath was thickly sprinkled with them. The query arises whether these creatures may not have an instinct to loosen their hold upon the tree, irrespective of the force of the wind, for the purpose of dissemination. This may seem improbable, but it is no more wonderful than many of the instincts of insects.

A still more important question is, how far they can be transported by the wind. This will depend very much, of course, upon the force with which the wind may happen to be blowing, at any given locality, at the hatching period. At the time I made part of my observations, last spring, there was a pretty fresh breeze blowing, but I did not detect any Coccids upon the ground beyond about three rods from the extreme branches of the trees. Nevertheless, some of them may have been carried farther, for it must be borne in mind that it is not an easy thing to find such minute objects upon the ground, except where they are numerously dis-

tributed. Actual observation shows that these insects, small a they are, are decidedly heavier than the atmosphere, and tha their tendency is to fall to the ground, at no great distance from the tree. That they are carried by the wind to great distances under any ordinary circumstances, is extremely improbable. To produce this result we must assume the coincidence of a violen gale or hurricane, such as would very rarely occur at any one tim year after year. And I repeat, lest it should be lost sight of by thos who are not familiar with the history of this insect, that there ar but three or four days in the year in which it is not immovably fixed to the tree. In view of the inadequacy of all the theorie thus far propounded, it must be admitted that the rapid and wide spread dissemination of the Apple-tree Bark-louse is yet involve in much mystery, and that such instances as the occurrence of th Bark-louse on the isolated crab tree above mentioned, remain to b explained.

The instrument by which this insect draws its nutriment fro the tree, is in the form of a long and extremely slender probosci or sucker, with a glossy surface and a redish tint, exactly resem bling a very fine hair. It is so delicate and fragile that it is usuall broken off in the act of removing the scale from the bark, and a it generally parts at its juncture with the insect's body, it escape for a long time the notice of the most careful observers. Even s acute an entomologist as Mr. Walsh, so late as the time of th publication of his Report in December, 1867, although he pre sumed from analogy that such an organ must exist, and though i had been discovered and described by European authors in the cas of allied species of the same family, nevertheless admits that "a to any organized beak he could discover nothing of the kind." An Mr. Riley, in his first Report, published a year later, says "Though from analogy it must have a beak of some kind, it is s exceedingly fine and fragile, that I have never been able to pe ceive it." I had myself also examined hundreds of bark-lic without detecting the proboscis, and indeed did not see it ti after I had discovered it in another and closely allied species, th *Coccus* of the pine leaf. I had noticed that in raising these scale they did not always drop from the leaf, but sometimes hung flu tering from its surface, as if suspended by an invisible thread. Th occurred so many times that my curiosity became excited to kno

by what means it was thus suspended. Upon examining one of these pendant scales with a strong lens, I saw a fine hair-like filament, attached by one end to the leaf, and by the other to the insect's body, at that part of the breast from which the beak of Homopterous insects appears to proceed. The idea at once occurred to me that this was nothing other than the long-sought-for proboscis of the *Coccidæ*, and a little further inspection with the microscope proved the truth of the supposition. I immediately went into my garden and obtained some twigs infested by the Apple-tree Bark-louse, anxious to see if I could detect the corresponding organ in this species. It is astonishing how easy it is to find a thing when you know just where to look for it. I found that the proboscis of the Apple-tree louse exactly resembles that of the pine leaf species, and is just as easily detected. Subsequently, upon looking over some of the back numbers of the Transactions of the American Entomological Society, which I had not before seen, I noticed the article upon the Bark-louse, by Dr. Shimer, of Mt. Carroll. From this, it appears that he detected this organ in the course of a series of microscopic observations upon this insect which he made in the summer of 1867; so that to him must be given the credit of first discovering the proboscis of the Apple-tree Bark-louse, which for so long a time has eluded our search.

Fine as this organ is, it is found, when examined under the microscope, and under proper conditions of the organ itself, to be not the single hair-like sucker which it appears, but to be composed of several still finer pieces or filaments, which, though usually lying together, are capable of separation. The number of these pieces in the proboscis of the *Coccidæ* has been a subject of some diversity of opinion amongst European entomologists. M. Percheron, a French author who investigated these insects many years ago, stated the number to be three. Dr. Shimer also saw the proboscis of the common species separate into three pieces, for a part of its length, and I have seen it several times separate sometimes into apparently two and sometimes three parts. But Mr. Westwood says, that in some species which he examined, he detected four, and M. Signoret, who has very recently submitted the whole family of *Coccidæ* to a most rigid scrutiny, gives the normal number of pieces in the proboscis to be four. It is altogether probable therefore that the reason why we have not seen

this number in our species is that we have not happened to see them all separated. The length of this proboscis is also difficult to be ascertained, on account of its fragility, and the consequent doubt, in any case, whether we have extracted the whole of it from the bark. In my experience it has usually broken off, either close to the body, or of a length somewhat less than that of the body, though I have seen it considerably longer. M. Signoret says that in some species he has seen it twice the length of the insect's body, and in rare instances even three times as long. I once removed a young female of the pine leaf species (*Mytilaspis pinifoliæ*, Fitch) just as it was beginning to form the terminal shield, and when it was scarcely one-thirtieth of an inch long, in which the proboscis was two lines, or one-sixth of an inch in length, by actual measurement, and therefore fully five times the length of the insect's body. In this instance I noticed that the proboscis was filiform, or of equal thickness for the greater part of its length, and that it thence tapered to a very fine point, from which I concluded that I had succeeded in extracting the whole of the instrument from the leaf.

It is difficult to conceive how so delicate and fragile an organ can be inserted into the leaf, and much more into the tough tissue of the bark. I once succeeded in tracing the proboscis of the Pine-louse, for about half its length, running horizontally, just under the semi-transparent cuticle, and it is not improbable that this is the situation in which the instrument is usually introduced. Notwithstanding the sluggish and apparently almost lifeless condition of the female *Coccus*, the proboscis seems to be endowed with a special vitality. I have often seen it move with a waving or serpentine motion, and M. Signoret thinks it is capable of a considerable degree of extension and retraction, and it was some action of the attached proboscis, no doubt, which produced the jerking motion of the insect's body noticed by Dr. Shimer.

Upon the interesting topics of the difference of the sexes in this tribe of insects, and the nature and growth of the scale by which they are protected, we have made a somewhat systematic series of observations during the past season, but we have preferred to avail ourselves, for this purpose, of the species which dwell on the pine-leaf, for the reason that the existence and character of the male of this species are known, and that the several par-

of which the scale is composed are so distinct and contrasted in this elegant species, that the investigation of it is much more practicable and satisfactory. We must therefore refer those who are curious in these abstruse and controverted branches of the subject, to the history of that species, at the end of this report.

We pass to a more practical question, whether the Oyster-shell Bark-louse flourishes best upon a healthy or a debilitated tree. This question also has its difficulties. For if the Bark-louse does not find the tree sickly, it makes it so, and as the two things always go together, it leaves an uncertainty which is the cause and which the effect. It is like the old question of the ague and the quinine: which it is that has damaged the constitutions of so many Western people. The popular hue-and-cry is against the quinine, which is a pretty good illustration of the danger of keeping bad company. We take the quinine only when we have the ague, and the two things becoming confounded in our experience, we perversely conclude that the disease is harmless and that the healing medicine does all the mischief.

That an insect, that lives by imbibing the sap of a tree, should flourish better upon a half dead and dried up tree than upon a thrifty and succulent one, is, on the face of it, extremely improbable. The conclusion to which I have come, both from reason and observation, is that if bark-lice get foot-hold upon a tree which is congenial to them, they will multiply and impoverish it, however healthy it may be at the time of attack, or however well the tree may be cultivated.

And this leads us to another question of considerable practical importance, and this is, whether the Oyster-shell Bark-louse exhibits any preference or exercises any selection between the different varieties of apple tree. That this is the case is, I believe the general opinion, and I am perfectly satisfied of it from my own observations. I saw the truth of this most satisfactorily illustrated in the orchard of Mr. Robson, of Galena. Here were trees some of which must be presumed to have been congenial, and others uncongenial to the insect, intermixed with the same inclosure, and the curious spectacle was exhibited of trees standing side by side, or alternating with each other, some of which were almost covered with scales, and others nearly or quite clear. These trees were so similarly situated with respect to all outside agencies that

it is difficult to conceive how they could have become so diversely affected, without supposing some selective taste or instinct on the part of the insects.

I have made some inquiries with the view of determining what varieties of apple tree are most infested by these insects, and what varieties are most free from them. There are some kinds about which the testimony is pretty uniform, whilst, as might be expected, some occupy a middle or debatable ground. Some of the varieties most largely infested are the Janette, the Yellow Bell-flower, the large Red Romanite, the Red Astracan, the Rambo, the Early Harvest, the Summer Rose, and several varieties of sweet apples. Some of those most free from the insect, are the Northern Spy, the Maiden's Blush, the Benona, the Soulard Apple, the Willow Twig, the Lowell and the Limber Twig, though with regard to the two last the testimony is conflicting.

The last of the questions propounded at the commencement of this article, was whether the Oyster-shell Bark-louse is at the present time increasing or decreasing in numbers. Happily for the prospects of the apple culturist, the uniform answer to this question from all quarters, at least from all those parts of the country where these destructive insects have most largely prevailed, is that their numbers are rapidly diminishing. This result has not been brought about by human agency, but by a reaction on the part of nature itself, whereby the excessive prevalence of this insect has been followed by a corresponding increase of its natural enemies, until these last have come vastly to preponderate, so that the notorious Bark-louse of the apple tree seems to be in a course of rapid extinction. The chief of these destroyers of the bark-lice are the *Acari*, or mites, and certain little roundish, footless maggots, which are the larvæ of little four-winged flies belonging to the family of *Chalcididæ*. The amount of destruction caused by the Chalcides can always be determined with mathemathical certainty; because we can either find the maggots under the scales, (except when they are very young and therefore not easily discoverable,) or we can see the little round holes through which the flies have emerged. By counting these and then comparing them with the whole number of scales on a given twig, we can estimate precisely the proportional number which the Chalcides have destroyed. But the work of the *Acari* cannot be so ac-

curately determined. Upon raising many of the scales in the fall of the year, we find them destitute of the eggs of the bark louse which should naturally fill them at this season. In their place we find a confused and discolored mass which we suppose to be the remains of the legitimate occupants, that is, the egg shells and the dried up body of the mother louse.

Amongst this *debris* the minute *Acari* are sometimes seen, and to them the ruin is generally attributed. But in most instances, so far as I have observed, no *Acari* are found, and some scales are almost wholly empty, so that if the *Acari* caused the destruction in both cases, they must, in the former instance, have done their work and left, and in the latter they must have devoured the mother louse, egg shells and all. But it is of no consequence to us who or what has wrought the ruin, so long as the bark-lice are destroyed. The important question is, what proportion of the bark-lice are destroyed, by any and all causes, and what part remain to propagate the race for another year?

Mr. Walsh, after examining many hundreds of scales in the summer of 1867, stated that the largest proportion which he had ever found with their contents destroyed, was two-thirds. From this form of expression we infer that it was only in certain cases, or perhaps localities, that so large a proportion were abortive, and this destruction he attributed solely to *Acari*.

The following observations will exhibit the matter in a more definite light.

On or about the twentieth of September, I examined all the scales on four twigs, taken from different trees, and from two gardens remote from each other, with the following result:

Whole number of scales	330
Number of scales with round holes, through which the Chalcides had escaped	116
Number of scales having under them the larvæ of the Chalcides	95
Number of scales, the contents of which have been destroyed by Acari, or unknown causes	85
Scales with ragged holes eaten by Coccinellæ	7
Scales containing more or less sound eggs	27
Whole number	330

Oct. 20th, examined four twigs taken from different trees:

Whole number of scales	284

Chalcis holes.....
Chalcis larvæ.....
Acari, or unknown.....1
Coccinellæ.....
Eggs.....

Whole number.....2

Oct. 25th, examined a number of twigs obtained from differe orchards in DuPage county:

Whole number of scales.....2

Chalcis holes.....
Chalcis larvæ.....
Acari, or unknown.....
Eggs.....

Whole number.....2

From this it appears that in the localities which I examine more than twice as many bark-lice were destroyed by Chalcide than by all other agencies combined. But the most important r sult is, that, of eight hundred and forty-four scales examined, on fifty-seven, or about one in fifteen, contained any eggs for anoth year's crop; and the case is really much more decisive than a pears from the statement as it here stands, because I have incl ded all the scales which had any eggs under them, though mo of them were more or less damaged, and in some of them t Chalcis larvæ had commenced their work of destruction.

The history of this little Chalcis-fly furnishes one of the mo interesting chapters in the literature of economic entomology. had long been known to exist, by the smooth, round holes in t scales through which it had escaped. But it was not till the pre ent season that I had an opportunity to trace the insect its through its changes and witness the mode of its beneficent oper tions. I have drawn up a brief sketch of its history for the D cember number of the American Entomologist, illustrated by figure of the fly and its larva.

Parasitic Chalcis of the Apple Bark-louse (*Aphelinus mytilaspidis*, nob.) *a*, fly; *b*, tenna; *c*, larva.

The following extract from this article presents some interesting observations not otherwise stated in the body of this report.

The causes which have been instrumental in producing the destruction of the Oyster-shell Bark-louse, and which are still operating to its completion, are matters of much interest. The agencies to which it has been usually attributed are the four following: Insectivorous birds; predaceous insects, especially the *Coccinellæ*, or Lady-bugs, and their larvæ; the larvæ of the parasitic Chalcis-flies, and the Mites, or *Acari*.

It has been generally supposed that the smaller insectivorous birds, such as the wrens and warblers, devour many of the eggs of the Bark-louse, but these eggs are so minute and so completely concealed under the bark-like scales, that even the sharp eyes of a bird could scarcely detect them, unless it were endowed with a special instinct for the purpose, and I know of no record of any actual observations which confirm this supposition. I am therefore inclined to the opinion that birds have done little or nothing in the way of exterminating the Bark-louse.

The *Coccinellæ* devour a very small proportion of these insects, whilst they are in their incipient and active state; but this lasts only three or four days, and therefore but very few of them can be thus destroyed. These predaceous insects, and especially their larvæ, also destroy a few of the bark-lice, in their subsequent stages, by gnawing ragged holes through the scales, and thus getting access to the insect beneath. Mr. Walsh conjectured that these rough holes were made by *Acari*, but I have repeatedly seen the larva of the Two-spotted Coccinella in the act of gnawing just such holes in the scales of the Bark-louse of the pine tree, and devouring its contents, and it is therefore probable that they are the authors of the similar holes on the apple tree. But the small number of scales eaten into shows that but few bark-lice are destroyed in this way.

The destructive work of the *Acari* is supposed to be indicated by the brownish, discolored remnants of the eggs from which the contents seem to have been extracted, easily distinguished from the pure white shells from which the insects have been hatched. Both Mr. Walsh and Dr. Shimer, who were the first to notice these mites, attribute much efficacy to their depredations, but that they are the sole authors of this work is rendered somewhat doubt-

ful by the fact, that in some localities, at least, where the scale containing these discolored eggs are not uncommon, the *Acari* ar comparatively rare. Of eighty-one scales just examined (Sept. 26) containing these shriveled and discolored eggs, in only four wer *Acari* seen. It is possible, however, that they may have left then after having extracted their contents.

But, besides the ragged holes above mentioned as the work o the *Coccinellæ*, a much larger number of scales are found throug which has been bored perfectly smooth and round, or slightly oval holes, which we know from analogy must have given exit to som parasitic fly. These holes have been particularly mentioned b several of our entomological writers, and must have been seen b all who have made a special study of the Apple-tree Bark-louse.

So long ago as the year 1855, Dr. Fitch, in his first Report upo the Noxious Insects of New York, gave a history of this Bark-louse so far as it was then known, and mentions the frequent occurrenc of these round holes in the scales at that time. He also discover ed under some of the scales a little oval, footless maggot, which h conjectured might be the larva of some hymenopterous parasite which, in its exit, made the holes in question.

In 1867, Mr. Walsh, in his history of the Bark-louse, in his firs annual Report upon the Noxious Insects of Illinois, refers to Dr Fitch's statement, and adds that he had often noticed the roun holes in the scales, which he also attributes to the exit of a para sitic insect belonging to the Chalcis or Proctotrupes family. Bu he says he had never met with the larva described by Dr. Fitch.

In the course of a series of observations upon the Apple-tre Bark-louse, during the past season, it has been my good fortune t trace the history of this interesting little insect, which, if it ha ever been seen before, has not been identified, and whose very ex istence has been only a matter of inference from the visible mark of its beneficent operations.

In the early part of the season, whilst examining the lice upo an apple tree, I noticed two or three little yellow Chalcides running along the infested twigs, which I conjectured might be the para sites of the Bark-louse, but had no proof that this was the case But about the first of August, upon raising one of the scales, happened to uncover one of these insects in the last stage of it transformation. Its wings were not yet unfolded, but it ran s

rapidly that I had some difficulty in keeping it within the field of the lens. As soon as it paused long enough to be examined, it was easily recognized as a Chalcis by its general aspect, and especially by the peculiar vibratile motion of its short, geniculate antennæ.

Having once become familiar with its appearance, I have had no difficulty in capturing, in the latter part of August and September, all the specimens I desired on the infested trees. I have repeatedly watched the female Chalcis in the act of inserting her ovipositor through the scale of the Bark-louse, for the purpose of depositing her egg in the cell beneath. She always places herself transversely with respect to the scale. Sometimes she mounts upon it, and then her tiny body is seen to be considerably less in length than the width of the scale. Usually she backs up upon it only so far as to bring the tip of her abdomen about opposite the middle of the scale. Then bringing her ovipositor down perpendicular to her body, she forces it through the scale by a series of boring or short plunging motions. Having accomplisned this she remains stationary for many minutes, whilst by some invisible intestine motion the egg is carried down the ovipositor and deposited beneath the scales. So absorbed is she in this delicate operation, upon the successful accomplishment of which not only her own hopes, but those of the horticulturist, so largely depend, that nothing can deter her from it. In one instance, having drawn down a branch of an apple tree, I discovered a Chalcis in the act of depositing. Whilst holding the branch in one hand and viewing the insect through a lens held in the other, the branch slipped through my fingers and flew back with violence to its place. Drawing it down again, the twig I had hold of broke, and it flew back a second time. I supposed that that observation had, of course, been brought to an abrupt termination. But, upon drawing down the limb the third time, there stood my little Chalcis as immovable as a statue, at her post. She may be touched with the finger whilst thus engaged, or even crushed, as I have often inadvertently done in my attempts to capture her, but nothing short of this actual violence can move her from her position. With such wonderful perseverance and devotion do these living atoms of creation perform their allotted part in the complicated economy of nature.

The egg thus deposited hatches into the little footless larva previously mentioned. This larva is so admirably described by Dr. Fitch, in a single sentence, that I cannot do better than copy his description: "Under these scales I have repeatedly met with a small maggot, three-hundreths of an inch long, or frequently much smaller, of a broad oval form, rounded at one end and tapering to an acute point at the other, soft, of a honey-yellow color, slightly translucent and shining, with an opaque brownish cloud in the middle, produced by alimentary matter in the viscera, and divided into segments by faintly impressed transverse lines."

The only motion of which this small grub is capable is a slight extension and contraction of its body, particularly at the two extremities, by which its form is correspondingly modified.

There is usually but one larva under each scale, and I have never seen more than two. In the earlier part of the season it is seen adhering to the body of the Bark-louse, but later it is found in the midst of the eggs or their remains.

The Chalcis-fly itself is a beautiful object under the microscope. Its length is a little less than half a line, or about one-twenty-fifth of an inch, though I have captured a few specimens considerably smaller, being but little more than one-third of a line. I at first supposed that these smaller individuals were males, but all the specimens that I have examined have proved to be females. Their color is a uniform pale lemon yellow. The only variation from this color is in the minute mandibles, which are reddish brown. There are three coral red occelli on the summit of the head, and the ovipositor, which lies in a groove on the underside of the abdomen, exhibits a slight reddish tint. The wings are thickly beset, over nearly their whole surface, with bristly points, and their margin is ornamented with a long fringe.

But a better idea of the appearance of this little insect will be obtained from the magnified figures which accompany this article, than from any verbal description.

By observations, made as late as the first week in November, the opinion is confirmed that the Chalcis of the Bark-louse has two broods in a year. By the middle of September we find many of this year's scales pierced with the round holes through which the first brood of Chalcides has escaped; and late in the fall we find, under about an equal number of scales, the fully-grown larvæ

of the second brood, sometimes with the eggs of the Bark-louse upon which they have subsisted all consumed, and sometimes with a few remaining; and in this state they undoubtedly pass the winter. This second brood must appear in the winged form early enough next summer to deposit the eggs from which the first brood of next year will proceed.

The drawing made for the American Entomologist having been inaccurate, and the engraving imperfect, Mr. Riley kindly consented, at my request, to have a new engraving prepared, and the figure here given is a copy of the improved engraving.

From this general destruction of the Bark-louse, it would seem that its virtual if not total extermination must be near at hand. Yet it would be imprudent to permit ourselves to come to this conviction with too much haste or certainty, since it is a truth with which we have become painfully familiar, that noxious insects have their periods both of increase and decrease, and that some species, of which the Chinch-bug is a notorious example, have returned with renewed life and profusion after years of apparent extermination. One of the ways in which this is brought about, I conceive to be this: the numbers of a certain species having become greatly reduced by the operation of its natural enemies, parasitic and others, these, in their turn, being deprived of their appropriate nutriment, also become reduced in like proportion. The remnant of the former species, being, we may presume, naturally prolific, take a new lease of life and rapidly multiply again in all their former profusion. Judging from known facts and experiences, it is reasonable to suppose that such ebb and flow in the prevalence of particular species, are ever taking place in the multitudinous world of insects. Such reflections have forcibly occurred to my mind, as I have watched the parasitic Chalcis-fly of the Bark-louse, coursing busily over the branches, amidst the dry and empty scales, in search of some suitable pabulum in which to deposit the germs of her future progeny. Another circumstance which gives rise to some apprehension is, that these insects, within the last few years, have been found farther south than it has been heretofore supposed that they could subsist. I have received, this year, infested twigs from Mr. A. C. Hammond, of Warsaw, as far south as the northern border of Missouri. And I was informed at the horticultural meeting at Mr. Flagg's, near Alton, on the sixth of October, that the Oyster-shell Bark-louse

was known to exist, and was thought by some to be on the in
crease in that section of the country. And, furthermore, it ap
pears from the correspondence of the American Entomologist, tha
this insect has been found even so far south as the State of Missis
sippi. The question therefore arises, with considerable pertinency
whether this destructive insect may not be disappearing from th
north, only to enter upon a new career in the more southern lat
tudes. All I can say in answer to this question is, that this ha
always been regarded as an essentially northern species, and, there
fore, it is supposed that it will not multiply to any great extent a
the South. A little circumstance, incidentally mentioned by Mr
Walsh, gives us additional encouragement. He states, in a not
to his report, that he received some branches infested with this in
sect from Mr. Huggins, of Macoupin county, and that upon exam
ining them he found that in nineteen-twentieths of them the con
tents of the scales had been destroyed, as he supposed, by *Acari*

It is not necessary here to go into a detailed account of the vari
ous remedies that have been resorted to for the purpose of destroy
ing this insect. Mr. Walsh instituted a thorough series of experi
ments in this matter, and has given us the results in his treatise
upon the Oyster-shell Bark-louse, in his first report. To that
refer those who are interested to know the past history of the
treatment of this pest. The essential and universally approved
remedies can be stated in a few words. The treatment is of two
kinds: that which is appropriate on or about the first of June
when the lice are young and tender, and that which may be ap
plied at any time in the winter or early spring, with a view o
destroying the eggs under their protecting scales. At the former
period, much weaker applications, of course, are successful than
in the latter, and we are necessarily restricted to such on account
of the danger of injuring the young foliage. Various kinds of
narcotic and alkaline washes have been tried for the purpose of
destroying the lice in their incipient stages, but the most effectual
of all is common soap-suds. This has to be used of different de-
grees of strength, according to the part of the tree to which it is
applied. Undiluted soft-soap can be applied to the trunk of a
tree of considerable size, without injury; on the smaller branches
it is better to dilute it to the extent of from four to six parts of
water to one of soap; and on the young shoots and foliage it must
be very largely diluted, not exceeding two or three cups of soap

to a pailful of water. Even of this strength it discolors the foliage, but does not kill it. The one great difficulty in the way of exterminating the bark-lice, is their habit of spreading on to the terminal twigs. Here they do most of their mischief, and here it is most difficult to reach them, and we are debarred from using very efficient washes on account of the tenderness of the foliage. The practical rule is this: with a whitewash brush wash over the trunks and branches of the trees as far as you can reach, with the strong solution, one part soap to four of water; then syringe the remainder with the weak solution, two or three cups of soap to a pailful of water. The strong solution will kill every louse it touches, and the latter, according to Dr. Mygatt's experience (Trans. Ill. St. Agricult. Soc., I, p. 516), will kill about half of them. But this is the best we can do, unless we take a dull knife and scrape every twig, which might be done on one or two very small trees, but would of course be utterly impracticable in an orchard. The above course, to be successful, must be put in practice when the young lice have just hatched, or within a few days thereafter. This time varies two or three weeks, according to the character of the season. The usual time is the last week of May or the first week of June. But this year they began to hatch, in the latitude of Chicago, on the 15th of May, the season being unusually hot and dry. The only way to be sure is to watch, and examine the trees at this time of the year with a pocket lens, each one for himself.

But the great desideratum is something that will kill the eggs through the scale, without injuring the tree, and which can therefore be applied in the winter or early spring, when farmers are most at leisure, and when there is no foliage to be damaged. No such application, at the same time safe and effectual, has been discovered. The scales are sufficiently thick and impervious to protect the eggs beneath from any of the ordinary applications. Even undiluted soft-soap does not affect them. Greasing over the infested branches with any kind of oily substance, is sure death to them, but it is questionable whether it does not also injure the tree. Mr. Walsh collected much testimony upon the subject, but it is very conflicting. Some say that it killed their trees, whilst others assert that it does not injure them. Even if the greasing process were unobjectionable, there would still remain the difficulty

of applying it to the extreme branches. Mr. Walsh attempts t
explain why oily applications are more effectual than washes, b
saying that nature has made the scales of the Bark-louse wate
tight, but did not think it necessary to make them oil-tight. It
a sufficient explanation, and I think a more probable one, th
greasy applications destroy all life beneath the scales, simply b
rendering them impervious to the air.

There is one application from which I had been led to expe
the most satisfactory results from the strong testimony I had hea
in its favor, and this is fish brine—being the refuse liquid
which mackerel and other fish have been pickeled. This possess
two of the essentials of a universal remedy, namely cheapne
and a liquid consistency, so that it can be thrown with a syrin
over all parts of a tree. I visited the orchard of Mr. John Robs
of Galena, and saw the trees upon which the experiment with th
substance was, I believe, first made, some three or four years ag
and about which a good deal was said at the time. It was assert
that the scales peeled off from the branches to which it was a
plied, leaving the bark uninjured. I found the trees in a cle
and healthy condition, but some doubt was thrown over the spec
efficacy of the application, by the fact that other trees standi
near them, and which had been treated with common alkal
washes, were about equally clean. I made some experime
with this remedy upon some infested trees in my garden, ab
mid-summer, after the scales had become fully formed, but a li
before the time of depositing eggs, by dipping the ends of
branches into a solution, such as Mr. Robson made use of, name
one pint of the brine to two gallons of water. If the applicat
were effectual it would of course arrest all future development
the insects beneath the scales, and consequently no eggs would
found deposited. All such experiments have been rendered v
unsatisfactory the present season by the almost universal destr
tion of the bark-lice and their eggs, as previously related, by pa
sites. But truth compels me to state that I certainly found sc
filled with sound eggs on the branches thus treated, very f
indeed, but about as many as the Chalcides and other paras
had left on the other branches. I suspect that whatever vi
the fish brine may be found to possess, is due to the oil with wh
it is largely impregnated. And even in this point of viev
may prove to be a valuable remedy by furnishing a cheap

available means of applying oil in a diluted form. But as the proper time to apply this remedy is in the winter or early spring, when there is no foliage on the trees, it could undoubtedly be used much stronger than it was in Mr. Robson's experiments and mine.

I cannot close this chapter, already, perhaps, too long, without briefly referring to a subject of the utmost interest and importance, and one directly suggested by the foregoing history, and that is, the practicability of transporting beneficial parasites from one part of the country to another, or if necessary, importing them from abroad.

The incalculable benefits resulting from the depredations of parasitic insects upon those kinds which are injurious to mankind, are now generally known, and they can have no more striking illustrations than those furnished by the history of the Chalcis-fly in a former part of this chapter, and the parasitic Tachina of the Tussock-moth, described in the first article of this report. It is also a notorious fact that many of our most pernicious insects have been imported from abroad, and one reason why they have proved so intractable, is, that in introducing the noxious insect, we have failed to import with it the natural enemies which held it in check. Mr. Walsh was so impressed with the importance of this subject that it became almost a hobby with him, and he went so far as to advocate the artificial breeding of parasitic insects, if they could not be otherwise obtained. However difficult this might be in ordinary cases, since we should also be obliged to rear the noxious species upon which the parasite subsists, yet that the transportation of them, at least, is not necessarily impracticable, is very clearly shown by the case of the Chalcis of the Bark-louse. One brood of this insect passes the winter in the larva or pupa state under the scale of the Bark-louse, at whose expense it has subsisted, ready to emerge on the opening of the succeeding summer.

The twigs of apple trees, where the Chalcis is known to abound, could be easily gathered any time in the winter or spring, and carried to any other part of the country, or even to a foreign land, and all that would then be necessary would be to tie these twigs, here and there, upon the branches of the trees which it is desired to protect. That this operation will ever have to be performed with this particular species, is not, perhaps, very probable, but

the case is none the less interesting, as showing that parasitic in sects, even of the most minute character, can be transported, i some instances, with perfect ease and certainty, and should cau tion us against dismissing the whole subject from our minds, a we have been inclined to do, as impracticable and absurd.

POSTSCRIPT.

Since writing the above, my friend Capt. Edward H. Beebe, o Galena, procured and transmitted to me (Nov. 8) a number o apple twigs, obtained partly in that town and partly from th Southern part of Wisconsin, a section which has suffered mor from the depredations of the Bark-louse than almost any othe locality. A very brief inspection of these twigs was sufficient t show that our infinitessimal friend, the Chalcis, has not yet foun its way to that region, or at least not to that particular locality Not a trace of it could be discovered, either by the round holes i the scales or the presence of the larvæ beneath them. The di appointment, however, was somewhat mitigated by finding tha more than two-thirds of the scales are, nevertheless, from som cause or other, abortive. Upon carefully raising and examinin two hundred scales upon six different twigs, sixty of them wer found to contain sound eggs of the Bark-louse, and one hundre and forty were abortive. These abortive scales present the sam appearances that such scales have when obtained from other lo calities; that is, a small proportion of them contain only the thi and dried remains of the female Bark-louse, who has perishe from some cause, without depositing or perhaps even forming he eggs. But most of the scales exhibited the brownish, granulate mass which they generally contain, and which we may presum to consist of shrunken and discolored eggs. This mass of *debri* also has, in most cases, a furry aspect, which is probably owin to mould.

The interesting question here arises, what, in the absence o the Chalcides, has caused the destruction of this large proportio of the bark-lice and their eggs? I searched carefully for *Acari* and lest, from their minute size, I might overlook them with common lens, I put many of the scales under the microscope, bu did not detect more than half a dozen in all; just enough, how ever, to show that they are not altogether absent. All the phe

nomena in the case would be satisfactorily explained by the theory that the female Bark-louse, in these instances, had failed to become impregnated. In this case she might perish without forming eggs, or she might go on to the formation and deposition of her ova, since we may infer from analogy, such for example as that of the common fowl, that the presence of the male is not essential to the formation of ova, but only to their fertilization. This theory is so plausible that I can scarcely avoid the conclusion that it affords the true explanation of a part, at least, of these cases; but how large a proportion, if any, is of course wholly a matter of conjecture.

The absence of the Chalcis of the Bark-louse in this locality will furnish an excellent opportunity for testing the practicability of transporting it thither from those places where it is known to exist. If, after taking the necessary preliminary steps, as described in a former part of this article, we should find, next September, upon the trees experimented with, the characteristic holes in the scales which mark the exit of the Chalcis, we should know that the friendly parasite had entered upon its work. If such an experiment could be conducted to a successful issue, it would furnish one of the most admirable instances on record of the triumph of science, in its application to economic entomology.

NOTE UPON THE CLASSIFICATION OF THIS SPECIES.

We have in the more Northern sections of the United States, two species of Bark-louse infesting the apple tree: one a native American species, known as Harris's Bark-louse, which prevails mostly South of the thirty-ninth parallel of latitude, though found in diminishing numbers considerably farther North; the other, supposed to be an imported species, much more injurious than the other, and occupying a more Northern geographical range, often called, by way of emphasis and as indicative of its notorious character, simply the Apple-tree Bark-louse, or more specifically, the Oyster-shell Bark-louse, this name being derived from the shape of the scale. It is the latter species of which we have here been treating.

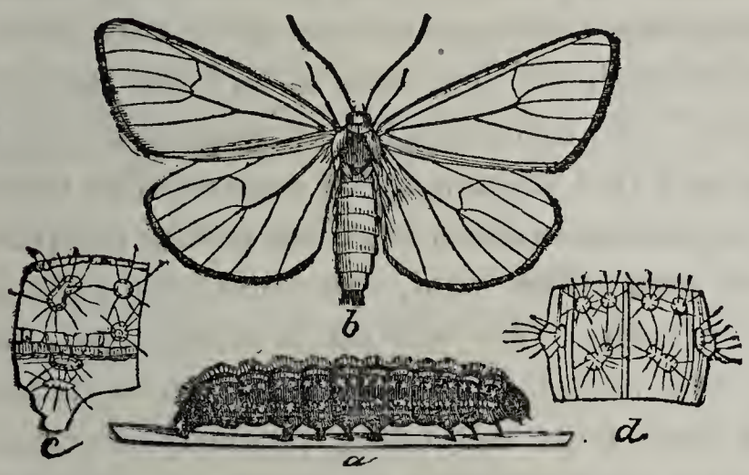
This species has been classed by all our more recent entomological writers, under the genus *Aspidiotus* of Bouché, following the determination of Dr. Fitch, as obtained from Mr. John Curtis, a distinguished English entomologist. In the recent elaborate revision of the family of Coccidæ, by a French author, M. Signoret, the genus *Aspidiotus* is restricted to those species having a rounded form, with the larva scales attached at or near the middle, and a new genus, named *Mytilaspis*, (meaning muscle-shaped shield,) is formed to contain those species which have a long narrow form, usually a little curved to one side, like the shell of a muscle, and having the larval scales attached to the anterior and smaller extremity.

Though opposed, as a general principle, to the disposition exhibited by many moder authors, to the excessive sub-division of genera under distinct sub-generic titles, yc the name *Mytilaspis* is so happily expressive of the form of these insects, that I hav thought it best to adopt this term for the present species, and also for that found on th leaf of the pine, treated of at the close of this report.

The specific name, *conchiformis*, was originally given by Gmelin to a European specie the history of which is a good deal confused. It appears to have been originally applie to a species found on the elm; but Dr. Shaw, as quoted by Dr. Harris, states that it i abundant on the apple trees in England, and Mr. Kirby and Mr. Rennie add that it i also found on the currant-bush, all of which, as respects its habit, goes to identify tha species with our Northern Apple-tree Bark-louse. Moreover the description given b M. Signoret of the *M. conchiformis*, as found upon the elm, corresponds, in all its mor obvious characters at least, to our apple-tree species; but on the other hand it is a re markable fact, and one which tends to throw considerable doubt upon the identity of th species, that the *M. conchiformis* of Europe seems to be generally admitted as peculiarl the Bark-louse of the elm, whereas our American species, so far at least as I have bee able to observe, is never found upon the elm in this country. The force of this fac however, as affording an argument against the identity of the two species, is considerab weakened by the occurrence of our species on the currant-bush, and very abundantly c the Persian Lilach—plants as far removed as the elm in their natural relations to th apple tree. This question of identity can be definitely settled only by the actual com parison of specimens obtained from these several sources.

But here follows some interesting statements appertaining to this subject. M. Signore writing, we may presume, more especially from observations made in the latitude France, speaks of the *M. conchiformis* as being exclusively an inhabitant of the elm, an described another species, under the name of *M. pomorum* of Bouché, as being the sp cies which infests the apple tree. Upon referring to this description and the figure illu trating it, we find it to be quite different from the species that infests the apple tree this country. Besides some minute particulars, it is described as having a blackis brown scale with a white apical border, whereas our species is of a uniform ashen-brow color, like the bark of the tree, and still more remarkable as having red eggs, whilst th eggs of the American *conchiformis* are invariably white. Neither can it be identifi with the Harris's Bark-louse of this country, which, though it resembles the other having red eggs, is of different form and belongs to a different sub-genus. From a this we draw the interesting conclusion that in Europe, as in this country, there are tw species of Bark-louse, a more Northern and a more Southern species, which inhabit t apple-tree.

INSECTS INJURIOUS TO THE PEAR-TREE.



The Pear Calimorpha and its larva, of the natural size, with some of the segments of the latter magnified to show the characteristic markings.

THE CALIMORPHA PEAR CATERPILLAR.

(*Callimorphia Lecontei*, Boisd., var. *fulvicosta*, Clemens.)

Order of LEPIDOPTERA. Family of LITHOSIIDÆ.

The only new insect injurious to the pear tree, which has come to my knowledge the past season, by which I mean the only insect that has not been heretofore known and described as a noxious insect, is a blackish hairy caterpillar, an inch and a quarter long, with five narrow yellow and white stripes extending the length of the body, which is the larva of the above named moth.

On the sixth of May I received a box from Mr. E. J. Ayres, of Villa Ridge, at the southern extremity of the State, containing seven of these caterpillars, with the following account of their habits:

"I send you a few specimens of the Solitary Caterpillars, which have been quite troublesome to my pear trees. They appear to be quite general feeders, as I have found them on both cherry and

peach trees, but they appear to be quite partial to pears. I hav killed perhaps a thousand of them in my pear orchard this spring My pear orchard consists of two thousand trees, set two years ago.

In a subsequent letter, dated May 10th, Mr. Ayres makes th following additional statements: "The caterpillars of the kin first sent have all disappeared. I think they must go throug their transformations under ground, or else somewhere outside o the orchard; nor do I think that the eggs are laid upon the pea twigs, for I should certainly have found some of them." He goe on to say that he thinks they must pass the winter in the caterpi lar state, from the fact that he had seen no very small caterpillar but that they make their appearance all at once, from one half t fully grown, though he had seen a very few not more than one quarter grown. He adds that they appear to be very migratory i their habits, and that he had killed a caterpillar nearly every da for a week on the same small tree, one taking the place of another Of the seven caterpillars sent, one must have been lost, as I hav a record of only six- One was put in alcohol and preserved in th larva state; two were taken into Chicago to be delineated and en graved, and died from not being properly supplied with food The other three were put into a glass covered box and regularl fed with pear leaves. The box was partly filled with earth, tha they might go into it to transform if it were their nature to do so and some chips were laid upon the earth to which they might a tach their cocoons. On the 13th and 14th of the month, that i about a week after I received them, two of them crept under th chips and inclosed themselves in their cocoons, into which littl bits of loose earth were woven so that nothing but the earthen par ticles were visible. The other continued to feed ten days longer till the 24th of May, when it made its cocoon like the others, o web and particles of earth, attached to the under side of a chip Two of them, owing probably to the unnatural conditions to whic they were subjected, failed to come to maturity. One of them for tunately completed its transformations, which was all that wa necessary to determine the species.

The perfect, or winged form of this insect, is a whitish moth with yellow markings the body three-quarters of an inch long, and the wings expanding two inches. The ge eral color of the body and wings is white, with a satiny lustre, and with a scarcely pe ceptible yellowish tint. The antennæ are blackish-brown. Palpi yellow tipt with brow The head, collar, scutellum and first segment of the abdomen are yellow; as are also th

des of the breast, the legs, and the costa, or anterior border of the wings. The ante-
br and middle tarsi and the tips of the posterior tarsi are blackish-brown. In some
dividuals the anterior and middle tibiæ, or shanks, are also blackish-brown on their
ter face.

This proves to be a pale, and remarkably distinct variety of a very variable species of
oth belonging to the genus *Callimorpha* of Latreille. It has been described and
amed no less than four times, by different authors, as so many distinct species, in the
llowing order of priority:

Callimorpha Lecontei, Boisduvol.
C. militaris, Harris.
C. fulvicosta, Clemens.
C. vestalis, Packard.

The last variety appears to have been founded upon a pair of small specimens of the
eceding one. The descriptions of the two varieties are almost precisely identical. The
naller size and the absence of the blackish tint on the tibiæ and tarsi are insufficient
aracters to establish a well-marked variety upon, much less a species, especially in so
riable an insect as this. In Mr. Walsh's, Mr. Riley's, and my own collections are spec-
iens varying nearly as much in size, and in which the black shade upon the legs is of
rious degrees of distinctness, and in several of the specimens is wholly wanting.

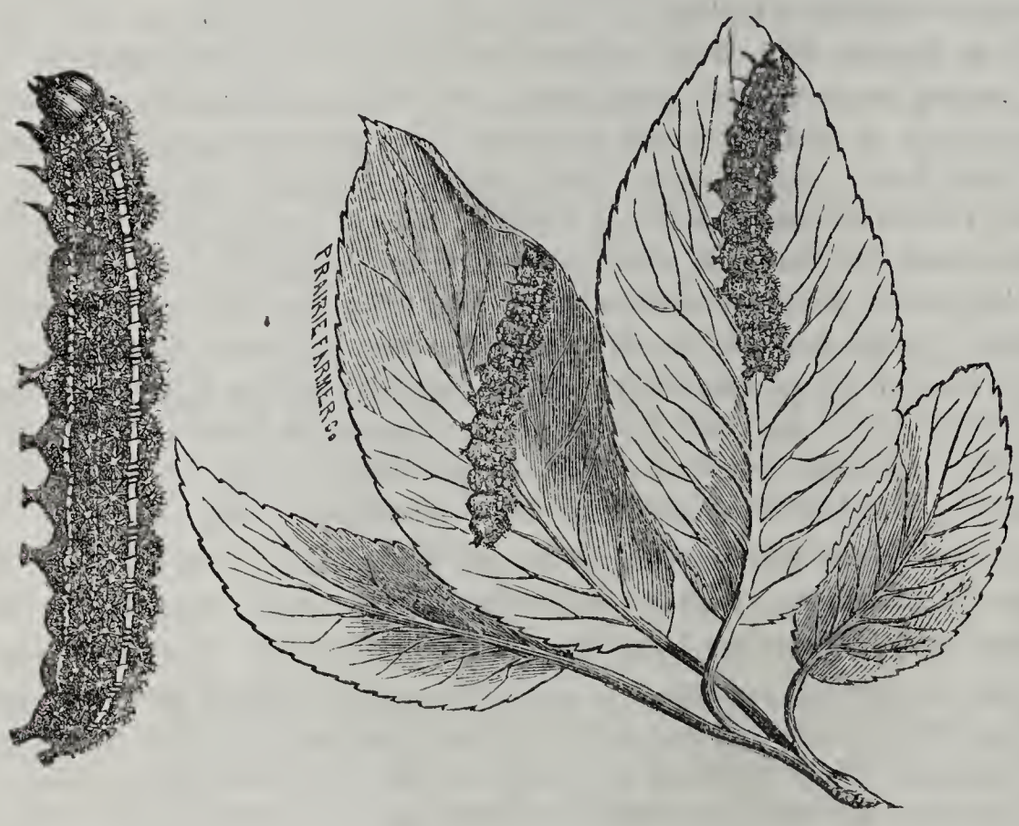
The other three varieties, however, are so strongly marked, that it is not at all surpri-
ng that they have been described as different species. Indeed they never could have
en suspected to be the same, were it not that intermediate grades have been discovered
nich bridge over the space between them. The white variety above described is the
lvicosta. In the *militaris* the fore wings are bordered nearly all around with dark
own, a band of the same across the end, and also an angular projection from a little
yond the middle of the costal border. In the *Lecontei* the brown color predominates,
that Dr. Harris describes the fore wing of this variety as being brown, with five large
nite spots. The hind wings are simply white in all the varieties.

The caterpillar was first described by me and figured in the Prairie Farmer, where it
as, by mistake, assigned to the wrong species. I now place it in its true relations.
ne following description was taken from the specimens sent by Mr. Ayers:

Length one inch and a quarter. It may be described in general terms as a blackish,
mewhat bristly caterpillar, with a shining black head, and with three narrow but con-
icuous orange stripes extending the length of the body, one dorsal and one on each
de; and below the latter a whitish line interrupted by yellow spots. The orange
ripes, when closely examined, are found to be made up of little elongate pieces ar-
nged in a linear series. In the middle portion of the dorsal stripe, these pieces have
e form of little urns with their mouths directed forward. The lateral stripes are still
ore irregular or jagged. These stripes are not wholly orange, but interspersed, espec-
lly the lateral ones, with white and lemon-yellow. There is also a yellow spot on the
ter side of each of the prolegs. The broad portion between the dorsal and lateral
ripes is velvety black, divided longitudinally into two parts by an indistinct whitish
ne with wide interruptions. The body is rather sparsely clothed with short stiff hairs
bristles, black and white intermixed, radiating from little black warts or tubercles,
th steel-blue reflections, of which there are twelve on each segment, arranged as fol-
ws: Three between the dorsal and lateral stripes, one between the first and second
teral stripes, one below the last stripe, and one at the base of the prolegs. The under
de of the body is sordid white sprinkled with blackish.

This is an interesting insect, in a scientific point of view, but has not multiplied, as yet, to a sufficient extent to make it of mu practical importance. Its solitary habits, that is its mode of fe ing separately, or not in flocks, would render it a troublesome sect to contend with should it ever become very numerous. T only method that suggests itself to us, at present, of destroyi them, is by the common practice of hand-picking, or shaking th from the trees and crushing them under foot.

The following cut, made at the office of the Prairie Farmer, hibits another view of these caterpillars, both in their natural s and magnified.



INSECTS INJURIOUS TO THE PLUM-TREE.

THE GREEN, CHESTNUT-BACKED PLUM CATERPILLAR.

(*Acronycta superans*, Guenée.)

Order of LEPIDOPTERA. Family of NOCTUIDÆ.

On the 18th of June I discovered upon a plum-tree, and at a istance from each other, two rather thick-bodied green caterpilrs, with a broad chestnut stripe along the back, once inch long hen extended, but usually a little shorter owing to their habit of umping up the anterior half of the body, whilst the head and osterior part remained upon the same level. When first observed, n the middle of the day, they were not feeding, but resting perectly motionless. I put them in a box and fed them with plum eaves. During my absence from home one of them escaped. he other crept under a chip lying upon the earth with which the ottom of the box was covered, on the 23d of June, and inclosed self in a thin cocoon mixed and covered with particles of earth. nd attached to the under side of the chip, in a manner very simiar to that of the Pear Caterpillars described on a preceding page.

On the first of July I found upon another plum tree, a much maller, less than half grown individual of the same species, havng a small Ichneumonideous cocoon attached crosswise to the uner side of its body, just in front of the anal prolegs. The paraitic Ichneumon-fly emerged from this cocoon on the 10th of July.

On the same day, (July 10th,) the first mentioned caterpillar merged from its cocoon, in the form of a gray and white moth, elonging to the genus *Acronycta*, and very similar to, if not idenical with the species named at the head of this article. It is a

very rare moth in this part of the country, and has not befo
I believe, been reared from the larva state. There is no specim
of it in the Walsh cabinet, but Mr. Riley has a single specim
presented to him by Rev. C. J. S. Bethune, of Canada, under t
name given above, of *Acronycta superans*, of Gueneé. It wou
seem to be a more common species farther north, as Mr. Bethu
in his notes on Canadian Lepidoptera, speaks of having captu
numerous specimens at Cobourg, in June, 1855. It can scarc
at present be considered a noxious insect. Nevertheless it fe
upon one of our fruit trees, and, from its considerable size and
non-gregarious habits, it might become a serious pest if it sho
ever become numerous.

In the short account given above of these caterpillars, and wh
contains all we at present know of them, five circumstances
mentioned which we here repeat, in order to show what import
inferences may sometimes be drawn from a few well attested fa
First, they were found upon a plum tree and were afterwards
to maturity upon plum leaves; they must, therefore, in proport
to their numbers, be injurious to this tree, and must be admit
into the catalogue of noxious insects. Second, from their be
found at a distance from each other, we conclude that they are
itary in their habits, and therefore would be more difficult to
stroy if they should ever multiply to any serious extent. Th
from their being stationary by day, we infer that, like many, a
perhaps most caterpillars, they are night-feeders. Fourth, fr
the discovery of a much smaller individual later in the season
is probable that they have two broods in a year; and, fifth, fr
the attached cocoon of the Ichneumon-fly, it is evident that
shall have the aid of parasitic insects in keeping this specie
check. As this is a very rare moth, and as it does not appear
have been reared from the larva state, and moreover as the desc
tion of the *superans*, by Gueneé, is incomplete in some of
most characteristic particulars, I herewith subjoin a more deta
description of the insect in both the larva and the winged state

Larva, or Caterpillar.—Length, one inch. Body thick, green, with a broad, c
nut-brown stripe the whole length of the back, separated from the adjoining parts
yellow line. Within the stripe, on the top of each segment, are little shining blac
bercles, two on the first, second and third segments, and four on the others, arrang
a transverse curved line, each emitting one or more black hairs, but wanting on the
ring. Some long, sparse, whitish hairs along the lower part of the sides.

Imago, or Moth.—Length between seven and eight-tenths of an inch. Expanse of the wings, one inch and six-tenths. Antennæ setaceous, brown. Labial palpi, a little longer than the head, porrected; basal joint black above, with long white scales beneath; second joint white beneath at base, gray at tip, with a broad, oblique black band across the middle; third joint very small, gray. Maxillary palpi obsolete, appearing only as a minute pencil of white hairs. Proboscis quarter of an inch long, pale brownish; face dark gray, with a small but distinct white spot in center; thorax pale gray or cinereous, collar and tegulæ distinctly dotted with black; abdomen cinereous, indistinctly sprinkled with black points, most obvious near the tip; fore-wings varied with black or brownish black and white. The blackish portion presents, under the lens, and in the fresh specimen a tint of dark metallic green, which seems to be nearly or quite lost in the dried specimen. The coloration of the wing is somewhat equally divided between the white and the dark portions. Regarding the white as the ground color, the black portion may be described as follows: a broad, diffused, irregular vitta or longitudinal band extends the whole length of the wing, nearer the posterior than the costal margin. From the middle of this stripe, a broad, imperfect band extends across to the costa. There are three series of blackish spots across the end of the wing, two of which are approximate, and sub-terminal; the other, further inwards, less perfect, but presenting in its middle a larger, somewhat triangular blackish spot; the costal margin is divided into alternate portions of black and white. At the posterior basal angle of the wing is a pale, but distinct oblong buff-colored spot. Posterior wings cinereous brown, with a central lunule, a middle, transverse line, and the terminal border of a deeper color; their under side whitish, with the same lunules and lines and a series of terminal brown points, very distinct; legs black, annulated with white.

The characters of the posterior wings are here copied almost verbatim from Guenée, and serve more distinctly than any other part of his description to identify the species with the *superans*.

If this should prove to be a distinct and undescribed species, I propose for it the name of *Acronycta prunivora*.

INSECTS INJURIOUS TO THE GRAPE-VINE.

THE AMERICAN VINE-CHAFER.

(*Anomala lucicola*, Fabr.)

Order of COLEOPTERA. Family of MELOLONTHIDÆ.

One of the insects injurious to the grape vine in Europe, and sometimes to a serious extent, is a small beetle belonging to the family of Melolonthidæ, and resembling, in its general characters, the common May-beetle or Dorr-beetle which makes such a buzzing about our lamps in the early summer evening. This insect is known as the *Anomala vitis*, or Vine-chafer, and we have in this country one species at least, of the same genus, which has the same injurious habits, though never to so great an extent. This species is now generally regarded by entomologists, I believe, as the *Anomala lucicola* of Fabricius, though it has often been confounded with another species, the *A. varians* of the same author. Dr. Harris mentions it in his treatise upon the noxious insects of Massachusetts, and speaks of its being quite destructive in particular localities of that State in the year 1825.

About the last of June of the present year (1870), I received a box of these insects from Mr. E. J. Ayres, of Villa Ridge, to whom I have been indebted for many interesting insects, and to whom I am happy to have this opportunity of publicly expressing my thanks. Mr. Ayres gives so graphic an account of the habits of this insect, as observed by himself, that I cannot do better than copy his words:

"I send you a box of perhaps a dozen or more beetles which are new to me, and which are just now making sad havoc with

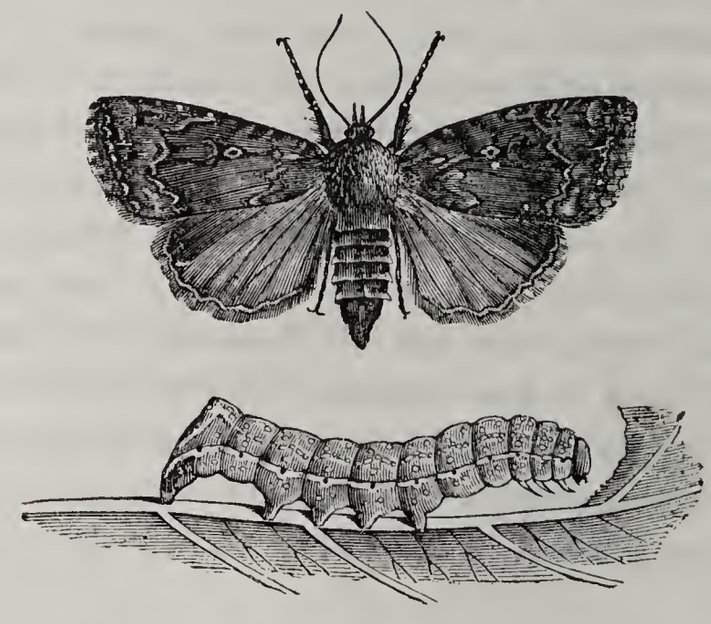
our Norton's Virginia grape-vines, eating the leaves in a manner similar to the leaf inclosed. The first I noticed them was about four days ago, when, about sun-down, in my pear orchard, they were flying close to the ground, in a ziz-zag style, as if they were hunting for something, and were in such numbers as to sound like a swarm of bees. After I had eaten my supper, and it had become quite dark, I discovered them in great numbers on the Norton's Virginia vines. They would shake off very easy, and 'play possum' for a few minutes, and then fly up and commence again. The next morning I went out to sprinkle the vines with lime, and to my surprise, found there was not a beetle on the vines; all were gone; but of two hundred and fifty vines they had eaten half of the leaves. In searching, I found large numbers in the ground, under the vines, but apparently not in so great numbers as they were on the vines the night before. This was Friday morning. I was obliged to go to Cairo on business, and did not get back till Sunday, and on my return found that the vines did not look as if they had been injured any during my absence, or at least but very little. I took a look to-day and found them still in the ground, about half an inch deep, and generally in pairs. In my vineyard of twenty varieties, they have disturbed none but Norton's Virginia. In a neighboring vineyard containing say a dozen Norton's, with several thousand Concords and Ives, they have eaten all the Norton's, and worked a little upon some adjoining Concords, but they were evidently not suited to their taste. Judge Brown, who has but three or four Norton vines, in a vineyard of three or four hundred vines of different kinds, finds his Nortons badly eaten and none of the others touched. I shall examine the vines to-night, and if possible ascertain if they come out of the ground and eat the vines. They do not eat at all in the day time."

Dr. Harris speaks of the Anomalæ as being diurnal in their habits, and the specific name of *lucicola* given to this species by Fabricius, if indeed it be the same, means loving or seeking the light. But from Mr. Ayres's observations, it appears that, like many of our larger Melolonthians, this is a night-feeding species. Mr. Ayres's description of its mode of flight calls to our mind the low, mousing flight of another and more common, allied species,

the Cetonia Inda, very much like that of a hawk, scouring over a field in search of mice.

The leaves eaten by these insects resemble a piece of coarse, irregular net-work, all the larger veins and part of the smaller ones being left.

From the great numbers and concerted operations of these insects, and the suddenness with which they make their attack, it is evident that serious loss might be suffered from them before their depredations were discovered. The ease with which they are shaken from the vines suggests the method of capturing them, by shaking them onto a sheet; but their nocturnal habits would render this inconvenient if not impracticable. Dusting the leaves with lime, as above suggested, or if this did not succeed, syringing them with tobacco water or whale oil soap, might prevent their depredations.



THE GREEN, CREAM-SPOTTED GRAPE-WORM.

(*Amphipyra pyramidoides*, Gueneé.)

Order of LEPIDOPTERA. Family of NOCTUIDÆ.

I have heard of the larva of this insect from various localities in the southern half of the State, but little has yet been recorded concerning its numbers or its habits. The Caterpillar is a fleshy, green, naked worm, about an inch and a quarter long when fully

rown, sprinkled with minute cream-colored or straw-colored pots. There is a cream-colored line along the back, and a yellow ne along the sides, connecting the spiracles, or breathing pores, hich appear like black points, each one being surrounded by a arrow white ring. The perfect insect is a dark brown or black-h moth, varied with rather obscure whitish spots and zigzag nes. The hind wings are dark coppery-red, with a dusky bor-er. The larva is figured in the American Entomologist, Vol. I., age 225, and the moth in Vol. II., p. 26.

I received some of these Caterpillars from Mr. E. J. Ayers, of illa Ridge, early in May, with the following note: "The green orms with cream-colored spots, I find on my grape vines. They re not numerous, but they are ravenous feeders. Should they ecome numerous they would be very destructive." At the time f their reception the leaves of my cultivated grape vines were ut just opening, and I fed them on the leaves of the wild grape ine which was running over my garden fence and which was nore advanced. They are, as Mr. Ayers remarks, gross feeders, nd are very easily reared. Some caterpillars are very restless in onfinement, but these creatures strongly remind me of a hog, eing perfectly contented so long as they had enough to eat. ometimes, after eating their fill, they would roll over upon their ides and take a rest, very much like the gluttonous animal just eferred to.

They began to transform on the 16th of May, folding a piece f grape leaf pretty close around their bodies, and lining the avity very slightly with silk. Different individuals remained in ne chrysalis state from forty-two to forty-eight days. The char-cter of the moth is strongly contrasted with that of the larva with espect to its activity. The caterpillar, as we have just stated, s gluttonous and sluggish in its habits. The moth, on the con-rary, is extremely alert, and rapid in its motions, lying in an ab-upt, zigzag manner. I came very near losing some of my pecimens, though they were within the walls of my office. One f them flew precipitately across the room, dove in amongst the ooks in one of my cases, and concealed itself so artfully and per-naciously, that though I saw where it flew, I had to take down pwards of an hundred volumes before I could discover it.

This insect has also been bred by Mr. Riley, of St. Louis, and

by Major Muhleman, of Woodburn, Ill. The former states t
he has found the same caterpillar on the Red Bud and the P
lar. They have not as yet been known to multiply so but t
they could be easily destroyed by picking or knocking them fr
the vines.

INSECTS INJURIOUS TO THE CURRANT.

THE SPINOUS CURRANT-CATERPILLAR.

(*Vanessa* (*Grapta*) *Progne*, Fabr.)

Order of LEPIDOPTERA. Family of NYMPHALIDÆ.

Fitch's Third New York Rep., No. 142.

A light-brownish or drab colored caterpillar, about one inch in length, thickly beset with white, branching spines, slightly tipped with black, and averaging in length about half the width of the body. The face also is prickly with short, whitish spines. The first segment or collar is narrower than the head and second segment, forming a neck between the head and body. Pupa suspended with the head downward, often attached to a twig or leaf stalk; pale brown, faintly clouded upon the side with olive-green, and the abdomen broadly striped, with the same on the back and sides. There is a deep depression across the middle of the back, on each side of which are two small silvery spots.

In its perfect state this insect is one of our most common and widely disseminated butterflies, being met with over nearly the whole of the North American continent. It expands from one and three-quarters to two inches. It has scalloped wings, of a bright tawny or orange-red color, with black spots. On the under side the wings are entirely different, being of a blackish-gray color, paler at the tips, and with a small silvery mark on the hind wings, resembling the letter L.

The larva or caterpillar of this species sometimes feeds upon the leaves of the currant, but from the fact that the butterfly is common, whilst its larva is not generally known as a currant-eating caterpillar, it is evident that it must, ordinarily, have some other

kind of plant-food. Dr. Harris speaks of having raised it fro caterpillars found feeding upon the elm, but makes no mention its eating the currant. Dr. Fitch, in his New York Report speaks of them as sometimes eating the leaves of the currant, an on the 15th of July I received a number of these caterpillars fro Mr. B. N. McKinstry, of Judson, Kankakee county, accompanie with the statement that they were doing considerable mischief b stripping the leaves from his currant bushes. This is, I believ the first record of its feeding upon the currant in this State, an it cannot be regarded, at present, as a noxious insect of a serio character.

I made a few observations upon the individuals sent to me, some scientific interest, which I will briefly state.

The chrysalis state, which is stated by Drs. Harris and Fitch vary from eleven to sixteen days, lasted, in my speimens, on seven days. The weather was excessively hot, the thermomet indicating, most of the time, 100 degrees, which may, perhap account for the rapid development.

As these caterpillars, after they had suspended themselves f the purpose of transformation, hung directly in front of my stud table, I was led to observe more closely than I had hitherto don the process by which these creatures divest themselves of the larval covering. It appears to consist of two stages: the first slow, gradual and almost imperceptible, occupying some twent four hours of time, during which, it may be presumed, there effected a gradual separation of the larval from the pupal envelop During this period the caterpillar hangs with its body curved fo wards and upwards, and appears to be almost motionless; but upo close observation it is seen to undergo almost continuous thoug slight changes, consisting of a nodding motion of the head, and a occasional variation in the curvature of the body. The secon stage is short and active, usually lasting but a few minutes, th object of which is to throw off the loosened larval skin; first, b bending the body it bursts open the skin upon the back, and the by a wriggling motion, works it up towards the point of attac ment, and lastly detaches and throws it entirely off by a series violent contortions, apparently at the imminent risk of severi the thread upon which its safety literally depends.

Should this insect ever become numerous in any locality, it would have to be destroyed in some of the ways commonly resorted to for caterpillars of this kind, namely: by shaking them from the bushes and crushing them under foot, or dusting the leaves with ashes or lime.

THE FOUR-STRIPED PLANT-BUG.

(*Capsus* (*Phytocoris*) *quadrivittatus*, Say.)

Order of HETEROPTERA. Family of CAPSIDÆ.

Upon going into my garden on the morning of the seventh of June, my attention was arrested by the blighted appearance of the leaves on some of the currant bushes. Upon examining them they were found to be more or less densely sprinkled with little, dried, somewhat square or angulated spots, not much larger than pin heads Some of the leaves were completely withered, and a number of parsnips which had been left for seed, were found still more severely affected, some whole branches and their leaves being as dead and brown as if they had been severed from the plant for a week. I examined the plants carefully, but could find no adequate cause for the mischief, and I was inclined to think that it was either some kind of blight, or that if any insects had been damaging them, they had run their course and disappeared. I saw on most of the bushes a small number of the pretty, black and yellow hemipterous insect whose name is placed at the head of this article, but they did not seem to be in sufficient numbers to account for the evil. I observed them, however, puncturing the leaves, and upon referring to the American Entomologist, I found on page 246 of the first volume, a notice of these same insects having been sent to the editor by Mr. M. B. Bateman, of Painesville, Ohio, with the statement that they were found to be quite injurious to the currant bushes and various kinds of shrubs.

This is an interesting insect, by adding another to the comparatively small list of noxious insects belonging to the order of Heteroptera. This list includes the Chinch-bug (*Micropus leucopterus*), the brown Squash-bug (*Coreus tristis*), the large grey

Plant-bug (*Brochimena annulata*), and the Lined Plant-bug (*Capsus linearis*). The last species, also known as the Tarnished Plant-bug, is one of our most pernicious insects, and belongs not only to the same order, but also to the same genus with the species now under consideration. All these insects do their damage by puncturing the leaves or stems of plants, and wilting them by the abstraction of their sap. The suddenness with which the parts beyond their punctures, wither, and sometimes turn black, has led to the general belief that they infuse a poison into the wounds; but no such poisonous secretion has been proved to exist.

This species has never been fully described, and I therefore append the following description:

Length, three-tenths of an inch. Deep honey-yellow, inclining to orange. Elytra bright greenish-yellow, with four black stripes.

Head, deep honey-yellow; nasus and antennæ, black. Thorax, greenish-yellow; its anterior border, honey-yellow, and with four black stripes; the two middle ones in the form of large sub-triangular spots, the outer ones slender and near the margin. Scutellum, greenish-yellow, with the lateral angles black. Elytra, greenish-yellow, each with two black stripes, the outer ones more slender, near the margin, and having a black dot beyond its tip. Membrane, black. Beneath, honey-yellow, the venter deepening into orange; vent black, in the male furnished with two black hooks; in the female with a blackish sword-shaped ovipositor, originating from the middle of the sixth segment, lying upon the venter, when not in use, and concealed between two valvular folds, forming a carina, with its point backwards. When elevated from its sheath, it appears to issue from the middle of the venter. Legs pale-greenish, with two black rings near the end of the thighs; last joint of the feet black.

The females are easily distinguished, at this season, by their more swollen abdomens. Upon opening them they are found to contain about 20 (from 15 to 24) oblong subcylindrical flask-shaped eggs, pale, with white tips. I have not been able to discover where these eggs are deposited.

These insects may be called social rather than gregarious, being sometimes found singly, but usually in small companies.

The insects of the genus *Capsus* are very active, and instantly take to flight when alarmed, especially in the heat of the day. The only time when they can be captured and destroyed is very early in the morning, when they are chilled by the coolness of the night, and therefore disinclined to fly. They can be shaken or brushed off into a pan or pail partly filled with lye or strong suds. Simple water answers just as well, so far as to prevent their flying away.

INSECTS INJURIOUS TO THE POTATO.

Explanation of figures.—a, a, eggs; b, b, larvæ; c, pupa; d, beetle of the natural size; e, wing-case magnified; f, leg magnified.

THE COLORADO POTATO BEETLE.

(*Doryphora*, 10-*lineata*, Say.)

Order of COLEOPTERA. Family of CHRYSOMELIDÆ.

Walsh's and Shimer's articles in the Practical Entomologist, vols. 1 and 2; Riley's 1st Missouri Report, page 101.

This insect does not need to be described. We all know the creature, alas! too well. Though one of our most recent acquisitions in the line of practical entomology, having been known in this State only for a period of six years, yet it is so unceremonious in its visitations, and so free and easy in its manners, after it has arrived, that we have already come to regard it as an old acquaintance. As such we have everywhere extended to it a warm recep-

tion, devoting whole fields of our most valuable esculent to it uses—at least, it has not hesitated to appropriate them thus—and adorning it with our most brilliant pigments. But having, in accordance with the old adage, "Welcomed the coming," we are now quite willing to "speed the parting guest." To tell the plain truth, our visitors from Colorado, with their enormous families have got to be an intolerable bore. In no former years have the complaints of their depredations been so loud and so universal the hot and dry summer having evidently been favorable to their multiplication.

I have heard of a few localities, both in Iowa and Illinois, where these insects were numerous last year, but have nearly or quite disappeared this year, giving us a gleam of hope for the future. But such cases, the past season, I believe to have been rare and exceptional, and we have reason to be not a little suspicious that our visitors from the Rocky Mountain country will prove to belong to that class of friends alluded to by the poet in the following stanza:

"I do not tremble when I meet
The stoutest of my foes;
But Heaven defend my from the friend
Who comes—but never goes."

In our dilemma, the question then is, what can we do to expedite their departure?

In the first place mother Nature has come to our relief, to a certain extent, and has sent a host of assistants to aid us in the task. We can now enumerate at least nineteen different kinds of insects which prey upon the Colorado Potato-beetle. We give their names below, numbering for the purpose of reference:

COLEOPTERA.

1. Tetracha virginica.
2. Calosoma calidum.
3. Harpalus caliginosus.
4. Pasimachus elongatus.
5. Philonthus, sp. undetermined.
6. Lebia grandis.
7. Lytta vittata.
8. Lytta cinerea.
9. Hippodamia maculata.
10. Hippodamia, 13-punctata.
11. Hippodamia convergens.
12. Coccinella, 9-notata.

HEMIPTERA.

13. Reduvius raptatorius.
14. Harpactor cinctus.
15. Arma spinosa.
16. Stiretrus fimbriatus.

DIPTERA.

17. Promachus apivorus.
18. Lydella Doryphoræ.

ARACHINDA.—19. Phalangium.

Of these insects, the first five are ground beetles, and are predaceous both in the larva and perfect states, and they devour the Potato-beetles and their larvæ, mostly on the ground or whilst undergoing their transformation beneath the surface.

The next three attack them on the vines.

The next four belong to the family of Lady-bugs and help to destroy the Potato-bugs by eating their eggs.

The four Hemipterous insects are all predacious. They attack the Potato-bugs wherever they can find them and kill them by puncturing them with their beaks and extracting their juices.

No. 17 is a large, savage two-winged fly, which, it would seem, attacks almost any insect that comes in its way. Its specific name means bee-eating, and it is the same insect which has been called the Nebraska Bee-killer. It also kills Horse-flies, and now is proved to add the Potato-beetle to its indiscriminate bill of fare. I received a pair of these insects from Mr. A. R. Whitney, of Franklin Grove, who caught them in the act of seizing and carrying off the mature beetles. These ferocious insects resemble the hawk in their mode of dealing with their prey. They seize , fly off with it for a short distance and then alight and devour at their leisure. Whilst so engaged they allow themselves to e approached quite nearly, and are easily captured. Mr. Whitey followed a number of them, and got possession of the beetles, hich he always found dead by the time he could reach them.

No. 18 is a parasitic fly, belonging to the family of *Tachinidæ*, e larvæ of which live in the bodies of the Potato-bugs, and thus estroy them. It was actually bred by Mr. Riley from the infested sects, and I have several times seen this fly or another similar ecies alight upon the vines in the midst of the beetles and their rvæ.

No. 19 is commonly known as the Daddy-Long legs, and I place in the list of Colorado Potato-bug destroyers on the authority of r. Arthur Bryant, as given in the Transactions of the Illinois orticultural Society, Vol. I, page 102. To this list may be added, ough with some doubt, the Little-lined, or Tarnish Plant-bug (*apsus linearis*). Early in the season, I received a letter from r. James Taylor, of Somonauk, in which, amongst other matters, spoke of a small insect which pierced with its beak and deoyed the eggs of the Colorado Potato-beetle. As I could not

from his description, identify the insect with any known depre
tor upon the Potato-bug. I wrote to him requesting him to se
me specimens, and soon after received from him a number of
above named species. As the *Capsidæ* are all vegetable feede
and as the *Capsus linearis* is often abundant on early potato vin
which they injure by puncturing the young shoots, I at fi
thought that Mr. Taylor had confounded this species with
Arma spinosa or some other species which is well known to
stroy the eggs of the Potato-beetle in the way he describes. I
as he speaks as if he had actually seen them performing this
and as the *Capsus linearis* is a very indiscriminate feeder as
spects its plant-food, and finally as the two *Lyttæ*, above m
tioned (Nos. 6 and 7), are also plant-feeders, and yet are admitt
on what is supposed to be sufficient authority, to be occasio
feeders upon the larvæ of the Potato-beetle, I am inclined to
lieve that, after all, Mr. Taylor's observations may have been
rect. This point, however, will have to be settled by future ob
vation.

To these insect depredators upon the Potato-bug I have pre
good reason to add a four-footed animal, which we are not in
habit of regarding in a very friendly light, and that is the Sku
This animal is well known to relieve the opprobrium which u
ally attaches to his name, by destroying the May-beetle, and
larva the White grub, and some other of the larger sized inse
Whilst on a visit to Benton Harbor, Mich., early last spring,
L. Camfield stated to me that a part of his potato field furth
from the house was comparatively free from Potato-bugs,
that he knew that skunks frequented it from the fact that his
was often heard barking there, and bore unmistakable evide
on his return, of the company he had been in. I told Mr. C
field that as every fact of this kind was of interest, I wished
would watch, some moon-light night, and see if he could verify
supposition. Later in the season, in answer to a letter of in
ry from me, I received a reply from Mr. Camfield, under dat
Aug. 15, saying that he had not seen a skunk about his premi
they having been probably frightened away by the dog. But
adds that his brother and neighbor, who have potato patche
the same inclosure, near a thicket much frequented by skun
have been but little troubled by Potato-bugs, though others

hat section have suffered serious damage. That the Skunk hould eat Potato-bugs has no intrinsic improbability, and I think very one must be impressed with a feeling of the extreme appropriateness of the diet.

The testimony with respect to these insects being eaten by omestic fowls is contradictory. The truth seems to be that some hickens will eat them and others will not, or that they will eat hem under some circumstances, such as the pressure of extreme unger. My next door neighbor, Mr. Wurts, says he has taught is fowls to eat the bugs by throwing them down to them like so uch corn, when they were hungry; and he thinks that if all hickens do not eat them it is because their education has been eglected.

The question will naturally be asked, why, with all these enehies, do the Potato-bugs continue to multiply, like the locusts of Egypt? The best answer I can give is, that no one of these any enemies, if we except, perhaps, the parasitic Lydella, is exlusively appropriated to these insects, like the Tachina of the Tussock-moth or the Chalcis of the Bark-louse, mentioned in the arlier part of this report. In other words these various enemies epredate upon the Potato-bugs when they happen to come in heir way, but do not depend upon them for subsistence. Beides, the predaceous insects above enumerated do not belong to he prolific class, and therefore are too few in individuals to make uch headway againt such a multitudinous host as the Colorao Potato bugs. I have repeatedly walked through potato fields warming with bugs, with the express intention of taking note of heir destroyers, without seeing any creature seriously deserving f the name.

Nature, if left to her own resources, often exhibits wonderful urative and recuperative powers, which are ordinarily sufficient o preserve the balance between the world of insects and that of lants. If in any case, like the present, she seems to fail, it is ecause we have abruptly disturbed the balance by supplying hese prolific insects with a superabundance of congenial food. And now that we are overrun by them we stand aghast at the onsequences. But nature often accommodates her economy to uman wants, and rectifies our errors and our follies. And I ave no doubt that the Colorado Potato-beetle, like other nox-

ious insects that have been equally prevalent, will in time disa
pear, especially in those localities where it is now most abundar
even though we leave the work wholly to Nature. But we mu
give her time. Nature moves more slowly but more surely tha
man, and her judgments take the course of an inevitable retrib
tion. If we can have more patience, and get along with few
potatoes for a year or two, I doubt not the day of our redemptio
will draw nigh. But as we do not know exactly when that tin
will come, and as patience without potatoes may seem to many
tedious virtue, I opine there can be no sin in our doing what v
can to hasten the wished-for result. Let us see, then, what hop
we can derive from any success that has attended past efforts
this direction.

There are four principal methods and agencies which have bee
adopted for the purpose of destroying these prolific and perniciou
insects: first, hand picking and mechanical contrivances; secon
sun-burning; third, starvation; and fourth, Paris-green. M
S. S. Barnes, of Olena, Henderson county, says he has preserve
his potatoes for the last five years, by mashing between his thum
and finger, every bug that made its appearance on his vines, an
picking off their eggs. He says that for early kinds, twice goin
over, once when the vines are three or four inches high, and agai
in ten or twelve days afterwards, is all that is necessary. Th
may be styled the *experimentum crucis* method, and is of cours
a sure cure, where it can be applied; that is where the field
not too large, nor the bugs too numerous, nor the operator to
sensitive.

Speaking of mashing these insects in the hand, suggests th
question of their alleged poisonous nature. Mr. Barnes says th
though he has practiced this method freely for five years, he ha
never experienced any poisonous effects from it. There is n
doubt, however, that they are poisonous to a certain extent, and th
has been most strikingly manifested in the effects of the fume
arising from their burning bodies. Major W. N. Davis, of Au
Sable Grove, recently told me that his neighbors, the Messr
Cherry, were quite severely poisoned by the smoke arising fro
an ignited hollow stump into which a quantity of Potato-bugs ha
been thrown. It affected them very much like an attack of ery

sipelas, their faces being so much swollen as almost to close their eyes. There are also several cases on record of severe inflammation of the hand and arm, after handling these insects, when there was an abrasion of the skin.

But it is not necessary to touch the insects with the hand. The common practice is to knock them off into a pan or pail. As simple and convenient a plan as I have heard of was adopted by one of my neighbors, Mr. H. C. Hawkins. He took an old meal bag, cut it off in the middle so that it might not be inconveniently long, and fitted into it a small hoop so as to keep the mouth open, and then, passing along the rows, knocked the bugs into the bag with the flat side of a shingle, occasionally shaking the insects down to the bottom of the bag, from which they could not easily escape.

It is not my intention to enumerate the hundred and one mechanical contrivances that have been resorted to for the purpose of killing these insects. I only mention a few that seem to me most worthy of imitation. Mr. J. W. Clark, of Twin Hills, Wisconsin, makes use of the following wholesale method, in field culture. A person with a common broom held perpendicularly with one hand and grasped as low down as convenient with the other, passes along close to or astride a row of the vines, and with a quick lateral motion strkes the vines first on one side and then on the other, scattering the bugs into the spaces between the rows. Another hand follows immediately after with a plow and crushes or buries the greater proportion of the insects. If the potatoes have been already plowed and hilled up, he drags along the furrow a heavy bundle of brush, or a small harrow made for the purpose. A considerable proportion of the insects will of course escape, but the operation is so rapidly performed that it can be repeated as often as necessary. Mr. C. closes by saying: "On the whole, we confidently offer this system of treatment as one that will be found cheap, rapid and effective. The work can be performed in half the time that it requires to apply Paris-green, which, moreover, is not a fit thing for children to handle. The only cost is labor, and this not difficult. A smart boy or girl will easily broom over an acre in two hours."

The second of the methods above enumerated is sun-burning.

If these insects are knocked off the vines in the middle of a very hot and dry day, the mercury in the thermometer ranging at 95° or upward, they will die in about one minute, as I have tested by actual experiment. The soft-bodied larvæ roll over and over and seem to almost liquify from the heat. The beetles spread their wings and attempt to escape, but cannot rise from the broiling surface. Two of my fellow travelers on the *ad interim* Committee, Mr. Galusha and Mr. Wier, both certify, from their own experience, to the efficacy of this method when the conditions are favorable. The former adds that it is most effective where the potatoes have been hilled up, so as to present an inclined plane of crumbling earth, up which the insects must climb, under the fierce fire of the enemy, before they can reach the protecting shelter of the over-spreading foliage. The objection to the practice of this plan is that the operator has to expose himself to the same heat which is fatal to the insects, and besides, there are usually but few days in the year when this remedy is available.

Another agency for lessening the numbers of the Potato-beetle is starvation. This takes place from the simple fact that the insects, in some cases, eat all the potatoes and other available food within their reach, whilst many of them are immature, and before the season is far enough advanced for them to go into winter quarters. I have been forcibly struck the present season with the efficacy of this condition of things in my own neighborhood, and it must have occurred in many other localities. I have seen myriads of these insects, in all their stages, leaving the potato-fields, where they had left scarcely a stump standing, and traveling over fences, buildings and roads, and I may say everywhere, but where there was no congenial plant food within their reach. The perfect insect, it is true, can fly to a considerable distance, but the supply of food sometimes gives out when the great majority of the insects are in their larva state. I have heard of their being seen crawling half a mile or more from any place where potatoes grew: this, however, I think must have referred to the mature beetles, which had availed themselves of their wings for a part of the distance. An important question arises in such cases, whether these insects are capable of subsisting upon other plants besides the potato, to a sufficient extent to preserve them from starvation. It is

a curious fact that these ravenous insects seem to be exclusively appropriated to the natural family of *Solanaceæ* or the Night-shade family, upon all the species of which they will feed to some extent.

This family includes, in addition to the Potato, the Tomato the Egg-plant, the Bitter-sweet, the Black Night-shade, the Horse-nettle, the Ground-cherry, the Thorn-apple, the Henbane, the Tobacco, wild and cultivated, the Box-thorn, and the Cayenne Pepper. Upon two of these plants, the Egg-plant and the Horse-nettle, these insects feed as readily as they do upon the potato, but upon all or most of the others they eat sparingly and only from necessity. We sometimes hear of them eating other plants, and I have seen the Thistle and other plants slightly gnawed by them when on their march for more congenial food, but it is only as an act of desperation. The Thorn-apple, or Apple of Peru, they will eat more freely, but they do not like it; and the Cayenne Pepper, if eaten to any considerable extent, is fatal to them. Mr. Ellsworth, jr., of the Naperville nursery, informed me that he had several times found the bugs lying dead under the pepper plants upon which they had been feeding. Now it is evident that all the plants above enumerated are too rare in locality, and too small in quantity to afford subsistence, to any considerable extent, to such a prolific and multitudinous species as the Colorado Potato-beetle; and there can be no doubt that in such a season as the present, in many localities, millions of these insects must have perished for want of food. And though there will probably be enough left to continue the breed, yet they will be so much reduced in numbers that their presence will hardly be noticed for years to come. And, besides, in proportion, as their numbers are reduced, they will become subject to the depredations of predaceous and parasitic foes.

In such ways as these does Nature come to our relief from the indefinite encroachment of the many noxious insects to whose depredations we are exposed, and says to the advancing tide, with more authority than did Canute, of old: "Thus far shalt thou come, and no farther."

I think there is no doubt that we could avail ourselves of the starvation process to exterminate the Colorado Potato beetle, if this insect should prove to be of a sufficiently persistent character

to induce a concert of action amongst agriculturists. This could be accomplished by planting only the earliest varieties of potatoes. If this method were universally put in practice, there would be no potatoes after mid-summer for the insects to feed upon and they would probably all perish from starvation. And even if a small proportion of them should subsist upon other plants till fall, they would be of too old a brood to survive the winter and perpetuate the race another year.

But it is now generally admitted that the most effective remedy for the Colorado Potato-beetle, so far as human agency is concerned, is the application to the vines of the poisonous substance commonly known as Paris-green, and chemically designated as the Arsenite of Copper. This substance proves fatal to the insects, not by coming in contact with them, but by being eaten by them. Indeed, these creatures have a very pertinacious vitality under all the ordinary applications which prove destructive to insects. I have thoroughly sprinkled the infested vines with copperas water, one ounce to the quart, which has been highly recommended; and with fish brine, one quart to two gallons of water, but both applications hurt the vines much more than they did the insects. I have also immersed the beetles in diluted carbolic acid, and then rolled them over and over in Paris-green, and put them in a box, and some of them were alive on the next day. But when this article is eaten by them with the foliage, it proves speedily and certainly fatal.

The first time that I knew of this substance being used on a large scale, was in the summer of 1869, by Mr. E. W. Grosvenor, of Hastings, Minnesota. This gentleman used twelve dollars worth of Paris-green, diluted at about the rate of one quarter of a pound to half a peck of flour, and saved his potato crop. Upon the older vines it had to be repeated, but upon vines three or four inches high, he thought it affected them in some way which rendered them thenceforward repugnant to the insects. But upon this point it is proper to remark that the testimony is conflicting. Mr. Grosvenor also mentioned the interesting incident that in stripping the bark from some old fence posts in the winter time, near the fields that had been infested by the bugs, he found thousands of them, which had availed themselves of this shelter for the winter,

though it is generally supposed that the majority of them hybernate under ground.

To show the efficacy of Paris-green on a large scale and in energetic hands, I cannot do better than to quote, in full, two letters which I have recently received, relating to this subject, and from two very remote localities:

BIG THOMPSON, COLORADO, *Oct.* 7, 1870.

DR. WILLIAM LEBARON:

Dear Sir—In the Prairie Farmer of May 28, you requested a report from those who experimented with Paris-green. Here is mine:

The Colorado Potato-bug attacked my potato field early in May, and having a large crop (twenty-five acres), I procured nine pounds of Paris-green and mixed it with six times its bulk in flour, and applied it to the vines in the morning, when the dew was on. The result was, I killed millions of bugs and saved my potato crop.

I commenced digging my potatoes on the 10th ult, and have now about eighteen hundred bushels in the pits, and expect to have about three thousand bushels in all, The second brood of bugs have made their appearance, and the ground is literally covered with them; thousands of them crawl into the potato pits and eat the potatoes voraciously, especially the cut ones. I found as many as twenty-five bugs on one potato. Will they live in these pits all winter? If so, I fear that they will damage the potatoes to a great extent. Is their any remedy that will exterminate them now?

Very respectfully, your obedient servant,

JOHN SULLIVAN.

In reply to this letter, I stated that if Mr. S. thought it too early in the season to close his pits with earth, I should advise him to cover them with a close matting of straw, which would be likely to exclude most of the insects, and yet give sufficient ventilation; and as to their damage in the pits, I thought it would be of short duration, as approaching winter would render them torpid, and in the spring their tendency would be to leave the pits in search of light and fresh food, and in obedience to the instinct of propagation.

RUSHVILLE, INDIANA, *Sept.* 26, 1870.

DR. WILLIAM LEBARON:

Sir—Having seen, by chance, a number of the Prairie Farmer, of Sept. 10, containing a few remarks by you in reference to the Colorado Potato-bug, I send you my experience and observations. The first ever seen in this locality made their appearance in June, 1869. Paris-green, mixed with five to ten parts of wood ashes, effectually destroyed them, and the crops of potatoes were unsurpassed. Last Spring they came much earlier in the season, very soon after the potato tops were above ground, and by millions. Paris-green, used in the same way, was entirely effectual; but a second brood appeared, which was destroyed in the same way, and potatoes are good for this season. Variety, mostly Early Rose. Many of my neighbors used Paris-green in the same way with similar re-

sults. Have not known it fail in a single instance; and have not heard of a single c of any evil result from using the poison. All were informed that it was poisonous, a to be used with care.

Why not form a line North and South from Lakes to Gulf of Mexico, at a point E of where they have thus far been found, and the farmers on that line organize and pois them out as they come, and prevent their migration eastward? Every farmer east the line is interested and should aid.

Respectfully,

GEORGE C. CLARK

It is refreshing to read such letters as these, written with a cle head and a strong hand, and which give us faith to believe th the Colorado Potato-beetle, like most other ills that afflict humar ty, can be mitigated, if not wholly overcome, by energy and pe severance.

With regard to Mr. Clark's suggestion of a cordon of Par green across the continent, I replied to him that I thought it very excellent one, with one slight drawback, and that was that would be impossible to carry it out. Farmers are never guilty such concerted, beneficent action. If they were, the worst pes that afflict them, the Potato-bug, the Curculio and the Codlin moth would, before this, have been practically exterminated. B farmers are like other people; some are ignorant, some are shi less, some are timid, and some have other and greater interests stake to distract their attention; and the result will be that ga enough will be left, through which the advancing hosts will marc on to their allotted destination. My friend, Prof. Welch, told m that when he made his visit to his old homestead in Maine, la summer, he took a box of the Potato-beetles with him, and th circumstance becoming known on his arrival, the liveliest curiosit was excited to see the notorious strangers, and that some peop traveled fifteen miles to get a sight of them.

Have patience, friends, and in due time, in all probability, you utmost curiosity will be gratified. This Western tortoise in mini ture is plodding on his way to you-ward, at the rate of fifty or sixt miles a year, and, in good time, he will meet you at your thres old and will say to you, "Lo! I am here. I have come a lon and weary journey, I have crossed high hills, broad lakes an rushing rivers, enemies have waylaid me on every side, and man fold perils have beset my path; but I have overcome all obst cles, and have arrived at last, and shall abide with you for a sea

son; and to see me you will henceforth need to make no distant pilgrimage."

Here is a letter upon the other side of this question:

SALINA, KANSAS.

DR. W. LEBARON:

Dear Sir—Some time since you requested a report from those who experimented with Paris-green. Here is mine:

The Colorado Potato-bug attacked my potato patch. I dusted the vines with Paris-green, mixed with twice its bulk of flour. The poison was applied in the morning when the dew was on. I killed thousands of bugs—in fact the ground was really covered. I could scrape them up by the handful. Many potato vines turned black and died For every bug that died a thousand seemed to come. They ate up all my potatoes and Paris-green too. I dissent from the position that the bugs shun the presence of the Paris-green; if so they would not eat it; and I found as many on the vines that I thoroughly dusted as any. They ate them entirely up, stalks and all. L. P.

Fighting against these voracious, prolific and many-brooded insects is often, it must be confessed, very discouraging work, of which the letter just quoted gives an example, and the following case is another of a somewhat different character. One of my townsmen, Mr. John Hepworth, an industrious and careful farmer, had nearly an acre of choice potatoes, which, by frequent hand-picking he had preserved from the insects till about the middle of July, when, being driven with harvest work, he paid no farther attention to them. Two weeks later I saw these vines and they were half eaten up by the second brood of these loathsome vermin, and covered by them to such an extent that the owner abandoned them to their fate. A week later, Aug. 6, nothing but the leafless stalks remained, and the insects, mostly in the larva state, were leaving them and crawling in all directions in search for food. In this case most of the insects had come in from a neighboring potato patch which had been neglected. No doubt hundreds, if not thousands of similar cases have occurred throughout the country in the course of the past season. A timely use of the Paris-green would have gone far to save the crop in such cases. But where the potatoes have become worthless, either from necessity or neglect, there is but one resort left to procure any return from the land, and that is to plow it up in season to raise some one of the rapidly maturing crops, such as buckwheat, turnips, or Hungarian grass.

The great objection to the use of Paris-green is its virulently poisonous nature, which renders it liable to injure seriously and

even fatally, both the plants and the operator. With regard to i injury to the plants, I believe it can always be sufficiently obvi ted by largely diluting the poison with flour or ashes. The form is preferred, because if applied when the plants are wet with ra or dew, it makes a paste which prevents the poison from bein blown from the vines. Experiments would seem to show that th poison is about equally effective upon the insects, whether dilute with five, ten, fifteen, or even twenty times its bulk of flour. An the more it can be diluted without destroying its efficacy, the les injurious, of course, it will be to the vines, and the more widel it can be diffused at the same expense.

Considering the extremely poisonous nature of this substance and the very considerable extent to which it has been used, it i remarkable that, so far as I am aware at least, no case of deat from its use as an insect-destroyer is on record. The only proba ble exception to this statement that has come to my knowledg was in the case of a child four years old, in my own neighborhood who, together with a still younger brother, was taken suddenly sick with very suspicious symptoms, after playing amongst some potato vines near the house, to which Paris-green had been applied These children were taken with griping, and vomiting, and purg ing of green colored matter, and in a week from the time of the attack, the older one died. This case was, to say the least, of so very suspicious a character, that it made me much more careful in using and recommending this poison, and I immediately pub lished a caution in some of the papers against the use of it in any place to which children would be likely to resort.

With regard to to the method of applying this substance, there is no simpler and more effectual way than to shake it from a gauze bag tied to the end of a stick, the operator always taking the pre caution to stand so that the wind shall not blow the powder to wards him.

The remarkable success which has attended the use of the Paris green for the destruction of the Potato-bug, has very naturally raised the query whether this poison would not be an equally ef fective remedy against other noxious insects, and a good many interesting experiments have been performed to test this question. Experience shows, what we indeed should suspect, that this poison is speedily fatal to all foliage-eating insects, but not to those which

live by suction. As these introduce their beak into the substance of the plant, or its fruit, and imbibe the juices, they avoid the poison which lies upon the surface. And as respects the former class, the use of the Paris-green will have to be limited to those insects which subsist upon low or herbaceous plants, as its application to trees would evidently be inconvenient, expensive and dangerous. There are at least three of our worst insect pests for which the Paris-green has been successfully used. These are the Colorado Potato-bug, the several kinds of Blister-beetles (*Lyttæ*), which are sometimes almost equally destructive to the potato, and the small, striped Cucumber-beetle (*Diabrotica vittata*), which, if not properly counteracted, often renders the cultivation of cucumbers and melons an impossibility. One of the most satisfactory reports that I have met with on this branch of the subject, is in a paper read by Mr. Barler before the Alton Horticultural Society. He applied the Paris-green mixed with four parts of flour, by means of a sifter tied to the end of a long pole, to fifteen acres of melon plants. "Absolutely every bug disappeared within twelve hours after they were dusted." I have sought for opportunities to submit this use of Paris-green to additional tests, the past season, but have not been able to find enough of these insects to serve the purposes of experiment; and Mr. Parker Earle informed me that the same scarcity of them has been noticed in the southern part of the State, and Mr. Galusha bore the same testimony respecting them in the more central section where he resides. This, at first sight, would seem to be the more remarkable, as the past hot and dry summer would have been favorable to their multiplication; but it is not improbable that the excessive rains of the preceding year may have proved destructive to them at the propagating season.

The fear often expressed that the poisonous qualities of Paris-green will be communicated to the potatoes, may be safely dismissed as unfounded. The article has been in use long enough to have developed any such danger if it existed.

Upon the whole the Paris-green, if properly used, may be considered to be an almost infallible remedy against the Colorado Potato beetle, and many other leaf-eating insects. Any harm from its use, either to the plants or the operator, can be obviated by observing the following rules:

1. Always dilute the poison with at least ten times its bulk of flour.

2. Apply it to the plants when wet with rain or dew.

3. Never entrust its use to young or careless persons.

4. Never use it near the house where young children resort.

5. Apply it with a gauze bag or some other sifter, attached to the end of a pole.

6. Let the operator always keep upon the side from which the wind is blowing.

7. Do not apply it to any plant where it will come in contact with the fruit.

Before closing this article I wish to call the attention of agriculturists to the practicability of substituting arsenious acid, or the white powdered arsenic of commerce, for the Paris-green, for the destruction of noxious insects. The simple arsenic is a lighter substance than Paris-green, that is more bulky for the same weight, and would, therefore, go farther, pound for pound; its white color would render the extent of its application more easily visible on the green foliage, and its cost is less than one-quarter of that of Paris-green, the wholesale price of the latter being about forty cents a pound, whilst the price of arsenic is only about eight cents. If, as is generally supposed, the efficacy of Paris-green in destroying insect life depends wholly upon the arsenic in its composition, there seems to be no reason why the simpler and cheaper article should not be substituted for it. This matter was brought to my notice by an intelligent druggist, but too late in the season to put it to the test of actual experience, and I would here call attention to it as a matter well worthy of future consideration and experiment.

It is proper to add here, that with regard to this whole matter of using violent poisons to destroy insects, some judicious persons take strong ground against it; arguing that if the use of such dangerous substances becomes common, they will almost unavoidably fall into the hands of some young and careless persons, and that some valuable lives will be lost. The argument is a weighty one, and shows the necessity of great caution in the use of such articles, if not their total abandonment. It is my desire, in this report, to state, as far as possible, all the known facts bearing upon the case, and then leave it to the judgment of each one to determine for himself whether to use them or not.

INSECTS INJURIOUS TO THE ROSE.

THE ROSE-SLUG.

(*Selandria Rosæ*, Harris.)

Order of HYMENOPTERA. Family of TENTHREDINIDÆ.

Harris's Treatise, p. 525.

Few things are more distressing to a person of taste and refinement than the blasted and ruined aspect which the rose bushes, almost everywhere, have, for many years past, presented. In traveling through various parts of the State, in the course of the past summer, I have seen many gardens upon which much labor and money had been expended, rendered unsightly by the lifeless skeletons of these queenly plants, which should have been their ornament and pride. Those who suffer most from this sad spectacle are the women, who being naturally more refined than men, are, in the same proportion, greater lover of flowers. Now, if by anything that I can say, I can put the fair women of the land in the way to restore their lost darlings to their pristine life and loveliness, I have no doubt that they would unhesitatingly conclude that the office of State Entomologist is a great institution, and I should not be much surprised if they should combine to pay the salary of the incumbent, as people sometimes raise monuments to the great and the good, by the universal payment of penny contributions.

Well, I believe all this can be done—I mean the roses saved, not the monument built—at a very trifling expense, and without any great amount of labor, by the general putting in practice of knowledge which has long been had by the few, and in reiterating which I therefore lay no claim to originality. All the merit I can assume is in explaining a little more fully than our writers have

usually done, the philosophy of the thing, so that we may work understandingly and therefore effectually.

The blasted appearance of the foliage of the rose bushes is the work of a little soft, green worm, scarcely noticeable without close inspection, on account of its similarity of color to that of the leaves on which it rests. This insect is generally known as the Rose slug. It is the larva of a small Hymenopterous or wasp-like insect, scientifically named the *Selandria Rosæ*.

In conversing with people upon this subject, I have found that many are acquainted with the insect, but very few know anything of those peculiarities in its habits upon which its successful treatment depends. If we only hastily examine a rose bush which is infested with these worms, we shall be very likely to fail to discover the agents of the mischief, for the reason that, like the majority of caterpillars, they are night-feeders, and conceal themselves during the day from their enemies, and from the heat of the sun, by retiring to the under side of the leaves. When we examine the damaged leaves more closely, we find that it is only the upper cuticle of the leaf that is eaten off; and yet, at the time when we usually look for them, they are upon the under side of the leaves—all of which is easily explained in accordance with their habits. They rest during the day upon the under side of the leaves, and reserve their appetites for their noctural foraging visits upon the upper surface.

It is evident from this brief statement that whatever applications are made use of for the purpose of destroying these insects, must be made in the evening after they have exposed themselves upon the upper side of the leaves. I regret that I did not take pains, at the proper season, to determine more particularly at what time in the evening they come upon the upper surface, and also at what time in the morning they retire. This, however, any one can easily determine for himself. If it should appear that these worms, or any part of them, remain in concealment until it is quite dark, as we have seen to be the case with the Fall Web-worm described in the second article of this report, then we should have to make our applications by moonlight, or by the light of a lantern, in order to be wholly successful, or successful in the shortest time.

The long known and established application for the destruction

of the Rose-slug is a solution of whale-oil soap. The first use of this cheap and effective article, now extensively used to destroy a variety of insects, was made many years ago by Mr. David Haggerston, of Watertown, Mass., as stated by Dr. Harris, in his Treatise, when speaking of the insect now under consideration. Mr. Haggerston used it of the strength of two pounds of the soap to fifteen gallons of water. The Hon. Lewis Ellsworth, proprietor of the Naperville nursery, and his son, who make the cultivation of roses a specialty, informed me that they find this article to be all sufficient for the purpose of destroying the Rose-slug in their green-houses and elsewhere, and that they do not find it necessary to use more than one pound to fifteen gallons of water. As it is a very coarse and disagreeably smelling article, it is of course desirable to use as weak a solution as can be without impairing its effect. It is applied with a water-pot or a garden syringe. The whale-oil soap being so effectual, it is not necessary to resort to other applications.

I will take this opportunity to state, however, that I have experimented with the carbolic acid about which so much has been said as an insect destroyer, by mixing, first, one ounce of the pure acid to one gallon of water, and afterwards two ounces to the gallon, and applying it to the Rose-slug and to the equally tender slug of the Pear-leaf, but with very unsatisfactory results. It appears from my diary, kept at the time, that the Rose-slugs were only driven temporarily from the leaves, but not killed, even by the stronger solution, and that the Pear-slugs having been dipped into it with the leaves to which they were attached, were found the next day feeding upon the same leaves, unharmed. It is probably more effectual in the form of carbolic acid soap, but whether this is any better than the cheaper whale-oil soap, I am unable to say, from any experience of my own.

There are two broods of these insects in a season; the first usually making their appearance early in June, and the other in August. But if the former be pretty thoroughly exterminated, there will be little to fear from the late brood.

I hope that the dissemination of this report may prove instrumental in calling attention to this subject, and in saving from utter destruction this favorite flower. If it should be permitted me, when another June calls the roses to blossom, to revisit the beau-

tiful grounds which I have this year seen robbed by the spoile
half their beauty, I should deem it a most grateful consumma
of my labors to see my fair country-women once more smi
and hopeful, embowered amidst their roses, and no longer mo
ing over their loved and lost, like Rachel, comfortless, or
Niobe, weeping.

INSECTS INJURIOUS TO THE PINE.

THE WHITE PINE LEAF-LOUSE.

(*Mytilaspis pinifoliæ*, Fitch.)

Order of HOMOPTERA. Family of COCCIDÆ.

Fitch's 1st and 2d New York Reports, page 256.

The White Pine (*Pinus Strobus* of Linnæus,) is the tallest and ıost valuable of our timber trees, and also one of the most highly alued for ornamental purposes. Unfortunately its balsamic and ungent qualities afford it no immunity from the attacks of de- tructive insects. Many distinct species and myriads of individu- ls find sustenance in its majestic trunk or on its almost innumer- ble leafets.

The species now under consideration appears in the form of ittle oblong, white, muscle-shaped scales, one-tenth of an inch in engtb, attached to the leaves, and differing but little, except in olor, from the well known scales of the Oyster-shell Bark-louse f the apple tree. The insect, indeed, though it lives upon the eaves instead of the bark, belongs to the same family and the ame genus as this last mentioned notorious species. I do not now that they infest the tree in its native forest, but they are very injurious to ornamental trees, not only to the White Pine roper, but also it would seem to a still greater extent, to the va- iety known as the Gray or Scotch Pine. They sometimes mul- iply so as to almost completely whiten the foliage, like a fine now storm. They belong to the sucking, as distinguished from he gnawing division of insects, and impoverish the leaves to a greater or less extent, by imbibing their sap. The leaves turn brown and unsightly, and in some cases the whole tree presents a sickly and decaying aspect. I have noticed that the scales with which the insect covers itself assumes a different form upon the

two varieties of pine above mentioned. On the narrow leafet the White Pine, the scale—or I should specify, for reasons whi will appear hereafter—the *female* scale, has a slender and line form, exactly corresponding to the width of the leaf on which it moulded; but on the broader leaf of the Scotch Pine, where it h space to expand, it may be supposed to assume its normal shap It here often appears almost in the form of an elongated triang with its terminal or shorter side rounded. Its generic tendenc to the muscle shape is perceptible only in one of the long sid being nearly straight and the other a little more arched.

Upon a more critical examination, these scales are seen to b composed of three parts, one behind the other, gradually increa ing in size, and thus marking the successive stages of the insect growth. Mr. Walsh designated these parts, respectively, as th larval scale, the medial scale, and the anal sack. The Frenc authors call the large terminal portion the buckler or shield, b to avoid unnecessary changes I shall, in the present article, ado Mr. Walsh's names. Besides, the term anal sack expresses mo accurately the composition of this part, it being turned under its edges so as to inclose the insect and its eggs. But this inferi lamina is very thin, and being adherent to the surface of the le it is necessarily ruptured in raising the scale.

The larval scale is of a pale, transparent amber color, and flattened, oval form, slightly elevated or carinated along the mi dle, with transverse furrows on each side, indicating imperfect that division into rings or segments which characterizes all th annulose animals. The larval scale, as its name implies, is ev dently the moulted skin or envelope of the insect in its primitiv or larval state. In retreating from it, the insect leaves all i members attached to it.

The small, and scarcely more than rudimental legs, and th slender anal filaments become obliterated and indistinguishab as soon as the larva is fixed; but the antennæ remain and ca generally be seen attached to the anterior extremity of the sca after the lapse of a year, and after the insect beneath has passe through all the phases of its existence.

In leaving its larval envelope, the insect retreats a little upo the leaf, and at the same time becomes clothed with a new integ ment, closely resembling the former, but a tint darker colored

more opaque, with the segmental divisions less sharply defined, and about four times as large; that is, about twice as long and twice as broad, indicating the corresponding growth of the insect. This is the medial scale. It is, in reality, the second larval skin, and though in the course of a very short time, not exceeding a day or two, the insect beneath becomes detached from it, as it did from the first envelope, yet there is a short period when it is evidently a part of the insect itself, and cannot be detached from it without violence.

As soon as the medial scale is formed, there begins to appear from under its posterior edge, a white membraneous border, which is the commencement of the anal sack. This increases rapidly day by day, so that in from two to three weeks from the time the insect hatched from the egg, the growth of the whole scale is completed. The anal sack, when fully formed, is more than four times as large as both the former scales combined, by which I mean, as in the former case, not four times as long, but more than twice as long, and considerably more than twice as broad. It is of a pure milk-white color, beautifully contrasting with the amber colored larval and medial scales, and rendering this a really elegant little insect, notwithstanding its pernicious habits and its opprobrious name.

If we raise the scale at any time during the growth of the anal sack, we find the soft, wrinkled, memberless body of the insect itself, apparently wholly detached from the scales above, and at once suggesting the question, in what manner and from what source is the growth of the anal sack accomplished. Upon carefully examining the insect, however, with a strong magnifier, a number of fine silken threads can be detected projecting from its sides and posterior extremity, which were ruptured in the act of raising the scale, and which formed the connecting tissue between the insect and the scale above. It must be by means of these filaments that the anal sack is constructed. What strikes us as remarkable is, that so comparatively large and rapid a growth can take place through such sparse and attenuated media. We see, from this account, that the anal sack is very different in its nature from the two preceding envelopes, and never, like them, strictly constitutes a part of the insect itself.

Perhaps a correct idea of the nature of the several envelopes with which these anomalous insects are invested, may be obtained by tracing the analogy which exists between them and the successive integuments of the higher insects, more especially the caterpillars or larvæ of the nocturnal Lepidoptera. The larval and medial scales may be considered as analagous to the first and second skins of the caterpillar before and after the first moult, the most important difference between the two successive envelopes being the increase of size, in order to accommodate the insects' growth. The anal sack exhibits a remarkable analogy to the cocoon in which the caterpillar subsequently incloses itself. Neither is strictly a part of the insect, but is constructed by it solely as a means of protection. Both are constructed from silken threads secreted by the insect, with this difference: that the caterpillar constructs its cocoon with a single thread, secreted through a spinaret near the mouth, whilst the *Coccus* forms the anal sack from a number of threads produced from pores in the posterior part of its body. The analogy seems to fail in that the caterpillar leaves its cocoon upon arriving at maturity and before depositing the germs of its future progeny, whilst the *Coccus* lays her eggs beneath, or more strictly speaking, within the anal sack. But even here the analogy is maintained by certain exceptional moths, one of which, the Tussock-moth (*Orgyia encostigma*), never wholly deserts her cocoon, but lays her eggs upon the outside of it; and another, the Basket-worm moth (*Thyridopteryx ephemeræformis*, preserves the analogy still more completely by actually depositing her eggs within her cocoon.

Such is the view which I have been led to adopt, after an almost daily examination of the development of these insects duing the past summer, of the nature and formation of these scales and their component parts. The whole subject is, at first sight, abstruse and difficult, and entomologists have held a diversity of opinions concerning it. Drs. Harris and Fitch, probably from not having traced the insect through all its stages, thought that the whole scale was the dried remains of the mother insect. Dr. Shimer supposed that all the parts of the scale were the results of successive moultings, and adopted the gratuitous notion that they are cemented together by the animal's excrement; and Mr. Walsh,

whilst he corrected the errors of his predecessors, failed himself to detect the radical difference in the nature of the anal sack as compared with the larval and medial scales.

We have thus far spoken only of the female insects and their scales, but in addition to these we find upon the leaves about an equal number of a much smaller scale, being only one-half as long and scarcely half as broad; straight, linear, and carinated. This is the scale of the male insect. It is found, upon examination, to be composed of only two of the corresponding parts of the female scale, namely, the larval scale and the anal sack, the medial scale, and that stage of growth indicated by it, being absent. Accordingly it attains its growth in a shorter period than that of the female, requiring only about ten days for its completion. The male of this species is deserving of special interest, from the fact that this sex, in the more widely known Bark-louse of the apple tree, has never been discovered. From the similarity of the two species in all their important characters, so far as they are known, it is reasonable to assume that the male of the *Aspidiotus* (or as it is now called, *Mytilaspis*) *conchiformis*, if it ever be discovered, will be found to resemble, in all essential characters, the male of the Mytilaspis of the Pine.

The first sight that I obtained of this interesting insect was on the 19th of August, when, upon raising a number of the small linear scales, I detected under one of them a male individual, in a condition analagous to the pupa state, with its rudimental limbs lying flatly upon its sides, and with a short, obtuse, and but half developed style projecting from its anal extremity. On the 23d of the same month, I saw a fully developed specimen after it had emerged from its cocoon-like scale, and for two weeks following this, any number of them could be obtained by inclosing the infested leaves in a closed bottle.

It will be borne in mind that the minute larvæ of this very anomalous tribe of insects, enjoy but a very brief period of active life; that they move about over the adjacent leaves and twigs for a time, rarely exceeding two or three days from the time they leave the egg, and then fix themselves immovably. At this incipient stage of their existence the two sexes cannot be distinguished from each other. But as soon as they become fixed and begin to

develop the scales which cover them, they can be distinguished at a glance by the characteristic differences in their respective scales which we have described above. The female never afterwards leaves the scale, but attaches herself to the surface, on which she rests by means of a slender, hair-like proboscis or sucker, which we have particularly described in a former article when speaking of the Apple-tree species. She increases in size in proportion as she enlarges her protecting shield, and presents the appearance of a soft, wrinkled, footless, and apparently almost lifeless grub. She, however, fulfills, infallibly, if she be not interrupted, the few but paramount laws of her being, attains her normal development, in due time becomes impregnated, and shortly after deposits her eggs and perishes. With such unerring certainty does nature conduct her operations, in her lower walks, where she reigns supreme.

Fixed immovable to the surface on which she reposes, and hidden from view beneath the shadow of her vaulted carapace, but dimly conscious, we may presume, of some unfilled requirement of her being, the helpless female *Coccus* awaits the addresses of her unknown and invisible paramour. Nor does she wait in vain. Of all the countless myriads of these lowly creatures which congregate upon the bark of the apple tree, or whiten with their spotless phylacteries the foliage of the pine, not one, so far as we know, fails to be called to enact the offices of maternity. Nature, in the universality of her providence, takes them in her charge and ministers to their necessities, and no unloved or unfruitful virgin is permitted to languish in the halls of the *Coccidæ*.

At the same time that I was making my observations upon this insect, my friend, Mr. C. V. Riley of St. Louis, succeeded also in obtaining the perfected and hitherto unknown male of this species. The engraving at the head of this article, is the one prepared by Mr. Riley from his specimens, with a copy of which he had the kindness to furnish me.

The following is a description of the male of this species.

Length, one quarter of a line, or about one fiftieth of an inch. Color, pale red. Antennæ as long as the body, ten jointed, counting as two the stout, basal, indistinctly bi-articulated joint; the other joints elongate, somewhat equal, except the last which is a little more than half as long as the preceding, each joint with a number of bristles more than half its own length. Eyes prominent, black, with comparatively few facets. The three segments of the thorax well developed. Meso-thorax somewhat elevated above.

he pro-thorax. Scutellum large, sub-quadrate. Last segment of the abdomen abruptly narrowed and terminating in a straight awl-shaped style, as long as the abdomen. Wings two, large, lying flat upon the abdomen, and one over-lapping the other in repose, extending more than half their length beyond the tip of the abdomen; two veins, a sub-costal vein, parallel with the costa, and extending upwards of two-thirds the length of the wing, and emitting a branch near the base which runs somewhat parallel with the posterior margin, and extends more than half the length of the wing. Behind the wings are two poisers, somewhat like those of Dipterous insects, but furnished at their extremity with a slender hook-like appendage.

Middle and posterior legs approximate, situated far back and remote from the anterior pair. Tibiæ and tarsi bristly. Tarsi one-jointed but with two slight contractions which indicate three normal joints consolidated into one. The tarsi terminate in a bristle-like claw; and in addition to this are four flexible finger-like processes or digituli slightly enlarged at their tips.

We have thus far said nothing of the times of hatching of these insects, nor of their peculiar distribution upon the foliage, upon the understanding of which their practical treatment will depend.

Unlike the Bark louse of the apple tree, this species produces two broods in a year, and the periods of their hatching are not sharply defined, both of which circumstances will enhance the difficulty of reaching them effectively with destructive applications.

One brood, like the single brood of the Apple-species, passes the winter in the egg state, safely protected under the maternal scale. These eggs, unlike the white eggs, of the *M. conchiformis*, but similar to those of the Harris's Bark-louse of the apple-tree, and some other species, are of a blood-red color. Their number averages considerably less than those of the *M. conchiformis*. These latter, when in good condition, range all the way from forty to sixty and sometimes more, whilst those of the Pine species, so far as I have observed, do not exceed half the number. Of a considerable number of scales which I have this day examined (Nov. 15th), the number of eggs under each varied from twenty to thirty, a good average being twenty five.

I did not commence my observations early enough to determine the precise time in the Spring when this winter clutch of eggs hatch, but it must be quite early, since by the fourth of July they have completed their development and have begun to lay their eggs for the second brood, and by the middle of July the work of deposition is completed. It is proper to remark here that the past Summer has been excessively hot and dry, and probably the dates here given may range somewhat earlier than in ordinary years. We know that the eggs of the Apple-tree Bark-

louse hatched this year at least ten days earlier than usual. But all years are sufficiently hot in mid-summer, and all the stages of these insects are accomplished with great rapidity. By the 30th of July many of the eggs of this second brood had hatched, and by the end of the first week of August about half of the eggs under each scale had hatched, and the young had fixed themselves upon the nearest leaflets, many of them settling upon the same leaflet on which they were hatched.

And now began to be apparent one of the most remarkable peculiarities in the history of these singular insects. Up to this period—about the seventh of August—nearly or quite all the eggs that had hatched, and which appeared to have been that portion of them which had been first deposited, and which consequently lay farthest from the insect's body and nearest the end of the scale, had produced only male insects, clearly indicated by the development of the small linear scales. After this period, as the remaining eggs gradually hatched, a sprinkling of the broader female scales began to appear; a few mingling with the male scales upon the same leaflet on which they had hatched, or the leaflets next adjacent, but the most of them migrating outwards upon the young or terminal whorl of leaves, on which no male insect was to be seen. And here remark the wonderful instinct displayed by these creatures, which are usually considered as occupying almost the lowest rank in the insect scale. The males which will remain attached to the leaf but a short time, and which will soon acquire wings with which to transport themselves whithersoever they desire, attach themselves indifferently upon the first vacant space they can find, whilst the females, whose power of locomotion is limited to the first two or three days of their existence, improve this transient period to spread out upon the terminal foliage where they will find a fresh supply of nutriment, and in this way each succeeding generation comes into existence where it will find the easiest access to the youngest and freshest foliage. Amongst the many wonderful provisional instincts of insects, this is by no means the least remarkable. But wonderful and beautiful as all this is, so far as the insects are concerned, it is precisely that course of procedure which is most fatal to the tree. The eggs which produce females, and which, as we have seen, do not begin to hatch till about two weeks later

than the males, continue to hatch in a very gradual manner, some unhatched eggs being found under the scales all through the month of August, and as late as the middle of September, at which time I found a considerable number of scales, with from two to six unhatched eggs. But before the close of this month, the females from the eggs first hatched have completed their development, and have begun to deposit their eggs for the next Spring's brood. So that there is an almost continuous brood of these insects throughout these two months. I cannot perceive what is gained in the economy of this insect by this protracted hatching of the Summer brood—since the product of this brood all hybernate in the egg state—unless it be to baffle the opposition of mankind. For if they had this end expressly in view, they could not pursue a more effectual course, since it follows that at whatever time we make our applications for the purpose of destroying them, some of them will elude our assaults. If we make our applications early, the unhatched eggs will be safe beneath the maternal scale. If we make them later, those first hatched will have found protection under the scales of their own formation. The unsatisfactory results of my own experiments go to confirm this view.

On the 6th of August, that is at about the close of the hatching of the male-producing eggs, I applied to two branches of a badly infested tree, a wash, composed of common fish brine, diluted at the rate of one pint to two gallons of water, and to two other branches, the same wash, but of double the strength. Again, on the 23d of August, after the greater proportion of female producing eggs had hatched, I applied to other branches, soap-suds of the strength of one gill of soft soap to a gallon of water. I also wet a branch with water and dusted it thoroughly with unleached ashes.

Upon examining the leaves upon these several branches, late in the Fall, I could not perceive much difference in the result of the different experiments. Upon all of them could be seen, still adherent, the dead and discolored remains of a considerable number of small individuals whose development had been arrested whilst in the incipient larval state, and also a larger number which had attained their normal growth, the washes having failed to reach them for the reasons above stated. It did not appear that any of

these applications had injured the foliage much, if at all; there being some uncertainty upon the subject, from the fact that the leaves upon most of these branches had been more or less discolored by the depredations of the insects. At any rate it was evident that the resinous leaves of the Pine will bear stronger applications with impunity, than the foliage of the Apple and other common fruit trees.

The practical conclusion is, that owing to the double-brooded character of this species, and the protracted manner in which the eggs are hatched, no single application of any remedial substance will suffice, as it does in the case of the common Bark-louse of the Apple-tree. These applications will have to be made at two different seasons of the year in order to reach both broods. I have not learned at what precise time the Spring brood hatches, but any one can determine this for himself by examining them from time to time with a simple pocket lens; probably sometime in the month of May. The second brood will require attention, to simplify the matter as much as possible, once a week through the month of August.

If soap-suds be used, I would suggest making it, if practicable, of the coarse whale-oil soap, which is known to be more destructive to some species of insects than the common kind. Perhaps throwing air-slacked lime into the trees when the dew is on, would prove equally or more effectual. The way to apply washes to a tree is by means of a garden syringe, which is merely a large syringe made expressly for such purposes, by having the end perforated with many small holes, so as to throw the liquid in the form of a fine shower.

The difficulties which I have just pointed out as lying in the way of any effective counteraction of the depredations of these insects, on our own part, renders it doubly interesting and important to determine what prospect there may be of their being exterminated, or effectually held in check by the operation of natural agencies. My own observations upon this branch of the subject have been very limited in extent, but highly interesting so far as they have gone.

First, with regard to the parasitic *Chalcididæ*, I have seen in a few of the scales the round clean-cut holes made by these insects, and under others I have found the oval, pellucid larva, exactly

resembling that found under the scales upon the apple tree. It is evident, therefore, that the *Pine coccus* is subject to the attacks of some species of Chalcis fly, though apparently not as yet to any great extent.

Of the shrunken and abortive eggs, so common under the scales on the apple tree, and which are supposed to be the work of *Acari*, I have met with no well marked examples in the present species.

The most effective agent in the destruction of the *Pine coccus*, so far as my observations have extended, is the one which appeared to be the least so in the case of Oyster shell species, namely, the *Coccinellidæ* and their larvæ. I have seen whole branches covered with the scales of the *Coccus*, where scarcely one could be found that had not been gnawed into and its occupant destroyed by these predaceous insects. Most of this destruction is effected by them in their larva state, and as these, being wingless, do not move very rapidly from one part of a tree to another, it is often observable that one branch will be nearly cleaned by them whilst an adjoining one will be scarcely touched. The species of *Coccinella* which I have usually seen on the pine tree is the *Chilocorus bivulnerus*, the small black species with two red dots.

The *Coccus* of the Pine-tree has long been known to be injurious to trees cultivated for ornamental purposes, a brief account of it having been published by Dr. Fitch, as long ago as the year 1856, from specimens sent to him from trees growing in the yard of S. Francis, Esq., in the city of Springfield, in this State; and I saw, last summer, many valuable ornamental trees in that city almost ruined by what we may presume to be the lineal descendants of those identical Pine-tree parasites, and as little or nothing has been done to counteract their ravages, the only reason we know why they have not spread more extensively, and effected still greater mischief, is that they have been held in partial check by such natural enemies as those which we have just enumerated.

The present article has grown under my pen beyond the limits I contemplated, but I have not seemed to be able to state in any briefer manner the history of my observations respecting the interesting insect which is the subject of it. Besides I consider the history of one species, thoroughly elucidated, of greater value than many brief and imperfect sketches; for this reason especially, that every insect may be taken to a certain extent as a type of its ge-

nus and family, and to this extent, the history of one is the history of all.

In treating of the two species of *Coccidæ* included in this report the *Mytilaspis conchiformis*, and the *M. pinifoliæ*, I have intended to dwell more fully upon those points in their common structure and history in the one article, which I have touched upon the more lightly in the other, so that the two articles combined, and both taken in connection with the results of the labors of my predecessors in the same field of investigation, might present a comprehensive view of the subject, not perfect indeed, but somewhat approximating to completeness.

I have mentioned, a few pages back, the wonderful instincts of the *Coccus* of the Pine, which prompts the female insects to improve the short period of their active existence, to migrate outwards upon the terminal foliage, where they and the generation succeeding them will find themselves in the midst of the greenest and freshest forage, whilst the males which are to acquire wings, and the consequent power of locomotion, fix themselves indifferently upon the first vacant space that offers; thus indicating a kind of prophetic vision utterly beyond any reach of intelligence which we can reasonably attribute to beings so low in the scale of creation. The student of entomology is continually meeting with instances of this kind, which arrest his attention and excite his wonder, and which baffle his utmost ingenuity to explain.

Permit me, by way of conclusion, to refer briefly to a few of these instances, not merely as marvellous stories, intended to excite the curiosity of children, but as remarkable facts in nature, fraught, it may be, with a profound significance.

It is the common instinct of insects which are wood-borers in their larva state, but which have no such power in their subsequent stages, to gnaw their way to the surface of the tree before they stop feeding, so that they can emerge without obstruction after they shall have completed their transformations.

The Plum-gouger (*Anthronomus prunicida*), whose history was so carefully traced by my predecessor, Mr. Walsh, and which in its larval period occupies not the flesh but the kernel of the plum, when it has completed its growth and is ready to transform in the kernel, takes the precaution to gnaw a round hole in the shell, through which it may subsequently emerge. If it did

not do so it would be fatally imprisoned, in its future beetle state, within the mature and hardened shell, an event which the Gouger carefully guards against, though the horticulturist might regard it as a consummation devoutly to be wished.

The Dissipus-butterfly (*Nymphalis disippus*, Gdt.) an interesting account of which is given by Mr. Riley, in the first volume of the American Entomologist, lives in its caterpillar state, on different kinds of willow. In this state it passes the winter, inclosed in a willow leaf, rolled into a cylindrical case. But as the leaf would fall like the rest, when touched by frost, or be blown away by the wind, the insect fastens its footstalk with silken threads to the branch on which it grows, and thus securely rides through the frosts and storms of winter.

The larvæ of a beautiful East Indian butterfly, the *Thecla Isocrates*, live in companies of half-a-dozen or more, in the fruit of the pomegranate, and there also pass the pupa state. But before changing to chrysalids, each larva cuts a round hole in the rind, through which the future butterfly, which itself has no teeth, but only a slender flexible proboscis, may be able to escape, and as the worm-eaten fruit would be likely to fall prematurely to the ground the larvæ crawl out and make the stem fast to the tree with their web and then return and go through their transformations.

Those moths whose larvæ or caterpillars are leaf eaters, always lay their eggs upon that kind of plant or tree upon which it is the nature of their future progeny to subsist, though they have no other relation to the tree, and though the eggs do not usually hatch till after the death of the parent, and sometimes not till the following year.

Many kinds of wasps exhibit a wonderful provisional instinct. The female wasp burrows into the ground or sometimes into rotten wood, constructs a cell at the bottom of the cavity and there deposits her eggs. She then carries in insects which may serve as food for her future progeny. Some species take the additional precaution to disable but not kill the insects thus provided, so that her young may find themselves provided with fresh provisions. Having completed her task she closes the hole, and never again re-visits it, but shortly after perishes.

Now are we to understand that these insects are really endowed with a prophetic vision? Do they know what will be their own

condition the next month or the next year, or what will be th
future necessities of their offspring which perhaps are yet unborn
We are hardly prepared to attribute to them such superhuman in
telligence. If they do not know, then what is it that prompt
them to take such wise and far-reaching precautions? Who wil
answer? I ask the question, but I shall hear no response, fo
there is no earthly intelligence which can solve the mystery.

I can conceive of the formation of a planet, by the condensatio
of nebulous matter, in obedience to the law of gravitation. I ca
form some idea, however unsatisfactory, of the development of o
ganic bodies by the operation of physical laws, responsive to th
impressions of surrounding circumstances. But that an insec
which was born yesterday, and which will die to-morrow, can
without the invocation of a wisdom superiors to her own, adopt
systematic course of conduct having for its object the safety an
welfare of her future progeny, which will not spring into activ
existence till long after she herself shall have perished,—this, i
passes the bounds of my imagination to conceive.

It is said that Galen was converted from Atheism by the con
templation of the human skeleton; but I confess that nothing ha
so strongly impressed upon my own mind the presence of an all
pervading intelligence in nature, as the wonderful prophetic in
stincts of insects.