U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF ENTOMOLOGY.
BULLETIN NO. 4.

# REPORTS

OF

# OBSERVATIONS AND EXPERIMENTS

IN

# THE PRACTICAL WORK OF THE DIVISION,

MADE

UNDER THE DIRECTION OF THE ENTOMOLOGIST,

TOGETHER WITH

# EXTRACTS FROM CORRESPONDENCE ON MISCELLANEOUS INSECTS.

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## LETTER OF SUBMITTAL.

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DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
*Washington, D. C., January* 8, 1884.

SIR: I have the honor to submit for publication Bulletin No. 4, from this Division, prepared under your instructions.

Respectfully,

C. V. RILEY,
*Entomologist.*

Hon. GEO. B. LORING,
*Commissioner of Agriculture.*

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# INTRODUCTION.

This Bulletin contains a report by Mr. John B. Smith of his summer's observations upon insects injurious to the Cranberry in New Jersey and Massachusetts and to the Hop-vine in parts of New York; some notes by Mr. Lawrence Bruner of observations on the Rocky Mountain Locust and other insects in the Northwest in 1883; a preliminary report by Mr. John C. Branner on the results of his journey to Brazil as an agent of this Division, in connection with Mr. Albert Koebele, to study insects injurious to Cotton, to the Orange, and to Sugar-cane; and a report by Mr. Joseph Voyle on the effects of cold on Scale-insects. It concludes with extracts from the correspondence of the Division, including unpublished reports on experiments in the cultivation of Pyrethrum in different parts of the United States.

The damage to cranberry vines by insects, always severe, has been increasing of late years; yet our knowledge of the life-habits of the species concerned in the damage has been quite fragmentary. Beyond a few notes by Glover and Packard, and a short article by Dr. J. H. Brakeley, little has been published. I have long felt the need of more accurate knowledge of the insect drawbacks to cranberry culture and the best means of avoiding them, and Mr. John B. Smith, of Brooklyn, N. Y., was, therefore, specially charged with investigating them the past summer. His report will greatly help to a final and complete knowledge of the subject. Mr. Smith was also charged with the investigation of the insects injurious to the Hop-vine, and his report thereon is an important contribution to our knowledge of a subject that has so far received but little attention.

Mr. Bruner, with one assistant, explored, during the past summer, that section of the West between Central New Mexico and Idaho, following up the Rocky and the Big Horn ranges. On account of sickness he was unable to fully follow the latter part of the route mapped out for him, but succeeded in examining much territory that had previously not been examined. The chief object of the trip was to ascertain the status of the Rocky Mountain Locust, and, incidentally, to study the insects affecting the chief crops of the plains and mountain regions. As already indicated in my annual report, the results justify the conclusion that there will be comparative immunity from the ravages of the Rocky Mountain Locust in the trans-Mississippi country during the present year, 1884.

Mr. Branner's report is preliminary to a more extended one, but gives a definite idea of what work was accomplished during the Brazilian trip, and, with the statement of his instructions, will indicate the objects of the trip and the important bearing of the information on the work of the Division.

Mr. Voyle, in his report, gives the results of experiments by which he has determined the amount of cold which Scale-insects can bear, thus settling a point which has long been in dispute among orange-growers.

C. V. R.

## REPORT UPON CRANBERRY AND HOP INSECTS.

By John B. Smith.

Sir: Herewith I transmit my report on cranberry and hop insects, to the study or which, under your direction, I devoted the past summer. The notes with which you furnished me, and the aid and information given me during the summer in several difficult matters, materially lightened the work, and enabled me to report more fully than would have been otherwise possible. The damage done to both cranberries and hops this season was great—greater than it had been for years past—and fully justified your selection of these plants as requiring special investigation. For the determination of larvæ which I failed to raise to maturity, and for the notes on the insects raised from larvæ sent you, I desire also to express my thanks.

Respectfully submitted,

JOHN B. SMITH.

Prof. C. V. Riley,
*United States Entomologist.*

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### *CRANBERRY INSECTS.*

To ascertain the history of these insects, I visited some of the cranberry bogs of New Jersey, and some of the Cape Cod bogs. At Cape Cod, Hyannis was the center of my investigations, and thence I visited the bogs at Harwich and vicinity, and Cotuit and vicinity. To Mr. George J. Miller, at Hyannis, I am indebted for information as to the location of the larger bogs, and as to the persons best able to aid me; to Captain Ames, at Cotuit, and Captain Cahoon, at Harwich, I am indebted for much information; while to all others, growers and those interested in the cranberry culture, I owe thanks for uniform courtesy and ready assistance. My researches in the New Jersey district were principally carried on in the vicinity of Hornerstown and Prospertown, and most largely on the Lahaway plantations, where Dr. J. H. Brakeley, himself no mean entomologist, and a very careful observer, gave me all assistance in his power, aided me in my experiments, and placed at my disposal his house and all his bogs. To him and to Mr. J. T. Brakeley I would express my sincere thanks for their courtesy. A diary kept by Dr. Brakeley, recording the first appearance of the insects in the various stages, the times of greatest plenty and the number of broods, together with the experiments looking toward their destruction and their success or non-success, proved of great service to me, as I knew thus, at least approximately, what I had to expect. The insect enemies of the cranberry are not alike in New Jersey and Cape Cod in all respects. The

"Fire Worm" (*Anchylopera vacciniana* Pack.) and the "Berry Worm" they have in common, and these are the most generally destructive insects. The most important of these is—

## THE VINE WORM OR FIRE WORM.

(*Anchylopera vacciniana* Pack.)

This insect, the "Vine Worm," of Massachusetts, and "Fire Worm" of New Jersey, is in its perfect state a moth or miller, expanding less than half an inch, of a dark ash color, the fore wings being paler, dusted with brown and reddish scales, with white, narrow bands on the costa, alternating with broader, yellowish-brown bands, five of which are distinctly larger than the others; from four of them irregular, indistinct lines or bands cross the wing; the first is situated just beyond the inner third of the wing and is sometimes entirely and often partially obsolete, the portion nearest to the inner margin being usually distinct, while toward the costa it becomes obsolete. The second line is the largest and is distinctly bent once near the middle of the wing; the angle is rather darker than the rest of the band. The third line is oblique and becomes faint and sometimes obsolete before reaching the inner angle, and is forked on the costa. The fourth line is short, apical and diffuse. The apex of the wing is dark-brown and is acute and somewhat produced, while the margin below is somewhat excised. The secondaries are uniformly dark or smoky brown.

There are two broods of this insect; the first appears early in June and continues throughout the month, and the second appears the middle of July and continues to the middle of August. Stragglers are found from the end of May to the end of August, or even later.

The larva, when full grown, is slightly less than half an inch in length, of a rather dark-green color with a black, corneous head and collar; it is rather slender, very sparsely hairy, the hair being placed on small tubercles, and the head is not narrower than the middle of the body. The chrysalis is slender, the body being contracted at the base of the abdomen, on the rings of which are dorsal rows of spines.

On May 22, I visited Dr. Brakeley's bog, and obtained some larvæ about half grown from a small space which had not been flowed during the winter; May 23 one of the larvæ began to spin a slight cocoon, closed at both ends; May 25 it changed to a chrysalis, three-eighths of an inch in length and of a reddish-yellow color. June 2 the imago appeared.

At the time of my first visit to Dr. Brakeley's bog the water had not yet been entirely withdrawn, though the higher portions had been dry for nearly ten days. In those places where the water had just receded I found a large number of eggs of this insect. The egg is about 0.25$^{mm}$ in diameter, of a waxy-yellow color, very flat or lentil-shaped, and closely attached to the leaf; in fact, it most nearly resembled a fly-speck. Further up, where the water had been off some time, I found young

larvæ, and even where the water had scarcely receded, larvæ evidently two or three days old were found. Close search revealed the fact that many of the larvæ had hatched beneath the surface of the water, and had perished from want of air. A majority of the eggs found contained fully developed but dead larvæ, while in many cases the larva had hatched and had lived for a day or two between the upper and lower surfaces of the leaf, before dying of lack of air. This first brood, as a rule, feeds for a day or two, or even longer, between the surfaces of the leaf, then climbs to the tip and spins up the terminal leaves, but does not usually eat off the tip so as to prevent further growth of the plant. As the plant develops, the more tender leaves only are attacked, and either the upper or under surface of the leaf is eaten. The larva never eats entirely through the leaf, but to the center only, and often only a few bites from different parts of the leaf. This first brood, as a rule, does no great damage, even though very numerous, because the larvæ feed very largely on the old leaves, and become full-grown just about the time that the vines begin to grow vigorously. About the 10th of June, or before, the moths of this brood appear in force. While I had seen that the larvæ were very numerous, I was yet perfectly astonished at the vast number of imagines I found flying in the dusk, for an hour and a half before darkness set in. At other hours of the day they can scarcely be induced to rise, but at this time they rise in swarms and fly and hover very much after the fashion of the mosquito.

The duration of the life of the moth appears to be about five or six days, and their eggs may be found everywhere; scarcely a spray escapes, and I have found as many as fourteen on a single spray and four on a single leaf. By the 15th of June the moths were most plentiful, but they continued more or less abundantly throughout the season. About the beginning of July the second brood of larvæ appears, vastly more numerous than the first; its power to do damage is very greatly enhanced, and a difference in habit and more opportunity for destruction render it still more dangerous. The cranberries blossom just about the time when the second lot of larvæ begin to hatch, and the young larvæ immediately attack the blossom or young berry, eating just enough to destroy vitality, and then attacking another blossom. When the berries and blossoms are either all destroyed, or the berries have fairly set, the larvæ no longer trouble them, but attack the leaves; and now they are not content to spin up only the tips and touch only what they eat, but, instead, they web up all the leaves of a spray and take a bite here, another there, and a third elsewhere, until they have destroyed every leaf on the spray. Where the vines are thick, two or even three sprays are spun together by a single larva which, by nipping from all the leaves, will destroy every one: the leaves lose vitality and turn brown rapidly, and the bog looks brown and dry "as though a fire had swept over it." Not leaves only, but berries also, are thus spun up and killed in like manner. Nor does it take the larvæ long to do their work. Dr.

Brakeley, well as he knew the enemy, was caught napping; on one bog he noticed the larvæ, but apparently not in force or doing any damage; busy with other bogs, he saw this, three days after, almost entirely eaten up. Senator Emsen, on a Saturday, noticed the larvæ on a 40-acre bog; he decided to attend to them in a few days, but three or four days thereafter the larvæ had destroyed the entire bog and were beyond being attended to.

The larvæ, when full grown, do not pupate in their habitations, but drop to the ground and spin up in any rubbish at hand. The end of July and the beginning of August bring the second brood of moths, and until the middle of September they can be found on the bogs. By that time the eggs are all laid, the last straggler disappears, and the vines begin to recover; and by the end of September, except for the absence of berries, there is little to show the amount of damage suffered by the bog. But the new crop is provided for; everywhere upon the leaves are the small yellow eggs, innocent enough in appearance, but these quietly maintain their vitality throughout the winter, under water, ready to awaken to life and mischief in the early spring. During the past season this insect has been unusually plentiful; everywhere on all the bogs visited by me they had done damage, some places more, some places less. They usually appear in one spot in a bog in small numbers—a stray moth or two having found their way to it—attract no particular attention until suddenly their progeny will devour the entire bog year after year. Occasionally they disappear as suddenly as they appear. One bog not far from Cotuit had never yielded a crop; year after year this insect had destroyed it, until the owner had almost despaired. This season he had made the most extensive arrangements to fight it—was prepared at all points to do battle, and calmly awaited its coming—but in vain; scarcely a larva was to be found on the entire bog, and on August 9, when I saw it, the vines were full of berries and everything pointed to a large crop.

## REMEDIES.

An insect so destructive as this has, of course, been the subject of many experiments looking to its destruction, but they have been usually unsuccessful in the main end in view, viz., saving the crop, and this not because of any fault of the remedy, but simply because it was not applied at the right time. I made experiments with several insecticides, and ascertained what had been used by others, and was in most cases able to discover the cause of failure. The remedy recommended by Packard, and after him by Mrs. Treat and Mr. Saunders, is flowing the bog and letting it remain under water for two or three days. Unfortunately the vast majority of bogs require a week or more to flow them and half that time to run dry again, while many bogs could not be flowed at all in the summer. Nor could a bog be safely flowed at any time after the buds had formed and the blossoms had appeared; the result would be a de-

struction not only of the insects but of all hope of a crop as well. After the berries have fully formed, the bog cannot safely be submerged, for the hot sun would cause them to "scald." In one case in Cape Cod during a heavy rain-storm a bog was partially flowed; the sun came out strong before the water could be all drawn off; nearly half the berries were scalded. Yet the water can be advantageously used in two ways. Where there is an abundant supply it should be drawn off very early, say the middle of April or even earlier if the season is advanced. In parts of a bog not submerged, larvæ were found in considerable numbers on the 16th of April, and of these the imagines emerged June 2, or thereabouts.

Careful watch should be kept for the appearance of the larvæ, and when they are abundant and presumably all hatched, the water should be put on for twenty-four hours or longer. No harm will be done by allowing the larvæ to feed a few days before putting on the water, as they have only the old leaves, and do not eat off the terminal bud. Flowing a second time at this season will do no harm, as the sun is not hot enough to hurt the vines or the new shoots if they have appeared. The period of time required for the larvæ to hatch, varies with the temperature of the air, and with the temperature of the water with which they had been covered. This course has been tried by several growers with complete success. The larvæ are of course not all destroyed, but so few survive that no great damage is done, and they can be treated as hereafter described. Mr. Hopkins, of Hornerstown, reflowed his bog late in June or early in July for the second brood. I am informed that scarcely had the water covered the vines than the larvæ began appearing at the surface; it is their habit whenever their habitation is disturbed to slip out of the same and drop to the ground; the water was a disturbing element, and following their usual practice they found themselves afloat. Only a part of the bog could be flowed, and when the water was drawn off, a line of dead larvæ was heaped on the side toward which the wind had carried them. The weather was favorable, and there was no scald, but still a large portion of the berries were destroyed. On July 10, I examined the bog and could easily trace the line to which the water had reached. Scarcely a larva was found in the flowed portion, while the high parts to which the water had not reached were rapidly being eaten up. Last season, as I am informed, the insects being plentiful, the bog was entirely flowed; the insects were destroyed, but so was the crop. With a level bog and a large supply of water, a bog could be safely flowed for forty-eight hours at any time except when flowering, if a cool spell be selected for that purpose.

Where water is scarce and the bog cannot be readily flowed, another course must be pursued. Instead of drawing the water early, it should be kept on as late as possible, and should be drawn off very gradually *from below*. The reason for that is that the water becoming warm will cause the development of the larva in the egg, and will then suffocate

the larva as soon as it breaks the shell, or, indeed, in the egg. As the surface water is always warmest, it should be retained as long as possible and the cooler water drawn off from beneath. This can be easily done by building a second gate, not reaching to the bottom, outside the main gate, at a distance of about one foot from it. The water will rush in from below, rise to the level of the inside gate, and overflow without materially disturbing the surface water. This plan has been pursued by Dr. Brakeley, and on his bogs I had a chance to test it. May 22, the water had been about half drawn off, it having reached a temperature of 80° two inches from the surface. On that day I examined for eggs and larvæ in various portions of the bog. Where the water had not touched, the larvæ were abundant and half grown; where the water had covered, but had been off a week, no larvæ were found, and but few perfect eggs; while, on the contrary, many eggs in which were fully developed and defunct larvæ were found. Still there were eggs enough left to furnish a very respectable lot of larvæ, as will hereafter appear. Going down close to the water line many eggs were found largely containing fully developed but dead larvæ, but some also living; a few instances were seen where the larva had hatched beneath the water, had lived and eaten between the surfaces of the leaf for a day or two, and had then succumbed. One instance was noted where the larva was yet alive, and in the cavity in the leaf. This use of the water is not of course as successful as the first plan suggested, for while it destroys a large number of insects in embryo, a large number escape, owing to the difficulty of raising the water on an unequal bog to a sufficiently high temperature. Many bogs have 10 to 12 feet of water at the gates, and the vines at the edges scarcely covered; of course the deeper parts of the bog will not be warmed for a long enough time to force the development of the larvæ beneath the water far enough to destroy them, and many will thus escape. On a level bog, where the water covers the vines but a few inches, there is much greater hope of complete success.

On June 6, I again visited the bogs, and for several days experimented with insecticides. I found on those portions of the bog which had not been flowed full-grown larvæ, some pupæ, and a few imagos; on the portions which had been flowed, larvæ in all stages of growth; and on the portion first laid dry, some pupæ. The dates here given refer to the appearance and development of the insect on one particular bog only; the dates vary according to circumstances on other bogs.

*White hellebore* had been used by Dr. Brakeley in previous seasons with good success, and as soon as the larvæ became dangerous he turned his attention to them. On the part not flowed larvæ were abundant in May, and they were given a dose of hellebore; to ascertain what effect it had I covered a space of about three square feet, and this was thereafter not dosed.

The hellebore was applied in the form of powder, with a bellows con-

taining a receiver attachment, as explained in the annexed figure, *a* being the receiver in which the hellebore is placed from above, *b* the tin nozzle into which it drops through the narrow aperture at the bottom, and *c* the mouth of bellows. When examined in June the protected space was completely stripped of leaves, while the portion treated to hellebore, though badly damaged, showed the benefit of the treatment. To ascertain the effect of hellebore on the larvæ I placed several in a box of which the bottom had been dusted with hellebore. At first they paid no more attention to it than to so much dust; in ten minutes, after a continuous travel through the stuff, they began picking up particles with their mandibles; in twenty minutes they were very uneasy, and gradually became paralyzed, but were alive for more than an hour afterward. Ultimately the larvæ all died. The experiment was carried on in the open air. As to its effect when applied on the bog: It was applied twice on a portion of the bog where the larvæ were unusually abundant, and each time it seemed to reduce the number of larvæ, and undoubtedly did prevent their eating as much as they otherwise would have done, yet in the very spots where it had been thus freely used the moths appeared a few days later (June 11) by thousands. This was the result wherever it was used; it undoubtedly did much good, but I believe less by killing the larvæ than by forcing them to leave their poisoned quarters to seek food on the lower parts of the vine where they could do less harm. A drawback in applying this and other insecticides is that it is necessary to force it into the habitations of the insect, which is a difficult matter; moreover it is much more difficult to reach the second brood than the first, because the first spins up at the start only a leaf or two at the extreme tip, and must soon come out for food: the second brood, on the contrary, when it does begin to spin gathers up two or three sprays—enough for three insects—and so need not at any time come within reach of the poison, no matter how liberally applied outside its habitation. I am satisfied that not only contact with but the actual eating of white hellebore is requisite to destroy the insect. I consider hellebore valuable, but not the most valuable insecticide.

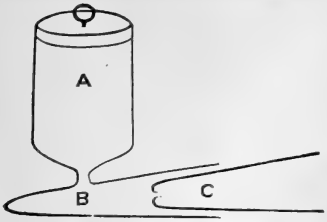

Fig. 1.—Powder bellows.

*Bisulphide of Carbon.*—Mr. Havens, of Prospertown, used a preparation said to be of this poison and handed me some to experiment with, but without giving me any further information as to the nature of the preparation, which was in the form of a brownish powder; it was tried on several larvæ, as in the case of the hellebore, and proved rather more active, but having the same general effect. I believe it to be open to the same objection there is to hellebore.*

* This could not have been the bisulphide of carbon.—C. V. R.

*Copperas.*—This poison is recommended as a certain cure by Senator Emsen, and he shows his faith in it by using it himself and recommending it to all others; but all experiments so far tried have failed to demonstrate its value as an insecticide—this insect of course in view. Dr. Brakeley has given it a thorough trial, and deems it valueless, and others give similar testimony. Decisive of the matter is the testimony of Mr. Emsen's secretary and manager. This gentleman informed me that he had transplanted some vines in a large jar, had placed therein a number of larvæ and so thoroughly soaked the whole with a solution of copperas that the leaves turned black; in a few days the larvæ had devoured everything, and were still perfectly healthy and ravenous.

*Tobacco.*—This is the favorite Cape Cod remedy, and the testimony gathered there is all in its favor. The tobacco is steeped in boiling water in the proportion of 1½ pounds to a gallon, and sprinkled on the vines, a gallon to a rod. The testimony of all who have so used it is to the effect that it kills the larvæ *wherever it reaches them*, but they find it somewhat difficult to reach them. There is a gentleman in Dennis, on the Cape, who makes somewhat of a business of preparing the decoction, and he claims that it is infallible. I was unfortunate in reaching Dennis at camp-meeting time, and did not succeed in finding this gentleman. Refuse tobacco of all sorts is used.

*Paris green.*—This poison has been used in a few instances that I know of, and probably in a quiet way to a considerable extent on the Cape. In New Jersey its use has been confined to a few, but wherever it has been used it has been a decided success. I have seen bogs on which it was used, parts only having been treated with it, and the difference in the appearance of the vines was striking: where it had been used the vines were green and flourishing, while elsewhere they were dry, unsightly, spun up and defoliated. It has been used stirred in water, a large tablespoonful to a pail of water, sprinkled on with a broom, and mixed with plaster, or rye flour. The latter is the preferable way. On Cape Cod the solution is preferred, in New Jersey the dry mixture is more favored. One grower mixed 3 pounds Paris green with 200 pounds cheap rye flour and scattered it broadcast while the dew was on the vines; it formed a slight paste and adhered everywhere; soon after not a larva was found on the part so treated. The advantage of this poison over all others is that it does not lose by exposure to the air as do all those previously mentioned: its disadvantage is that, applied when the berries have become fully formed, it sticks to them so closely that the gentleman referred to found the berries picked off the poisoned sections all more or less coated with the poisoned paste, which had dried on so closely that a heavy rain had not washed it off. Yet this poison may be safely applied early in the season to combat the first brood, before the berries have formed.

*Pyrethrum, or Persian Insect Powder.*—With this I have made a number of experiments: first as to its killing power. A few grains were

dusted on the bottom of box and several larvæ were introduced. In seeking to escape, all came in contact with a few particles: the effect was seen in half a minute; the larva began to squirm and to eject a greenish fluid from its mouth; in three minutes it was paralyzed; in fifteen minutes quite dead. Tried in a solution, one-quarter pound to 2 gallons of water, a single small drop produced a like effect, and this apparently irrespective of the spot where it touched the larva. Applied on the bog its effect was less satisfactory; the difficulty of reaching the larva in its hiding place was great and the powder lost power very rapidly: still a great decrease in the number of larvæ was noted. I tried it both in solution and putting on the powder pure. Later, Dr. Brakeley continued the experiments during my absence; the powder was thoroughly mixed with two and one-half times its bulk of cheap rye flour and applied with the bellows on a few rods of bog; at first no effect was perceptible, but two weeks thereafter the limits of the patch to which pyrethrum had been applied were distinctly traceable; where it had been used the vines were bright and fresh and were sending up vigorous shoots, while the surrounding space was all eaten up. The same mixture was tried on two larvæ which were placed in a vessel dusted with it. In a short time they became nervous, began a vigorous battle, and in a few minutes succumbed, though they did not die for some time thereafter.

*Carbolic acid.*—With this I made a few experiments which proved eminently unsatisfactory, killing the plants when strong enough to hurt the insects, and becoming harmless to insects and plants at about the same point. Squibb's solution, containing 1 per cent. of the crude phenols in water, was used as a base.

*Kerosene.*—With this the most extensive experiments were made, as it seemed to me best calculated to reach the insects; the vines are not easily affected by it, and it is penetrating enough to soak through a leaf or two and reach the insect in its hiding place. A number of experiments were tried to test its killing power. An imperfect emulsion of 2 parts kerosene to 1 part of milk was first used and diluted with 20 parts of water; a small drop was applied to a number of larvae; the effect was instantaneous; the larvæ seemed paralyzed at once, though they did not die for some time. A number of sprays of which the leaves at the tip were turned and spun up by larvæ were gathered, and a drop of the mixture was applied at the tip; the oil penetrated at once through every part of the leaves touched, and came into contact with the larva immediately, paralyzing it at once so that it could not leave the head, or, in some cases, it attempted to escape and was disabled before getting out. An emulsion of 2 parts kerosene to 1 part milk was made, mixed with 16 parts of water to one of the emulsion, and applied to the vines with a Lewis syringe. In the evening they were examined and a number of dead larvæ were found; traces of the oil could be everywhere seen, and where a drop had fairly struck a tip the larva was dead; for three

days dead larvæ were found (June 7 to 11), but thereafter no further effects were observed. Afterward the mixture was applied on a larger scale by Dr. Brakeley to the second brood, but with less success, because the amount of kerosene reaching the vines was insufficient to penetrate through the numerous shields of leaves protecting the larva, and so a large proportion escaped; another attempt, using but 10 parts of water to one of the emulsion, succeeded better and did not injure the vines. Mr. Bullock, of Prospertown, tried the mixture, 1 part emulsion to 10 of water, and says that it destroyed the larvæ; but while it did no injury to the vines it seemed to check the growth of the berries; I am informed that they eventually ripened but were undersized. No such effects followed the use of a 1 to 15 mixture used under my direction, but it was not so effective on the larvæ. Afterward a small space was treated with a 1 to 10 mixture where the larvæ of the second brood were nearly full grown, and the result was all that could be expected; most of the larvæ were destroyed and the vines were not hurt; berries unfortunately had been previously destroyed by the insects. The effect of kerosene on the eggs was then tried; pure kerosene was first directly applied to a few, and the effect was to destroy the vitality of the egg at once, it becoming loosened at the edges and flattening toward the center. The emulsion, diluted with 16 parts of water, was then applied to about two rods where eggs were numerous; for a few days thereafter eggs decreased in number, and no imagines were found on the spot; at the end of four days, however, the spot was as much frequented as ever by the moths, and eggs became more numerous; I then waited until the moths had nearly disappeared (August 20–23) and again applied kerosene to another spot of 4 or 5 rods, applying slightly more than a gallon to a rod and making the mixture 1 to 10. As the moths had not all disappeared and I was desirous of making my results exact, I marked a number of sprays and counted the eggs, marking only sprays containing a number (4–14), and setting close to them a stick marked with the number of eggs on the spray. The marked plants were treated precisely as was the balance of the patch, and the next day I examined the result; in a few instances the total number of eggs on the spray had increased, but fully 30 per cent. of the number marked on each spray had lost vitality, flattening out and whitening at the edges; next day nearly all had succumbed and the marked sprays were carried off to watch further developments; the leaves touched by the kerosene were easily distinguished, and in each case every egg on every leaf which had been touched by the kerosene first became depressed in the center, then loosened and white around the edges, and finally dried up, leaving only a small, glistening spot on the leaf; on leaves which the emulsion had not touched the eggs underwent no change whatever. Early in October (5th to 7th) I again examined the space treated; the vines had all recovered from the damage done by the larvæ and were promising well for

next season, and the most careful examination discovered but a very few eggs.

RECOMMENDATIONS.

Despite the success attending the use of some of the above insecticides, the damage done by the larva of this insect this season was immense—much more extensive in New Jersey than on Cape Cod, but sufficiently great even there. One of Dr. Brakeley's bogs, which for a fair crop should produce 1,500 bushels and has yielded 2,000, yielded this year less than 200 bushels; one 40-acre bog was almost entirely eaten up, and bogs of excellent vines, which easily produce 200 bushels to the acre, this season yielded but 40 to 50 bushels; only a few bogs were exempt, and the damage done amounted to many thousands of dollars. Many of the growers are becoming disheartened because, though they kill millions of larvæ, yet they still lose their crops. The difficulty is not with the means employed but with the *time* at which they are applied; *the greatest damage is done by the second brood of larvæ in the first two or three days of their life*, because then, before spinning up leaves, they eat into the buds, flowers, and young berries, a single larva in one day sometimes destroying two or three berries or blossoms and being then of a size so small as to be scarcely perceived; their appearance is noted when they begin to spin up the leaves and vines, and war is waged against them, but it is then too late, the greatest damage is done, and growers wonder why so few berries set. To be successful in saving a crop the war *must* be vigorously carried on against the first brood and against the imagines resulting therefrom. From the observations made and recorded above, and having followed Dr. Brakeley's efforts pretty closely during the past year, as well as from the experiences of others reported to me, I advise the following course as most likely to be successful:

The water, if used as first proposed, *i. e.*, reflowing when the larvæ begin to appear, will afford a nearly complete remedy, but even then the surviving members of the first brood must be attacked, for a single female produces from 20 to 25 eggs, and a few hundred escaped larvæ form the nucleus of a destructive second brood. Where the water cannot be so used, it should be held very late, and drawn off gradually, the object being to raise it to as high a temperature as possible, in order to hasten the development of the larva and destroy it in embryo. When the water is off, the vines should be daily examined, so as to note the first appearance of the larva; the time will vary according to the temperature of the air, as well as that of the water which had covered them. In from three to ten days the larvæ will be all hatched; at first they will burrow in the leaf, and then ascend to the tip, and their presence can then be readily noted by the fact that the under side of the leaves can be seen; the top will be found drawn together, and the larva inside; a little experience will enable any one to tell at a glance; as be-

fore stated, they do little injury now, and the danger seems small. One gentleman informed me that there were only a few larvæ on his bog, and he was rather sorry, as there were not enough to experiment with; I visited his bog a day or two afterward and found larvæ pretty evenly distributed over the bog, but doing no great damage. Some time afterward they had all disappeared, and the gentleman was jubilant. He was correct; they had gone—into the pupa state. The moths emerged, and in due time the second brood of larvæ. I did not thereafter hear any complaint of lack of insects to experiment with.

To return. It is at this time that they must be attacked, and best of all with kerosene; this will penetrate through and saturate the leaves, and, if liberally and carefully applied, will kill by far the greater part of the larvæ. The kerosene emulsion should be made with two parts kerosene to one part sour milk, and churned with a force pump; the "aquapult" or "Lewis" will answer. If the milk is heated and the vessel containing the kerosene warmed, ten or twelve minutes, and sometimes less, of churning will suffice to complete the emulsifying process, and the result will be a soft butter which will mix perfectly with water; it should be dissolved with a small amount of water, and then any desired quantity may be added; the most effective proportion for this insect at this stage is ten parts of water to one part of the emulsion. This will not hurt the vines, and should be applied thoroughly, with a syringe or a pump with a sprinkler attachment, if possible. A second application a week later might be advisable to reach any larvæ that had afterwards hatched or previously escaped. If the water has been drawn off gradually the larvæ will continue to hatch for as many days as the water occupied in receding, and the same number of days is gained in combating them.

Another plan would be not to await the hatching of the larvæ, but immediately after drawing the water and ascertaining the presence of living eggs, to apply Paris green mixed with cheap rye flour, while the vines are wet with dew or rain, and thus poison the food the young larvæ will be compelled to subsist on. No danger of poisoning the berries is to be apprehended at this stage, but perhaps the former plan is as certain in results; it is entirely without danger, and therefore preferable. A few larvæ will probably escape and pass into the chrysalis state, which they do usually on the ground among the rubbish. It is now necessary to watch for the first appearance of the moths, and as fast as they appear they should be caught with hand-nets; the time will be between the 1st and 15th of June, usually about the 10th. I noticed that the first moths that emerged were males; three evenings I caught specimens, and all were males. Dr. Brakeley had been in the habit of using a rather cumbrous machine mounted on wheels to catch the moths, and the first evening of using this all that I examined of the captures were males. On June 9 I found the first female, and found the same evening male and female *in coitu*. The female I dissected, and found the eggs still immature; later I caught and confined several females, and in all

cases they proved to be impregnated, but none laid eggs until the second day, and on examining the vines it was not until four days after the moths first appeared that I succeeded in finding an egg. There are, therefore, certainly two or three days during which, if the moths can be caught, they may be prevented from laying eggs. There was a space of a few rods on one of Dr. Brakeley's bogs on which the moths appeared very abundantly. At first, with the moth-catcher used by him, and which it required two men at least to manage, several hundred were caught in an evening, but so many escaped that I suggested large hand-nets; these were made about 14 inches in diameter, of mosquito-netting doubled, and with handles about six feet in length; three men were armed and sent to the infested place, and each caught several thousand—estimate.

There is only an hour and a half or two hours just before dark when this method can be employed, for during the day the moths do not rise; but just before and during the twilight they are easily disturbed and will readily rise, flying low and slowly, and hovering very much like mosquitos, which, by the by, often made their presence among them unpleasantly prominent. Walking slowly over the bog, hundreds of them are disturbed and rise up before one, and by sweeping with the net from side to side, and just over the vines, the great majority of them can be caught. Two or three evenings will suffice to clear as large a spot as there is force to get over, and if the retreat of the water has been gradual the moths will appear in most abundance a day or two apart at different points, and time to combat them will be gained. It must be borne in mind that every female destroyed in time lessens the second brood by 20 to 25, and may save just that number of berries.

The moths of this brood disappear in about eight days, though stragglers remain much later, and where the water has been gradually withdrawn, as recommended, the broods may lap. After the moths entirely disappear the vines should be closely examined for eggs; if they are found abundant, and the vines are not in blossom or the buds fully formed, a heavy dose of kerosene should be applied, which will destroy most of the eggs. If the buds are fully formed or the vines have begun to blossom it is not advisable to apply kerosene, as it may retard the development or injure the buds or blossoms. If all these measures have been *carefully* taken the second brood will be very light, and will do very little damage, even if not further disturbed; but the fight should not be abandoned here; watch closely for the first appearance of the second brood, which will probably be simultaneous with the blossoming of the vines. As already stated, the insect lives for a few days exposed, eating buds, blossoms, and young berries; its work can be noted by prematurely brown, dried-up blossoms, and the insect should now be attacked either by pyrethrum or Paris green, preferably the former. If pyrethrum be used it should be mixed with two and a half times its weight of poor flour, allowed to stand twenty-four hours in a close vessel, and liberally applied when the vines are dry. It is now compara-

tively easy to reach the larva, and nothing acts more rapidly and certainly than pyrethrum. If Paris green be used it should be used in solution and applied with a pump or syringe with sprinkler attachment; the "aquapult" is excellent for that purpose, and the "Whitman" answers every demand. Two or even three applications may be necessary to follow up the constantly hatching worms, but the result will repay for the labor expended. Should, by some combination of misfortunes, all these methods have proved vain, and the insect be still in force, I would recommend repeated heavy doses of the kerosene mixture (1 to 10), which will destroy them, though it may somewhat damage the crop; should, after all, moths appear in any number it would be good policy, after picking, and a few days before putting on the water, to apply kerosene to the vines for the purpose of destroying the eggs.

It may be objected that all this requires a great deal of labor and considerable expense; true as to the former, for it requires constant vigilance and the prompt application of the remedies from the time the water is first drawn to the time when it is again put on, yet if the work is carefully and conscientiously done early in the season, little indeed will remain to be done after the first brood has passed away, because it is utterly impossible that many can survive so vigorous a campaign as that I have mapped out; and as to expense, a dollar an acre will pay for the kerosene mixture. Paris green costs but a trifle, and but a very small quantity is required, while pyrethrum costs 25 to 30 cents per pound at wholesale, and can be mixed with two and a half or three times its bulk of cheap rye flour. Nor will it be necessary to carry on so vigorous a campaign for many years, as the insects will become so scarce that it will require only a very small expenditure of time and money to keep them in thorough subjection, while the increased crops will repay all labor or expense incurred.

I have given no place to tobacco or hellebore in the above campaign, because they are more expensive and, in my opinion, less effective than the preparations above recommended.

One more method I find in my notes as having been successfully tried, easy and simple enough in appearance, but which I hesitate to recommend, because I did not myself see it used, *i. e.*, simply with a kitchen broom to sweep off the tops of the vines. It is gravely asserted that this has been done, and a bog thereby cleared of larvæ; that there were no larvæ on the bog I can certify, because I saw it. Whether there ever were any, or whether the sweeping destroyed them, I will not venture to say; I leave it to be tried by others.

## TERAS OXYCOCCANA* Pack.

This insect is not found at all in Massachusetts, so far as I have been able to ascertain, but is abundant everywhere in New Jersey. The species is rather interesting and anomalous in that it has two very distinct forms—a gray winter form and a yellow summer form. This

* *Tortrix vacciniivorana* Pack.; *T. malivorana* Le B.; *T. cinderella* Riley.

dimorphism is unusual in the family, and though some time since recorded by Professor Riley, has not been accepted by Professor Fernald. Dr. Brakeley had several years ago reached that conclusion. The gray moth is called by Packard "the Glistening cranberry moth," and described as follows:

> The body is of a dark slate color, and the palpi, which are large and project well beyond the head, are of the same color, with a few bright reddish scales at the end of the second joint. The tuft of hair on the abdomen is much paler than the rest of the body, and of the same color as the legs and the hind wings, being of a glistening gray color. The fore wings are of a uniform reddish brown color, with a peculiar glistening or greasy hue. The red tint is due to scattered, bright red scales. There are no other spots or markings on the wing, and the fringe is mottled with red and gray scales as on the wings. On the hind wings the fringe is long, silky, glossy, grayish white. Beneath, the fore wings are pale gray, the hind wings being paler than the fore wings. Length of the body 0.25, expanse of the wing 0.64 of an inch. It may be readily known by the peculiar, shining, greasy look, and by the rich red scales scattered over the plain, unadorned fore wings.

Dr. Packard records his specimen as having been found in October, and the description shows it to have been a fresh specimen, and judging from the size, probably a female. Of those collected by me, the females are, as a rule, considerably larger than the males, though there are large males and small females. After a few days the moths largely lose their red scales, which rub off very easily, and they appear then of a uniform gray slate color.

These insects, emerging from the chrysalis in October—in my experience, on the 9th and after—pass the winter in this stage, seeking shelter in crevices, outhouses, and rubbish heaps. Dr. Brakeley informs me that he has often seen them in his cranberry house, and on bright, sunny days in winter flying at the edge of woods. In the spring, about the middle of April and to the first of May, they deposit their eggs and disappear. After the beginning of May they are rarely seen. By the 15th of May, or a few days before, the eggs hatch and the larva commences its career precisely as does the *Anchylopera*, except that it does not first burrow into the leaf. Some collected by me changed to pupæ May 24, and transformed into moths June 4; these moths were smaller in size than the gray specimens and entirely different in color, being yellow, with ochreous mottlings, but no distinct markings on the fore wings, and silky white on the hind wings and body. On fresh specimens the ochreous or reddish scales are dense, and give the insect a deeper color; flown specimens lack these scales and appear uniformly yellow. The sexes do not differ in size, and none expand more, and many less than 0.5 inches. None of these insects showed the slightest tendency to the slate-colored form. The second brood of larvæ appears toward the end of June or early in July, and has precisely the same blossom- and berry-eating habit as the *Anchylopera*; in fact, I found that the berry-eating larvæ were mostly those of this species. They continue this until nearly half grown, and then spin up sprays and leaves,

as does the *Anchylopera*. Toward the end of July the larvæ pupate, either in their habitations or on a leaf close by—never on the ground. The second brood of moths emerges in August (18th to 23d), and the moths of this also are uniformly yellow; one specimen only which I found had the hind wings and body dusky, but this escaped through the meshes of my net while I was examining it. These moths oviposit in the early part of September and produce larvæ about the 12th. The chrysalis is formed late in September or the first of October, and the moths emerge about the 9th or a little later. This brood of moths is uniformly gray. I did not meet with a single exception, and that it is the result of the eggs laid by the yellow form I am perfectly positive, for not only were there no gray moths on the bog to produce them, but I watched the yellow forms oviposit, obtained some eggs from females in confinement, and sent them to Washington to be reared, and Professor Riley informs me that gray individuals were obtained from them.* The moths continued to emerge and were flying on the bog when the water was put on.

The egg of this species is precisely like that of the *Anchylopera* in form and color, but is very slightly larger; it is laid on the under side of a leaf, as in that species, and at about the same time, so that practically it is impossible to distinguish the two; the larva also much resembles that

*In the "General Index and Supplement to the nine reports on the Insects of Missouri," 1881, in speaking of *Tortrix cinderella* Riley, we remarked as follows (pp. 82–83):

"From specimens reared from cranberry-feeding larvæ received from Mr. John H. Brakeley, of Bordentown, N. J., I am satisfied that this is the same species briefly characterized by Packard in the first edition of his *Guide* (p. 334) as *Tortrix oxycoccana*, and that *T. malivorana* LeBaron (my Rep. IV, p. 47) is but a dimorphic, orange form, subsequently described by Packard as *T. vaccinivorana* (Hayden's Report of the U. S. Geol. and Geogr. Survey of the Territories, 1878, p. 522). The orange and ash-gray specimens are thus bred both from Apple and Cranberry. I have reared both forms from Cranberry and from Apple, and they are undistinguishable in the larva and pupa states. The gray form is often more or less suffused with orange scales and the orange form less frequently with gray scales. This is the most remarkable case of dimorphism with which I am familiar in the family, and points strongly to the important bearing of biological facts on a true classification. The dimorphic coloring is not sexual, but occurs in both sexes. The eggs of this species are very flat, circular, and translucent, with a diameter of 0.7$^{mm}$, and are laid singly on the under side of the leaf near the mid rib. The species belongs to the genus *Teras*, and as Packard's specific name *oxycoccana* has priority, the insect should be known as *Teras oxycoccana*, Pack. The insect, according to Mr. Brakeley, who gives an account of it in the Report of the Seventh Annual Convention of the New Jersey Cranberry Association (1879, p. 7), commonly affects, also, the high-bush whortleberry. The gray form of the moth is most frequent in autumn."

Prof. C. H. Fernald, in his "Synonymical catalogue of the described Tortricidæ of North America, north of Mexico," 1882, as stated by Mr. Smith, still retains the four insects as distinct species, and thus doubts the correctness of our conclusions. We therefore took pains to put the question to so full a test as to leave no reason for doubt. Mr. Smith's experience in the field, as above shown, is confirmatory; but from material which he sent on to Washington, we not only actually bred the orange form from the first brood of larvæ received in May and produced from the hybernating slate-colored form, but also the slate-colored form from larvæ hatched from eggs laid by the orange form. Over two hundred specimens, reared from larvæ received in August, and produced by the second brood of orange moths are all referable to the slate-colored form. In fact all the moths which issued after September 23 were of this form, though there was but a difference of five days between the issuing of the last yellow and the first gray specimens, the latter continuing to issue through October. Many of the gray specimens, especially those which first appear, are so suffused with orange or reddish scales as to appear somewhat intermediate between the two extremes, but there are none which are not at once referable to the gray form. It is in fact an interesting case of seasonal dimorphism, and how far it is influenced by temperature, future experiment, which we hope to make, will determine.—*C. V. R.*

of the *Anchylopera* in habit and general appearance; the head and neck, however, are honey-yellow instead of black; the body is of a somewhat paler green, and the larva when full-grown is larger—nearly half an inch in length. The head is nearly as wide as the first segment; and the body tapers gradually to the tail, and is furnished with fine, sparse, pale hairs arising from prominent tubercles; the four dorsal tubercles are arranged in a trapezoid with a deep crease between the anterior and posterior pair; the anterior three pairs of feet are tipped with black. On each side of the base of the head is a lateral, S-shaped, blackish-brown, linear band, the upper part of the S terminating on the top of the occiput, the line being most distinct on the side of the head. The ocelli are black. The pupa is brown, rather slender, and has the head prolonged into a large tubercle surmounted by a large, round and roughened knob; there is an angular projection on each side of the head, forming a shoulder to it. "The wing-covers reach to the end of the third abdominal ring, while the antennæ reach to the end of the second pair of feet, which are parallel to the end of the second abdominal ring. There are two rows of teeth on the upper side of the abdominal rings; they are obsolete beneath, the posterior row being indicated by two remote, minute tubercles." It is about two-fifths of an inch long. There is no appreciable difference in size between the larva of the gray or winter form and that of the summer form, but the pupa of the latter is rather smaller.

## ENEMIES.

Unlike the *Anchylopera*, which appears free from insect enemies, this insect is preyed upon by two parasites: a dipterous larva belonging to a species of Tachinid and the larva of an Ichneumonid.*

These parasites I have found in the second brood only; all my larvæ of the first and third broods completed their changes, while those of the second brood were almost all infested with parasites, and these I apprehend will do much to prevent this species from becoming as plentiful as the *Anchylopera*.

## REMEDIES.

A bog that can be completely flowed need never suffer much from this insect. All that is necessary is to keep the water on in the spring until after May 1. By that time the surviving moths will either have perished without depositing eggs at all, or they will be compelled to deposit them on the apple trees or whortleberry bushes; the latter being probably their original food before the abundance of cranberries enticed them to the bogs and led to their rapid increase. This remedy has

* None of the specimens of the Tachinid bred by Mr. Smith had the wings developed, and all were otherwise so shriveled and imperfect that determination is impossible. The Ichneumonid is *Macrocentrus delicatus* Cr., figured in our Fifth report on the insects of Missouri as parasitic on the Apple Worm (*Carpocapsa pomonella*). It is an interesting fact, as bearing on the unity of habit in the same genus, that we have likewise reared *Macrocentrus* from two other Tortricids, viz., *Grapholitha caryana* Fitch and *Tortrix paludana* Rob.—*C. V. R.*

been some time known to growers in New Jersey, and they have used the water in this way with uniform success; a few moths of the second brood find their way on the bogs, but not in sufficient numbers to do any great damage. As their habits are otherwise the same as those of the *Anchylopera*, the remedies recommended for the latter may be as well used for this insect.

The moth is attracted by light and a fire; or, better, a torch of pitch pine with a basin of tar underneath, at intervals around a bog, will attract and destroy large numbers in the early evening, soon after darkness fairly sets in.

## THE CRANBERRY SPAN WORM.

(*Cymatophora pampinaria* Gn.)

The moth expands about 1½ inches, and is of a pale ash-gray color, sprinkled with black scales; the wings are produced at the apex, and the margins are dentate, most distinctly so on the hind wings. The fore wings are crossed by two distinct black lines; the inner, one-third from base and curved inward toward the center of the wing; the outer is one-third from the margin, and is curved first toward the margin and then inwardly toward the base of the wing. There is a less distinct and somewhat diffuse line between these lines, and there is a jagged pale line between the outer black line and the margin. At the margin is a distinct, scalloped black line. The hind wings are marked in much the same way, except that the lines are straight. Beneath, the wings are of a uniform pale gray, relieved on the anterior pair by a black discal spot.

This insect, I am assured by growers, appears on the bogs twice in the course of the season, once in late June or early July, and again the latter part of August. The larvæ appear in June and again about the middle of July; when full-grown they are rather more than an inch in length, of a livid reddish gray, smooth and slender, with five pairs of legs; the anterior three pairs on the three thoracic segments, one pair on the eleventh and the other on the last segment. The head is deeply indented above, and the anal plate is long, acute, and considerably projecting. The anterior part of the first segment is darker reddish brown, and there are two dorsal rows of very fine brown spots, and a wider row of a darker color at the sides; the stigmata are deep brown.

The second brood of these caterpillars becomes full-grown early in August (8th–11th), and transforms into a short, stout, reddish-brown pupa less than half an inch in length and rather rough and punctured. The pupæ are naked and are found in the sand about an inch beneath the surface. They are said to transform into moths toward the end of August, but how they pass the winter I was not able to ascertain.

These insects are, I am informed, found upon the bogs at Cape Cod in small numbers every year, but from their color, which resembles that of a

cranberry twig, and their habit of clasping the twig with their anal legs or claspers and stretching out from it perfectly straight and motionless, they are very often overlooked, and it is not until they become very numerous that they attract attention. Usually they are checked by parasites, which prey upon them, but in some spot, almost every year, they become numerous enough to be destructive. This year it was a bog at Cotuit under the charge of Capt. S. Ames. On August 9, in his company, I visited this bog. No sooner did we come in sight of it than the space covered by the insects was seen. Elsewhere of a deep, rich green, where they were working everything was of a bare, yellow brown. Reaching the bog I found where these insects were working that absolutely every green thing had been eaten up; not a leaf, not a bud remained; even the soft terminal shoots had been eaten off and only the hard, dry twigs remained. At first I could see no larvæ, but on closer examination I found that what I had taken as bare twigs sticking out were really larvæ; a dozen of them were sometimes found on a single spray, and not a spray escaped. Captain Ames says they started from a place about a rod square, ate that all up, spread out a little, and then started in a direct line across the bog. At this time they had nearly completed their journey, and were about full-grown. Reaching what might be called the head of the army, every spray was found loaded with larvæ; yet so deceptive was their appearance that it was at first impossible to realize their vast number. A small fire was built in that portion of the bog just passed over, the wind carrying the smoke through the advance guard of the host. In a moment everything was in motion; the very plants seemed alive from the host of larvæ crawling among them. The only thing at all comparable to it which I had witnessed is the march of the army worm. Going back over the eaten portion, almost everywhere I chose to dig, pupæ were found about an inch beneath the surface. The number of moths that would be produced should these pupæ all transform would be frightful. Luckily, the larva seems subject to attacks of parasites, and while I did not myself succeed in raising these parasites, a lot of larvæ sent to the Department to be raised may have done better.

## REMEDIES.

Where these insects cover an entire bog nothing in the way of a crop can be hoped for, and the best thing that can be done is to flow the bog. Where they cover but a part of the bog, or where it cannot be flowed, Paris green should be used, preferably mixed with rye flour, and it should be liberally applied. No danger can result, because no crop can be picked off the portion attacked by them. If they are noticed when they first begin to work, and cover but a small space, kerosene prepared and used as suggested for the *Anchylopera* is preferable. Being open feeders there is no difficulty in reaching them, and the action will be rapid and certain. Instead of Paris green, pyrethrum may be used; it is

quick and certain in its action where it touches the larva, and, liberally applied, it would undoubtedly destroy the vast majority of them. Where the larvæ are scattered singly over the bog they usually escape notice entirely and do no appreciable damage.

An insect common to the Cape and New Jersey, though much more destructive on the Cape, is

## THE CRANBERRY FRUIT WORM.*

The moth producing this pest expands rather more than half an inch, has narrow fore wings, and broad, somewhat triangular, hind wings; the head is broad, the eyes large and black, and the palpi project well beyond the head. The color of the body and secondaries is a rather pale gray, with a slight metallic glisten, more pronounced on the thorax, where white metallic scales are intermixed. The fore wings are rather darker gray, with a more decided metallic luster; along the costa is a snowy white margin, most distinct and widest at the middle of the wing, narrowing and sprinkled with gray scales at the base and apex. There is a darker, transverse shade very near the base; a more distinct, darker, transverse band just inside the middle, and an oblique and less distinct shade from the apex to the inner margin, more diffuse near the middle of the wing. Above the center of the wing, at the outer third, is a rather long, paler spot, constricted at the middle, at each end of which is a blackish spot. Beneath, the wings are of a uniform glistening gray color, darker on the fore wings. The fringes on both wings are concolorous. This insect appears on the bogs late in June and early in July, with the first appearance of berries; it is shy, flies rapidly, and is not easily captured. When and where the egg is deposited is not yet known, but probably on the young berry. The young berry-worm appears as soon as the berries are well set, eats out the center only, and then migrates to another berry. The vacated berry turns red and eventually shrivels up and drops. The larva, on entering the new berry, carefully spins up the aperture made to effect an entry with a dense web of fine, white silk, so that it is sometimes difficult to see where the hole was made. In this berry it becomes half-grown, and, working out, leaves a jagged opening, and again enters a new berry; the berries are by this time well grown, and sometimes the larva reaches its full size in this third berry. The place of entry is as carefully closed as in the previous case, and soon the berry begins to show a red color, denoting to the practised eye the presence of the enemy, but to the uninitiated appearing only to be nicely ripening. Where the larva does not complete its growth in this berry, it migrates to another, this time *not* closing the port of entry. The berries are by this time nearly fully grown, and about the latter part of September or the beginning of October the worms are fully

* This is a Phycid belonging apparently to *Myelois*, but as only one poor and damaged specimen was obtained, we cannot now properly characterize it.—*C. V. R.*

grown, leave the berry, and go into the pupa state. Dr. Brakeley, who has raised the insect, and from whom I obtained a part of the above history, says that the larva pupates in the ground, and the moth emerges next spring. The larvæ appear to differ greatly in rapidity of growth, as in early August, when I examined many hundreds at Cape Cod, all sizes were represented, from the mite but a line or two in length to the nearly full-grown larva half an inch in length and completely filling the interior of the berry. The full-grown larva is half an inch or a little more in length, of a bright green color, often with a reddish tinge, most prominent on the dorsum. The head is narrower than the first segment, and is of a paler, more yellowish color, except the mouth, which is brown; the segments are transversely wrinkled, and are clothed with a few sparse and rather long hairs. As a whole, the insect is more compactly built than either of the preceding, and is of the same thickness throughout.

The damage done by this insect in the cranberry bogs of Cape Cod this season is very large. In New Jersey scarcely a specimen could be found, and nowhere was it plenty. On August 7 to 11, I visited the Cape Cod bogs. Scarcely one but was infested by this insect, and many were so badly attacked that not 20 per cent. of the berries were sound; in one bog near Hyannis, which had escaped the fire-worm, the berries on August 8 were 90 per cent. red, and apparently ready to gather: closer examination developed a berry worm in almost every berry, and there was every likelihood of the whole crop being eaten, as the worms were scarcely half-grown.

## REMEDIES.

An Ichneumon fly is said to prey on this worm, but I did not succeed in breeding it, and it cannot apparently be depended upon to keep the species within limits. I could not find that any remedies against this insect had been successfully used. Tobacco had been tried, but without success, and the same result attended the use of Paris green. Flowing has been tried, but where the water has been left on long enough to destroy the insects, it has also destroyed the berries. The fact is that it is a matter of great difficulty, if not absolute impossibility, to reach this insect in the larva state. The fact that it lives in the berry, and carefully closes up the place of entrance, excludes poisons which kill by touch or by being eaten, because the larva never comes into contact with them. Flowing is an incomplete remedy for the same reason. It is possible for the larva to remain submerged for a week or more without being in the least discommoded, and so long a submergence during August or September would infallibly ruin the crop, although it might thereby also destroy the insect. It is probable that at some portion of its career this insect can be successfully combated, but as most of my investigations this season were made in New Jersey, where this insect was not to be found, I was not able to ascertain its complete history, and can therefore suggest no remedy.

## THE BROAD-WINGED LEAF-HOPPER.

(*Amphiscepa bivittata* Say.)

This little insect, while found on every bog, does little injury. It feeds on the juices of the plant, and did it ever appear in large numbers it might become injurious. The insect is about a quarter of an inch long, and the expanded wings measure half an inch. The head is red-brown, with a greenish vertex; the thorax is of a deep brown-red; the body is yellow, and the hind wings are transparent; the fore wings are bright green, except the inner margin, which is bright carmine-red. In shape the wings are broad, semicircular, and when the insect is at rest the folded wings resemble an undersized leaf. The hind legs are formed for leaping, and the insect is very active, using its legs and wings to good advantage in its changes of locality. Should it ever become injurious, the use of hand-nets and of the kerosene emulsion would be indicated.

## THE CRANBERRY-TIP WORM.

Early in July I noticed in one small spot on a bog an occasional vine which had failed to grow, and had a bud apparently just ready to open. Examining some of these, I found the tip eaten off and the outer leaf only covering the destroyed tip; further search developed a specimen or two of a small, red, apodous grub about half a line (0.04 inch) in length, tapering toward each end, but most toward the head. The specimens were evidently weak and did not enter the pupa state. A few pupæ were afterwards found close to the base of the outer leaf of the terminal bud and in a small cavity formed for it; they were enveloped in a dense, white cocoon of silk, and from one of these the imago emerged toward the end of August, during my absence from home; from the remains, the insect seems to be a minute midge, of a clay-yellow color, with long legs and antennæ. I could find none on the bogs, and up to October 10 there were no traces of larvæ in the terminal buds of the vines. In small spots this insect was apparently quite plentiful, judging from the destroyed tips, but none of the growers seem to have noticed it, and it has evidently never been very injurious. Should it become abundant at any time, the kerosene mixture will prove a complete remedy for it.

## LOCUSTS AND CRICKETS.

Ten species of locusts and a cricket (*Gryllus neglectus* Scudd.) were found on the bogs, and evidently do considerable damage. The locusts are *Acridium alutaceum* (?) Harr., *Caloptenus bivittatus* Scudd., *Œdipoda collaris* Scudd., *Œdipoda maritima* Uhl., *Tomonotus sulphureus* Sauss., *Œdipoda æqualis* (?) Scudd., *Œdipoda eucerata* Harr., *Stenobothrus maculipennis* Scudd. var., *Caloptenus* sp. near *femur-rubrum* Deg., and *Caloptenus punctulatus* (?) Uhl.

They often grow to an enormous size compared with their usual development. They do not find their food exclusively on the bogs, but when nearly full-grown they have the habit of biting pieces out of the cranberries, which, of course, soon wither and die. They seldom eat an entire berry, but usually eat out the seeds and then leave it. The cricket has the same habit. Probably all the species of locust found in the various localities find their way on the bogs, and none live exclusively in them, for I found the same species that were common on the bog were also common in the woods and fields everywhere in the vicinity. A cheap and very effective remedy against the depredations of these insects is a flock of turkeys. Dr. Brakeley has between 50 and 100, which day by day journey to the bogs and cross and recross them in every direction, coming home each evening with crops distended to their fullest extent. The difference between his bogs and those of his neighbors, in the matter of locusts, is marked; only an occasional one will fly up before you on his bogs, while on the other bogs visited by me locusts started up everywhere by the dozen. Both pyrethrum and kerosene kill the locusts when they come into contact with them, but turkeys constitute by far the best and easiest remedy to apply.

## THE CHAIN-SPOTTED GEOMETER.

(*Zerene catenaria* Gn.)

On some bogs of Cape Cod an insect locally known as the yellow span worm sometimes becomes somewhat injurious. The parent of the larva is known as the "chain-spotted geometer," and is pure white, except for the front of the head and the shoulder tippets, which are yellow. The fore wings have a narrow, zigzag black line on the inner third of the wing, a distinct, black discal dot and a scalloped black line half-way between the discal dot and outer edge. The hind wings have a black discal dot and a single black line, often more or less broken at the outer third of the wing. It expands nearly 2 inches.

The larva is 1½ inches or more in length, equally thick throughout, of a bright sulphur-yellow color with paler and black markings. It is readily recognized and easily seen on the bogs; it is found in moderate numbers on the various bushes growing at the edge of the bogs, and appears a general feeder. The uniform testimony is that the young larvæ are never found on the bog, but when they attain the length of an inch they sometimes leave their natural food-plants and invade the bog, eating rapidly and doing considerable damage.

The remedy for this lies in prevention, and is easy: Clear the ditches surrounding your bog, have them at least two feet wide and half full of water, and cut off the brush for a few feet from the edge of the bog. The remedy is complete.

## THE RED-STRIPED CRANBERRY WORM.

In the latter part of September and early part of October I found on a bog in New Jersey a few specimens of a larva described by Dr. Packard under the above name; the specimens agree very well with his description, which is substantially as follows:

The body is long and slender, nearly three-fifths of an inch in length, slightly tapering to the head, but more decidedly toward the tail; general color pale livid green with six longitudinal, pale reddish lines, broken and irregular toward the head, but more distinct and wider toward the tail, so that the body looks darker and rather more reddish posteriorly. The head is pale yellowish with a few long hairs; the mandibles are reddish, darker at the tip. Ocelli blackish. Prothorax unusually long, nearly as long as the head, and entirely without markings; it is slightly wider than the head, but narrower than the succeeding segment. On the front edge of the second and third rings is a transverse row of six black, minute warts giving rise to a hair, and a seventh one low down in the middle of the side. On the abdominal segments there are four dorsal black warts, the two anterior nearer together than the posterior, though not forming a decided trapezoid; on the side of the ring is another black wart in line with the two anterior dorsal ones and giving rise to a rather stout hair. Around the edge of the supra-anal plate is a row of four black warts and two median, dorsal, smaller warts. Beneath, livid greenish, the three segments between the last pairs of feet with each a transverse, straight row of minute, black warts.

The habits of this caterpillar are much like those of the *Teras* and of the *Anchylopera;* like them it draws together the leaves of a spray, but unlike them it often severs the leaves and forms a complete tube of silk with an outer covering of leaves; this tube is always open at each end, and the larva, which is very active, slips out at the least disturbance. It was found on a single spot only, and in small numbers, and this spot was just the one part of the bog not flowed during the winter. At date (October 22), the larvæ have not yet pupated, while the bogs are either entirely or nearly covered with water. The remedy is indicated by the length of larval life, and it consists simply in flowing the bog as early in the fall as it can be safely done and before the larva changes to the pupa stage. The fact that I found this larva in the only part of the bog not flowed, and not elsewhere, is significant and points to the best remedy.

Some other insects have been recorded as feeding on, or in some way injurious to, the cranberries, but these are all observed by me during the past season. Some of them may be found in Massachusetts or elsewhere, on bogs that I did not get to see, but I heard no complaints of other insects from localities which I have visited, except that Mr. Makepeace, of Hyannis, Mass., who has probably the largest acreage of cranberries under his care of any one man in Massachusetts, complains of a root

worm, and of an insect eating the runners of the vines. The roots of the cranberries are exceedingly numerous and fine, and it seems scarcely possible that an insect living in the roots, as it is claimed this does, should exist and do serious injury. Captain Ames, of Cotuit, has heard of this insect, and showed me places on his bog said to be caused by it. Careful examination revealed nothing. The insect said to injure the runners leaves traces of its work, but the insect itself seems very difficult to find. A cranberry plant will send off runners in every direction; the runners send out uprights which bear the fruit; the runners lie on the surface of the ground, and when a bog is resanded, or before, take root at intervals, though sometimes a runner will maintain six or more uprights from the main root. It is the bark of these runners that is eaten off at the under side; never much, but a little bite here and another little bite there; the runner loses vitality, the uprights die, and the infested space becomes brown and dry. This gradually spreads, though as yet no very great damage has been done. I examined several of these spaces and on every one of them I found the same appearance, *i. e.*, dead vines, and on the runners a few small patches deprived of bark; this, Captain Ames says, is sufficient to destroy a vine. One or two of these barkings appearing tolerably fresh, I made a close search for insects without any success; the only living thing found was a centiped. Captain Ames says that he has seen the depredator, and he is the only one whom I could find that had. He says it is an active, brown insect with many legs and some hair-like appendages at the sides. He says he has seen them early in the season and again late in the season, but never at the time I saw him, *i. e.*, August 9. I requested him to look out for the next appearance of the insect and to send me specimens, but I have not thus far heard from him, though he promised to comply with my request. The insect has received the name of "girdle worm" among Cape Cod growers.

I have found a few other insects on the bogs, some *Hemiptera homoptera* and some *Hemiptera heteroptera*, but they are not cranberry feeders. They live on the weeds and grasses found on neglected bogs, and the more neglected a bog is, the greater the variety and number of small insects that are found on it. I have no doubt but that most of these insects do occasionally attack the cranberry, but I am equally certain that, except the mosquito, they would not be on the bog were the weeds not there.

## *HOP INSECTS.*

The hop crop this year was greatly damaged by insects, principally the Hop Aphis, ably seconded by the "Grub," and materially assisted by a number of other pests. Herkimer in early summer, Waterville later on, and then Cooperstown furnished the centers of investigation. At Athens I examined a yard that had formerly suffered much from insect attack, and the yards in the vicinity of Deansville and Oriskany Falls were visited, so that I might be able to detect local pests, should there be any unusually abundant. To Mr. Frank Cutter, editor of the *Waterville Times*, I owe thanks for the courtesy, assistance, and information afforded me; to Mr. Lawrence, manager of the Hop Extract works at Waterville, I am indebted for information and free permission to dig, delve, and otherwise amuse myself in his hop yard, and to sacrifice such numbers of vines as the necessities of the case might demand. At Herkimer, Mr. George W. Pine assisted me in making a first acquaintance with the "Grub." At Cooperstown, Mr. J. F. Clark gave me great aid in my researches on the Aphis. To Mr. Ira C. Jenks, of Deansville, I tender my thanks for aid on the same subject, and to the growers everywhere I owe gratitude for such aid and information as they were able to give me.

One of the insects most destructive to the hop vine, and which threatened at one time to entirely destroy the yards in certain districts is—

### THE HOP GRUB.

(Larva of *Hydræcia immanis* Gn.)

This insect measures from $1\frac{1}{4}$ to 2 inches in expanse of wing, is stoutly built, of a yellowish brown or rather pale rust color; the middle portion of the fore wing is darkest, and incloses two large, somewhat kidney-shaped, paler spots; the outer portion of the wing is paler; the hind wings are rather more yellowish, uniformly colored, and not so thickly covered with scales as are the fore wings.

Of this moth a few specimens appear in the fall, but the majority appear in spring, from the beginning to the end of May or later, according to the season.

The egg is deposited by the female upon the tip of the hop vine when it begins to climb, and is, as I am informed by Mr. Fees and Mr. Jenks, about the size of a pin head, globular in form, and of a yellowish-green color. The egg hatches in a few days and produces a minute, slender, greenish larva, spotted with black, which immediately burrows into the vine just below the tip, and spends a part of its life in the vine at this point.

The vine soon shows the effect of the insect's work; instead of pointing upward, embracing the pole readily and growing rapidly, the tip points downward, will not climb, and almost entirely ceases growing. This appearance is called by growers a "muffle head," and such "muffle

heads," I am informed by growers, were quite common this spring. The heads had been opened and the larva detected, but the parentage was almost universally attributed to a "green fly" mentioned, but not more nearly described in several agricultural papers. This fly, as nearly as I can make out from the description of growers, is a *Syrphus*, and probably the parent of the larva found afterward destroying the hop aphis. At any rate, it is not the parent of this "tip worm," as the insect has been called. Not all "muffle heads" are caused by this larva, however, as will be hereafter pointed out.

When the insect attains a length of about half an inch or slightly less, it leaves the tip, drops to the ground, and, entering the stem at the surface of the vine, feeds upward, interrupting the growth of the vine and lessening its vitality; the larva now changes color, and becomes a dirty white with a strong, deep reddish tint, apparently proceeding from beneath the surface of the skin, and with numerous black spots. As the vine grows, it becomes hollow and hardens, and the more rapidly as the free flow of sap is interrupted. The larva, now about an inch in length, and still slender, burrows downward to the base of the vine at its junction with the old stock, and, eating its way out, completes its growth as a subterranean worker; it is in this state that it is best and most widely known as the hop "grub," and the ravages caused by it are most noted.

The journey from the stem to the ground is made in the beginning of June, and by the 21st of June, while I found many larvæ in the ground about the roots, none were found in the stems, though traces of their work were everywhere abundant.

The larva now is mainly a sap feeder. It eats a small hole into the side of the stem just below the surface and just above the old root, and grows fat rapidly on the juices that should nourish the plant. As the sap seeks courses to enable it to reach the upper part of the vine unmolested, the grub enlarges its opening until he sometimes severs it entirely from the parent root, and the vine dies. In other cases it is left barely attached to the root, and continues a precarious existence, yielding few or no hops. Occasionally an exceptionally healthy vine will entirely recover from a serious attack of "grub." By the middle or the 20th of July the larvæ are full-grown and ready to enter the pupa state. They are now about 2 inches in length, fleshy, unwieldy, and very slow in their movements; they are of a dirty white color, speckled with fine, brownish, elevated tubercles, each furnished with a single stout hair; the head is brownish and corneous, as is also the top of the first segment.

About the 20th of July the pupa is formed in a rude cell close to the roots of the plant, upon which, during its larval existence, the insect fed. The pupa is an inch or slightly more in length, stout, cylindro-conic, and of a deep brown or blackish color. In this condition it passes the winter, though, as before remarked, a few specimens appear in the fall. Whether these latter hibernate or whether they perish, I have not been able to ascertain, though the latter seems the more likely.

This insect is not equally common in all years nor in all localities. It will sometimes be plenty and greatly damage one yard, while the closely adjoining yard is untouched. As a rule, also, the outskirts of the yards are the greatest sufferers, while the interior yards escape. The habit of the moth seems to be to lay its eggs on all available places, and often every shoot from the roots, amounting to fifteen or more, will turn out "muffle heads," and consequently useless. As many as twenty larvæ have been found in a single hill, while I myself have found thirteen specimens. Where nothing is done to check them they do considerable damage, and may, and indeed have destroyed entire yards.

## REMEDIES.

The remedies to be recommended for the destruction of these insects are simple, cheap, and efficient.

First. Cultivate skunks. They are an invaluable aid, require no pay, no care, and ask only to be let alone and not interfered with in their work. In every yard in which the grubs were common, and where there were any convenient hiding and breeding places for skunks near by, traces of their presence could be seen in the tunnel made by the sharp snout of the animal in its search for the fat larvæ; for it is not until the larva is full grown or has changed into a pupa that the skunk cares to hunt it up, but then he is a thorough worker, and where the traces of skunk were seen on a hill it was very seldom that a larva or pupa could be found. It was thus that, relying on the large numbers of young larvæ found in early spring, I found in July, when I went to gather mature forms and pupæ, that everywhere the skunks had preceded me, so that it was with some difficulty I secured a few specimens, and later, when I requested a grower to send me a few, I received answer that none could be found. Of course some will escape and transform, unless reached by some other means, and I would recommend—

Second. Search for and destruction of the pupæ in early spring. This can be done without much additional labor when grubbing and cleaning the roots. Most growers assured me, when I had described or shown them the pupa, that they had seen the same thing every spring when grubbing, but had not connected them with the "grub," and had turned them under again when re-covering the roots. Instead of re-covering, destroy each pupa seen, and keep a sharp lookout for them in turning over the earth. A little experience will render the pupa readily recognizable.

Third. Destroy them when tip-worms and in the "muffle heads." The "muffle heads" begin to appear when the vines have begun to climb, and when growers are beginning to tie. In selecting the vines to be trained on the pole be careful there are no "muffle heads," and wherever one is observed pick it off, and by compression between the fingers destroy the larva in the tip. As all the vines have to be handled in selecting, very little time will be lost in picking off infested heads, and by going through the yards carefully every second day and picking off

"muffle heads" as they appear, a yard of considerable extent can be kept clear with little trouble; the larvæ do not appear to remain in the head more than a week or ten days, and that during the time when the vines are low, the tips within plain sight and easily reached.

Fourth. If none of the preceding methods have succeeded in entirely ridding the yard of grubs, and as a matter of precaution, even if no damage from grubs is observed, it is good policy to expose the roots for a few days; but little trouble is necessary to do this, for before hilling the roots are but scarcely covered, and only enough earth to bare the junction of the growing vine with the old root need be removed. This should be done early in June, when the larvæ have left the inside of the vines. They will not eat above ground, and will take to the old roots, to which they do little or no harm. Five or six days will be a sufficiently long time to expose the roots; then apply a handful of a mixture of coal and wood ashes, or ammoniated phosphate, and hill high. Both of these substances have been used as remedies against the grub, and both successfully by some and unsuccessfully by others; the differences are unreconcilable by the fact that in neither case was it the application of the ashes or phosphates that destroyed or kept off the grub, but the treatment adopted in conjunction with these applications. If, in addition to the application of any desired fertilizer, the vines are hilled, and the hills made high, the vines will throw off rootlets above the main root and be able to derive sustenance from them, whereas when there are no hills, or the hills are low, when the grub does attack the vine it immediately deprives it of a part of the necessary sustenance and impairs its vitality. Both the ashes and phosphate are repugnant to the grub, but not deadly, and it will dare them after a few days to get at its favorite location. Figs. 2, 3, and 4 explain my meaning; the former is from a vine almost eaten off, but still flourishing, being sustained by its rootlets, much longer and more numerous than indicated in the figure, while the two latter are from vines insufficiently hilled, and which were killed by the grubs. The vine represented in Fig. 3 had been slightly bent and partially covered with earth and was attacked by three grubs in as many places.

Fig. 2.

Fig. 3.

Fig. 4.

Parasites I have not found or heard of, but the larva of a Carabid, probably *Calosoma calidum*, is known to feed on the young grubs. A

gentleman in Sangerfield informs me that he several times tried the experiment of placing a grub in the way of the larva, and each time it was set upon and immediately devoured. I found none of these larvæ at Herkimer in June, and on July 22 the grubs had mostly changed to pupæ, while the carabid larva had also disappeared. I could not find a specimen, nor could my informant, though he said they were common enough a few days previous.

In the preceding account, the young grub is said to produce the "muffle head," and this is correct; but not all "muffle heads" are produced by the grubs. My attention was called by several growers to yards where the vines were stunted, the tops imperfect; they refused to climb; the hills were called "slide downs," "foolish hills," or "blighted," and, as a rule, the damage was attributed to the "fly," a little green leaf-hopper hereafter described. Several yards showed this appearance in nearly every hill, while in most yards there were some instances of it. At the Hop Extract works there was a yard, every hill of which was "blighted," and here I carefully examined the vines from root to tip to ascertain whether the trouble was caused by insects. My conclusion is that it is not so caused, because while in some few hills I found the grub or traces of his work, most of the hills were absolutely free from all insect attack sufficient to cause this appearance. The vines are short and bushy, the heads are fuzzy, the vines become wiry, hard, and bony toward the tip, the joints are but an inch or less apart, and the leaves imperfect. The arms thrown out by the vine grow well at first, but in a short time become as bad as the main vine. No crop can be expected from such vines. I soon satisfied myself that nowhere above ground was any insect at work on the plants, and found also that the affected vines were wiry and unhealthy to the parent root, and that the parent root was entirely free from insect attack, but of a more shriveled, unhealthy appearance than in normal hills. I found, too, that this "blight" was universal in low, moist ground; that hill yards were almost entirely free from it, and where it occurred in a hill yard it was in some depression where the water could accumulate; during the spring, rains were frequent and heavy, and the ground was sodden and unfit for working for some time, and early in the season there were several frosts soon after soaking rains.

The conclusion is that the frost nipped the vines in the moist grounds while it had no effect on the hill yards where the drainage was rapid and complete. At all events, whatever be the cause of this "blight" it is *not* attributable to insects. A "muffle head" caused by the grub can be at a glance distinguished from a "blighted" vine by the long joints and otherwise healthy condition of the vine. The "blight" shortens the joints and affects all the arms of the vine, while the "grub" affects only the heads inhabited by it and does not otherwise cause any abnormal appearances.

NOTE.—I have given this insect the name *Hydræcia immanis* Gn., though on close comparison with the European *H. micacea* Esp. I can

find no difference except in size. Guenée says the larva of *micacea* is of a carneous-gray color and that it lives in sedges. Lederer says the larvæ are pale yellow, with darker tubercles and horny plate on the neck, and live when young in the stems, later on the tuberous roots of *Cacalia*. Sepp figures the larva of *micacea* as of an obscure violet, in the stems of *Rumex*. This range of variation includes the different appearances assumed by our larva in its growth, but for the present, perhaps, the species had better be retained as distinct. *H. obliqua* Harvey, is, however, undoubtedly only a local variation of *immanis;* and as hop-growing in Washington Territory, whence that insect comes, is assuming large dimensions, we may expect soon to hear complaints of damage done there by the "grub."

## THE HOP SNOUT-MOTH.

(*Hypena humuli* Harr.)

The larva of a small, obscurely colored and marked moth was found in spring, at Herkimer, in a single low-lying yard. A hill yard close by was entirely free from it, and at Waterville I found no traces of it. The caterpillar is pea-green, speckled with minute black dots giving rise to short hairs, and there are two paler whitish lines on the back and one on each side; it has 14 legs, and when walking bends up the back a little. On June 22 I found a few specimens of the larvæ; they were then about an inch in length and very active, dropping from the leaf the moment they noticed approaching disturbance and making for some place of concealment on reaching the ground. The few specimens I gathered died. On July 14, in the same yard, I saw perhaps half a dozen specimens of about the same size. They did no particular harm, eating holes in some of the lower leaves, but not to a noticeable extent. The larva when full-grown spins a thin, silken cocoon in a folded leaf or in some crevice, changes to a brown chrysalis and soon after comes forth as a moth whose wings measure about an inch or a little more when expanded. The color varies from rust to black brown; they are slightly mottled with paler markings, have an oblique paler dash at the tip, and a scalloped, more or less distinct, pale transverse line beyond the middle of the fore wings. The hind wings are dusky, without evident markings. A peculiar feature of the moth and one by which it can be easily known is the projecting snout, formed by the long, flattened palpi or mouth-feelers which are held close together and projecting horizontally forward. There are said to be two broods, but I did not succeed in finding the larva again later in the season, and to nearly all growers of whom I inquired the insect was entirely unknown. Should it become numerous it can be controlled by taking advantage of its habit of at once dropping to the ground when disturbed; by brushing with a stick up and down the vines the larva will be induced to drop to the ground where a big foot, rightly placed, will prove a complete remedy. It will not take long and need be done but once or twice.

## THE COMMA BUTTERFLY.

(*Vanessa comma* Harr.)

The larvæ of this species were quite destructive in some districts, notably about Cooperstown, this spring, but they disappeared early in July. The vines soon recovered, and appeared to suffer no permanent injury.

This larva is the "thorny green worm" of some letters to local newspapers. It is usually of a green color, but varies from almost white to yellowish brown, dusted with a fine, whitish powder in some specimens. The head is furnished with two blackish, branched spines, while the spines with which the body is furnished vary in color with that of the other parts, but are always tipped with black. When fully grown it is between 1½ and 2 inches in length, and then transforms into a chrysalis of a woody brown color, furnished with spines on the body, a nose-like projection in front near the head, and ornamented with golden or silver spots. These chrysalids are known to growers and those engaged in hop-yards as "hop merchants," and according as the color of the metallic spots is golden or silver, so will the price of hops range high or low, so the story goes. The butterfly which emerges from these chrysalids expands from 2 to 2½ inches; upper side tawny orange, fore wings bordered and spotted with black; hind wings shaded with dark brown, with two black spots in the middle, and three more in a transverse row from the front edge and a row of bright orange-colored spots before the hind margin; outer edges of the wings powdered with reddish white; under side marbled with light and dark brown, the hind wings with a silvery comma in the middle.

These insects are usually kept in check by minute parasites, which deposit their eggs in the caterpillar, so that not one in ten ever attains the butterfly state. Still, they occasionally become numerous enough to do considerable damage, and require measures to reduce their numbers. The best of these is hand-picking. The only time they ever prove destructive is in early summer, when the first brood approaches its full size, and at a time when work in the yards and about the vines, trimming, tying, &c., is continually going on, and wherever they are perceived they should be at once picked off and destroyed. They are seldom numerous, but their size and voracity make their work very apparent. As when young they feed, if not in company, yet close together, an entire brood can often be destroyed in a moment, and by a little labor directed to that end a yard can be kept clear of these insects. The second brood does not seem ever to be perceived, and I could not learn that they had ever done any appreciable damage. In fall I found the larvæ few and far between, and the chrysalids I collected were one and all infested with parasites.

## THE WHITE-MARKED TUSSOCK MOTH.

(*Orgyia leucostigma* Sm. & Abb.)

This omnivorous insect I found in some numbers on the hop; not sufficiently numerous to attract the attention of growers, but sufficiently abundant to form the nucleus from which future broods may spring; numerous enough to demand notice. The larva, when full-grown, is from 1 to 1¼ inches in length, of a bright yellow color, sparingly clothed at the sides with pale hair. There is a dusky stripe on each side, and a darker or black stripe on the back; the head and two little warts on the ninth and tenth rings are bright coral red; there are two tufts or pencils of long, black hair on the first segment, and a single, similar tuft on the eleventh; the fourth, fifth, sixth, and seventh segments have each a thick brush of short, stout, yellow hair, giving the larva rather an odd but at the same time pretty appearance. When full-grown it spins a cocoon, and transforms into a whitish pupa. The female moth, emerging from the pupa, is wingless, and never moves further than the upper side of the cocoon from which she emerged. The male is winged; the wings expand about 1 inch; are of a deep ash gray, crossed by darker lines. The eggs are laid on the empty cocoon of the female; are covered by a white, frothy matter which soon hardens; and, when laid in the fall, do not hatch until the following spring.

These insects can be easily controlled. The cocoons and egg-masses are attached either to the leaves, vines, or hop poles, or occasionally to fences surrounding the yard. The vines are usually burnt when picking is over, and the egg masses on the vines are thus destroyed; the poles should be examined either when stacked for the winter or when set in the spring, and the adhering egg-masses should be collected and destroyed. Being white, they are easily seen, and as each egg-mass contains the embryos of caterpillars enough to eat up all the vines on a hill, the time employed in collecting it is not entirely wasted. During the winter, or in early spring, the fences surrounding the yards should be examined and the egg-masses picked off and destroyed. In this way yards can be kept free of this pest.

## THE FALL WEB-WORM.

(*Spilosoma cunea* Drury)

In several yards I noticed the vines on a number of poles enveloped by the web of the common Fall web-worm, so often seen on fruit trees. There is no need to describe the insect, as it is so well known, and there is no need for hop-growers to suffer any loss from it, for the whole colony can be destroyed when first noticed by simply cutting off the arms and leaves which are spun up and trampling them under foot.

## THE HICKORY TUSSOCK-MOTH.

(*Halesidota caryæ* Harr.)

At Waterville and vicinity I found a number of caterpillars, when fully grown about one inch or a little more in length. The head and under side of the body are black; the upper part, so far as can be perceived, is white, sprinkled with black dots, and with transverse lines between the rings. They are covered with short, spreading tufts of white hair, with a row of eight black tufts on the back, and two long, slender, black pencils on the fourth and tenth rings. The tufts along the back are so close together as to form an apparently unbroken ridge of short, dense, and somewhat bristly hair. The hair on the front part of the body is longer than the rest and overhangs the head. These caterpillars are full-grown about the 10th of September, spin a cocoon in some crevice, under stones or in heaps of rubbish, and transform into a brown chrysalis. In June following the moths appear. They expand from 1½ to 2 inches; the fore wings are long, pointed, of a pale ocher-yellow color, finely sprinkled with brown dots, and crossed by four irregular rows of large white and semi-transparent spots.

The caterpillars do not seem to feed very heartily, as even where they were most plenty the leaves were not noticeably eaten. They are nowhere very abundant, have not been known to do any serious injury, and are probably kept in check by the fact that before they are ready to spin up the vines are cut down, and then, when forced by want of food to make their cocoons in the piles of vines, they are destroyed when the vines are burnt.

## THE HOP PLANT-LOUSE.

(*Aphis* [*Phorodon*] *humuli* Schrank.)

This insect is well known to all growers, and was especially injurious during the past season, the hops being rendered universally of an inferior grade, and many spots so greatly injured that they were not picked. For many years past the hops have been more or less injured by lice, but this year they were especially abundant, the universal testimony of all growers being to the effect that never before had they known of such injury caused by them. Nothing at all was done to combat them, the worst infested parts of the yards only being first picked, sometimes a little before fully ripened, and most of the energy and ingenuity being devoted to bleaching out of the hop all trace of the "mildew" and "rot" caused by the insects.

As in respect to these insects my notes are full, I will simply transcribe them.

*June* 21.—At Herkimer, in Mr. Pine's yards, examined carefully for aphids, but find no traces of them. Mr. Pine says his low-lying yards

suffer most; he had them last year and previous years, but never sees them as early as this.

*June* 23.—At Mr. Harter's yard find no lice; it is a hill yard, cleanly cultivated, flourishing, and remarkably free from insects of all kinds.

*July* 14, 15, 16.—Examined vines for aphids, none found any where.

*July* 17.—Went to Mohawk; saw Mr. Steele and examined his yard; no aphids; says his yard, being on a hillside, well drained, always a current of air through it, suffers very little from insects, and while he has each year *some* lice, he does not suffer any appreciable damage. Hot, dry weather favors hops and is bad for lice, the reverse is bad for hops, good for lice.

*July* 19.—Arrived at Waterville with Mr. Cutter, of the *Waterville Times*. I visited the Hannover farm; found the first aphids I had seen, very few indeed, small in size, wingless; a single one to a leaf only. Visited Mr. Risley's yard; no lice here. Visited Mr. Coggeshall's yard; lice more plentiful here than anywhere else so far, and yet not numerous; they had evidently been here for some days, because there were large specimens, and on the same leaf a varying number of small and very small specimens, as many as seven or eight on a leaf, evidently the progeny of the old one. Not many leaves are affected, however, mainly the lower, large leaves, and very dense vines are more affected than the others.

*July* 20.—Visited the Hop Extract works, and spent most of the day in the yards there; the low, wet yard has a fair sprinkling of medium sized and very small wingless lice. The hill yard is as yet clear. Mr. Lawrence says a few sultry days will suffice to cover the vines. He finds winged ones in immense numbers in late fall in his storerooms, but they disappear soon after, and he never saw them in winter.

*July* 21, a. m.—With Mr. Eastman, of the Hannover farm, visited hop yards toward Sangerfield and vicinity; lice everywhere now, but in small numbers; always more abundant on low ground. Saw "honey dew" for the first time. The current belief is that this is produced by the lice, but there certainly are not lice enough now to produce all this "honey dew." Mr. Eastman and Mr. Fees think the lice have nothing to do with it; say they have seen lice without honey dew, and honey dew in abundance where there were no lice.

p. m.—Went to Deansville and saw Mr. Jenks. Mr. Jenks is a microscopist and has paid some attention to lice; says he has seen winged lice, males, early in spring, *i. e.* about May 20; saw at that time also wingless forms, females. Finds both on the stem of the vines, not far from the roots and crawling upward; later finds them on the lower leaves and then they disappear for a month or more. They are beginning to reappear now. Has never found them on the roots in the winter and never looked for them; never saw them in grubbing time.

Cranberry insects now demanded my attention, and my notes cease until—

*September* 4.—Went to Mr. Risley's yard; find them picking; lice not over abundant; plenty everywhere, but not doing any serious injury to the hops; in a few places only the hops are beginning to show traces of mold; winged forms are scarce, but there are a few.

p. m.—With Mr. Cutter went to the Hannover farm; picking is going on, full blast, lice are not over abundant, less than they have been before the cold snap (the night of the 3d and 4th the temperature fell to the freezing point); winged forms in small numbers. Saw Mr. Sylvester Gridley and his yard; lice plenty; hops fair, but in some spots badly damaged by the mold caused by lice. This is the worst so far. Mr. Gridley says he has seen the lice when grubbing; he has cultivated hops for many years, has always had more or less trouble with lice, and knows them perfectly; he was superintending grubbing, and was called by some of the men to look at some hills they were at work upon; found that the young shoots were completely covered with lice; whether winged or not he cannot say; saw this on several hills; the lice were of full size. Mr. Gridley's men claim that they have found the lice on the poles when setting them in spring.

*September* 5.—Hop Extract yard. Lice here very abundant, especially in the low, "blighted" yard; in some places they form double layers; toward the tips and on joints they are especially plentiful, often forming balls half an inch in diameter; many leaves are sucked dry; they shrivel up, become brown, and die, and the inhabiting lice with them; many vines were entirely brown and dry; the hops were covered inside and out, and were all moldy and rotting. There are many winged forms and many with rudimentary wings—pupæ. I noticed none of these yesterday. The night has been cold; this day, warm.

*September* 6.—The night has been cold; at the Extract yards the lice are not more numerous, but pupæ and winged forms are largely on the increase. Went to Deansville and called at all yards on my way. Everywhere the lice are fearfully abundant, and the hops are molding fast. The entire crop this way is tainted and lessened in value. On a bag of hops picked yesterday and left out over night the lice cover the outside in a layer fully an inch thick. Where the vines have been piled up clumps of lice, 4 to 6 inches in diameter, aggregated into a globular mass of living matter, are seen. The number is incredible, and the thing must be seen to be believed or appreciated. Toward evening it became warmer and I noticed swarms of the aphids on the wing. Though I watched long and carefully I could not find that they mated.

*September* 7.—The night has been warm. To-day it is warm and showery. At the Extract yards lice are, if possible, more numerous than yesterday. A notable fact is that while yesterday there seemed to be no very small forms and a large number of pupæ, to-day there are many winged specimens, there are very few pupæ and a new batch of very

small specimens, evidently not many hours old, and on every leaf I observed the process of bringing forth living young. None of the winged insects were so engaged. These were more active and less patient of observation, nor did I observe that any pupæ or those forms with but rudimentary wings brought forth young.

p. m.—In Mr. Risley's yard lice less abundant than elsewhere. On the whole, Mr. Risley's yard and the yards in the immediate vicinity are much less bothered with the lice than any other yards I have seen. Nothing particular to note except the small number of winged specimens and the entire absence of pupæ.

*September* 8.—Rain; temperature warm; lice are not active, and reproduction does not seem to be going on, but I spent only a short time "between drops" in the yards.

*September* 9. Sunday; rain all day; temperature high; evening closed in warm and muggy.

*September* 10.—Went to Oriskany Falls, Sangerfield Center, and the Hannover farm during the day. Lice in all yards more abundant than ever. The vines are one mass of the beasts. Merely walking under them I became covered. On the stems, leaf-stalks, and especially at the joints, there were three, and even four, layers of the insects, while on the ground, globular masses, 4 to 6 inches in diameter, were everywhere seen where the vines had been pulled and hops picked; everything is covered with lice, and everywhere they show that same tendency to bunch themselves.

*September* 11.—At Cooperstown, called on Mr. J. F. Clark and saw his yard. Nothing noteworthy in his yard. In the yards between Richfield Spa and Cooperstown picking is about over, and here many have finished picking and all are nearly done. Mr. Clark says that this spring, when grubbing—about the middle of March—one of his men turned up with the grubbing hook a mass of living lice; the mass was globular and as big as a fist. The man, whom I questioned closely, says they were about 6 inches or more underground, near to, but not *on*, the roots; he called the attention of his fellow-workmen to them and they broke up the mass to make certain they were really lice, and he is positive that they were identical with the lice now in the yards. Cannot say whether any of them were winged. Mr. Clark, also, has noticed the lice on the vines when they were still very low.

*September* 12.—Spent part of day in Mr. Clark's yard and with him grubbing up hills where picking had been over for some time. Everywhere in the ground we found lice—rarely singly, but in small masses, from three to ten, or more. In recently-picked spots they were numerous and close to the surface; in older spots they were more scarce and much deeper down; one mass of eight was found at least 10 inches below ground. Afterward I examined the spaces upon which the vines from which the hops had been picked were piled; where the vines were

dry they were clear of living lice, but on the ground they were everywhere crawling, making their way into crevices.

Thus far the excerpts from my notes.

I remained for a few days longer, until picking was over and the lice had disappeared, most of them destroyed, no doubt, by the deprivation of food and the numerous enemies, in the way of predaceous larvæ and small beetles of the *Tachys* group, which were everywhere abundant in the yards; but a large number of fully-matured forms, apterous and winged, no doubt found winter quarters. As several persons claimed to have found the lice on the poles in spring, I examined many poles after they had been stacked. Where the yard had been but recently picked, lice were found on the outside, in the crevices, and under the bark. In yards that had been picked and the poles stacked two weeks or more, very few were found, and they far in the crevices and fissures; none under the bark or in the crevices of the bark. The probability is that but few winter in the poles.

*A brief résumé of the results of my investigations is this:* The lice are found in the ground as early as March (Clark); they are seen shortly after on the very young shoots scarcely above ground (Gridley); then on the young vines not more than three or four feet high, *apterous and winged* (Jenks). They disappear early in June, for notwithstanding close search I failed to find any, nor could I learn of any having been then seen. In July, about the middle or toward the end of the month, single apterous individuals appear on the lower leaves; these produce living young, which are also apterous, and in two or three days also produce like young; this continues until the weather becomes cold, and then winged individuals appear. When the hops are picked, the fully developed individuals enter the ground, crevices on poles, and probably other sheltered situations. In the early part of the season the results are all viviparous females; early in September winged individuals begin to appear.

As to the mode in which they do their damage: Numerous as they become, did they only attack the leaves or stems of the plant the abundant vitality of the plant would still ripen the hops, though they might not be quite so full; but not satisfied with the leaves they go into the hop, *i. e.*, into the burr, and there puncture the delicate leaves; the sap exudes, ferments, and a fungus attacks it—the hops mold, become specked, lose vitality, and finally decay. Not always do the lice enter the hop; sometimes they have been very abundant and yet hops have not suffered, because the insects confined their attacks to the leaves. Dry, hot weather will keep them out of the hop, and will somewhat retard their increase. Hot, moist weather, or rainy weather with cold spells, will in the one case so favor their increase that they will cover the whole vine; and in the other, while retarding their development, cause them to seek shelter in the hop itself.

Nor are all varieties of hops equally affected by the vermin. "Hum-

phreys" and "Canadas," both red and white, are not apt to mold, but the "English" and "Cluster" suffer greatly and mold readily. The reason for this is in the form of the hop. "Humphreys" and "Canadas", after burring out, remain open, *i. e.*, the burrs do not close or shut down as they do in the "Clusters." The result is, in the first case there is ventilation enough, the exudation from the punctures and from the lice does not ferment, and mold does not form; in the second there is no ventilation, and first fermentation and then decay set in rapidly. "Humphreys" suffer least of all, and as they are an early hop they can be picked before the final host which attacks the hop is hatched. "Canadas" come next; they are later, but not only is the hop less liable to mold, but the vine itself seems less to the taste of the aphids than are the "English" and "Clusters."

## REMEDIES.

All sorts of remedies have been proposed and tried, with more or less success. Washes of whale-oil soap and syringing with decoctions of quassia have been tried by growers, with partial success. The numbers were decreased for a short time, but the loss was soon made up, and the labor was so great that operations were suspended, the more readily as the growers do not desire to risk tainting the flavor of the hop by washes.

The great error in all these cases was that the application was not made until after the insects were in full force, and the vines high up, almost out of reach; of course under these circumstances it was impossible to do more than temporarily reduce the numbers.

The attack should be begun in spring. When grubbing, the roots and young shoots should be examined, and any aphids that may be found destroyed. As the vines increase in size they should be carefully examined every few days, and when the lice appear these should be destroyed by hand, for the number will not be large and the method is certain. In my opinion it is now, if at all, that the winged female oviposits or lays her eggs—not more than one or two on a leaf, and probably close to the midrib. If this can be prevented it will save the crop, and that it should be prevented it is necessary to attack the insects when they first appear. Then, when the first of the late forms appear, about the middle of July, they will be found mainly on the lower leaves, wingless and in very small numbers; they spread very slowly at first, and afford the grower ample opportunity, should he desire to avail himself of it, for destroying them by means of washes or otherwise; as the season advances, they become numerous, spread all over the vine, and are then practically out of reach.

As good a wash as can probably be found is a solution of carbolic acid, either "Squibb's solution," containing 1 per cent. of the crude phenols, which can be diluted with seventy-five times its bulk of water and still

prove effective, or some of the many carbolic soaps recommended for that purpose.

*Soluble phenyl* (Little's) has been recently recommended as a valuable insecticide, and it is said that a teaspoonful of the liquid in four gallons of water will suffice to destroy aphids. If this be so (and it is worthy of a trial) it will make a very cheap wash, and should be freely used when first the insects make their appearance.

## NATURAL ENEMIES.

The hop louse is not without its enemies in the insect world, and quite a number of species feed on it, and in ordinary years suffice to prevent its too rapid increase. Prominent among these are the "lady-birds" and their larvæ known as "niggers." Three species of the lady-birds are found in abundance on the vines. The most numerous is the two-spotted lady-bird (*Adalia bipunctata*), a small red species, with two black spots on the wing covers. Next comes the nine-spotted lady-bird (*Coccinella 9-notata*), a larger species, with nine black spots on its yellowish-red wing covers; and least numerous of all is the twice-stabbed lady-bird (*Chilocorus bivulnerus*), smaller than either, entirely black, except two blood-red spots on the wing covers. The larvæ of these species are all very much alike, of an elongate, flat form, tapering toward the tip, with six legs; of a grayish-black color, spotted and marked with red or yellow. They are very active and very rapacious, feeding almost continually, and each larva destroys many aphids before attaining maturity. When full-grown they attach themselves by the tail to a leaf, curl up into a round pellet, and in a few days transform into the perfect beetle, which also feeds on the Aphis, but is not so voraciously as the larva. There are several broods of the insect in the season, the last transforming into the perfect insect about the middle or toward the end of September. The beetles hibernate in crevices of fences, under bark of trees, or stones, or wherever else they can find shelter, and reappear in spring to continue the work where they left off the year before. Were it possible to preserve a sufficient number of these insects through the winter, so that a goodly number of them would be on hand in early spring, the lice would never become numerous enough to do injury; as it is, but few survive the winter, and before they become numerous the lice, propagating more rapidly, become so plenty that they are beyond control. But, seriously, there is no reason why these coccinellids cannot be wintered. They become very numerous in fall, and several hundreds of them could be collected without difficulty, put into a large box with plenty of loose rubbish, and put into some cool place not exposed to the fiercest cold nor yet so warm as to cause them to become active—a barn or cellar would answer. The box should be covered so as to prevent the entrance of spiders which would feed on them. In spring the box could be placed in the open air, and the insects would then scatter through the yards in search of suitable places to deposit eggs. I firmly believe that this could

be done without much trouble, and that this would prove the best possible remedy to prevent the spread of or damage by the aphids.

Another enemy is the larva of a Syrphus fly, which I find in small numbers on the vines. This larva is of a uniform yellowish-white color, about one-fourth of an inch in length, with a stout body tapering to the head. It is a slimy insect, with no perceptible legs or head, but a mere rounded opening for a mouth. It glues itself fast in a position where lice are abundant, and, stretching its head in every direction, seizes all lice within its reach, and when it has cleared all within its reach moves on to a new center of operations.

The lice are also attacked by a disease, apparently of a fungoid nature. I noticed several instances where all the lice on a leaf appeared unnaturally large or swollen, and of a brownish-yellow color. On being handled they crumbled into a very light brownish, granular dust. The disease does not appear to be widespread, and I cannot give any nearer details as to its nature or origin.

## THE HOP-VINE LEAF-HOPPER.*

(*Typhlocyba* sp.)

An insect known as the "green fly" is pretty generally found in hop yards all through the summer, and sometimes very numerous. This insect has been said to "sting the heads" and to cause "slide down" or "foolish hills," while others claim it does no damage whatever. The insect is of a greenish to yellowish color, with a short, broad head, long, narrow body, and two pairs of wings, the first narrow, long, and yellowish-green, with a dark dot on each, the hind wing broad and transparent. The legs are yellow, the posterior pair very long and stout, the shanks set with spines, and as a whole fitted for leaping. The young or immature forms resemble the full-grown insects in all points, except that they want wings. They are very active, leaping off at the least disturbance, and when full-grown using their wings as well as their legs to good advantage. The adults hibernate in crevices, in barns, or wherever they can find shelter, and appear in spring as soon as vegetation appears. They mate and breed all through the season, and become very numerous occasionally. They seem to be somewhat local, as in some yards I could not find them at all, while in others close by they were abundant. As a rule, yards badly infested with aphids had none of these hoppers, while Mr. Risley's yard, which was by all odds most free from aphids, had these hoppers more numerous than they were elsewhere.

These insects do not damage the hops; they are found most usually on the lower leaves (*i. e.*, not more than 5 or 6 feet up the pole), and feed by puncturing one of the ribs and sucking the sap. The injury done by them consists in so weakening the veins that they are unable to

*This insect is an undescribed species of *Typhlocyba*, but the material received and submitted to Mr P. R. Uhler is considered by him in too poor condition to permit of proper characterization.—*C. V. R.*

accomplish their work, and the leaf loses vitality. Where these insects have made a puncture on the rib, a woody scar remains, and where these scars are numerous those parts of the leaf farthest from the main ribs are thinner and more flaccid than in healthy leaves; and such leaves, and no others, are affected by the "honey dew." A few of the leaves turn brown, but the vine is not in the least injured and the quality or quantity of the crop is not in the least affected.

The same remedies used against the Aphis will prove useful against these insects.

In addition to the insects hereinbefore enumerated, there are a few beetles, belonging to the *Chrysomelidæ* or leaf-eating beetles, and principally the flea beetles. Most common of the latter is the red-headed flea beetle (*Systena frontalis*), a black beetle about a quarter of an inch in length, with a red head, and with very heavy hind legs; a good jumper and no mean flyer. Next comes the striped flea beetle (*Phyllotreta vittata*), a black beetle less than one-tenth of an inch in length, with two yellow stripes on the wing covers. Finally comes the punctured flea beetle (*Psylliodes punctulata*), a brownish species, less than one-sixteenth of an inch in length. None of these are very numerous, and they are not found in all yards nor all together in any one yard. They eat small holes in the leaves and do no great damage.

The twelve-spotted leaf beetle (*Diabrotica 12-punctata*), a yellow beetle about a quarter of an inch in length, with twelve spots on the wing covers, has the same habit, and appears in small numbers in all yards.

## OBSERVATIONS ON THE ROCKY MOUNTAIN LOCUST DURING THE SUMMER OF 1883.

By Lawrence Bruner.*

Washington, D. C., *October* 30, 1883.

Sir: Herewith I submit to you a report of my trip through the Rocky Mountain region during the past summer, made for the purpose of studying insects injurious to agriculture, but more especially for the purpose of obtaining such data as would enable me to foretell the probable aspect of the locust question for the year 1884.

According to instructions, I left here on the 3d of May, and proceeded to my home at West Point, Nebr., where I procured an assistant and completed my preparations for the trip. From there we first proceeded to Albuquerque, N. Mex., via the Union Pacific and the Atchison, Topeka and Santa Fé Railroads, where we made a short stay, obtaining such data as we could relative to locusts and other insects injuring grain, vegetables, and fruits. Upon our arrival there we found the season very backward and all kinds of insects quite scarce; hence, after a few days' collecting, we proceeded northward to the Taos Valley, a rich farming district, where we spent almost two weeks gathering such data as we could concerning various insects. In these efforts we were much inconvenienced by the prevalence of small-pox in the various villages throughout the valley, and on account of the backwardness of the season, as well as the extreme ignorance of the natives in general upon questions relative to insect life. We did, however, succeed in obtaining some data in reference to the migratory locust (*Caloptenus spretus*) during the years of invasion. We also procured a small series of some of the insects found here in early spring.

Upon leaving Taos Valley we proceeded northward by wagon to Fort Garland, Colo., crossing on the way several small valleys in which farming is the chief occupation of the inhabitants. Here, too, we encountered the difficulties experienced while at Taos and neighboring villages, at times finding it difficult to obtain even the necessities of life. At Fort Garland we were detained several days on account of the sickness of my assistant. While here, the weather was quite cold and the post

*Mr. Bruner's instructions were, in brief, to make all necessary preparations at his home in West Point, Nebr., and thence to proceed directly to South Colorado and New Mexico, spending a week or more in the Taos Valley. Thence he was instructed to return north by way of Fort Steele, and work into the Big Horn country, eventually striking the Northern Pacific Railroad and proceeding to Fort Buford, and thence directly home.

The chief object of the trip was to ascertain all facts relating to *Caloptenus spretus* in the country indicated that would enable him to make a report as to the prospects for 1884, and also to collect facts upon insects injuriously affecting any cultivated crop in the settled portion of the region traversed.

was visited by a snow-storm. From this locality I forwarded to the Department a sample of plant that is said to kill stock, and is known in this section as the "loco" weed.* From Fort Garland we returned northward via Denver and Rio Grande Railway to Denver, and thence to Fort Collins, where we were detained until July 1 on account of the scarcity of funds. While there, we occupied the time in collecting and examining wheat fields for insects, as well as in studying the preparatory stages of different locusts. From Fort Collins we proceeded by wagon to the North Park, where we expected to obtain some data and material in special directions, but upon our arrival in the park we found we were too late to procure what we were after. We therefore, after learning that the streams were still too much swollen to reach the higher elevations, proceeded to Laramie City, Wyo. After a few days' detention at this point we left for Rock Creek Station, on the Union Pacific Railway, from which latter point we proceeded by stage to Junction City, Mont., the route by which we traveled taking us across the well-grassed plains between Forts Fetterman and McKinney and along the eastern flanks of the Big Horn Mountains, a section admirably adapted to be a breeding ground for *C. spretus*. On this trip we laid over a few days at Fort McKinney and part of a day at Custer's battle-field, to collect.

From Junction City, with your permission, we deviated from the original plan and proceeded westward instead of following down the valley of the Yellowstone to its junction with the Missouri and thence across the plains lying to the northward between this river and the Souris. We first went to Bozeman, where we procured horses, after which we rode across the country via the valleys of the Yellowstone, Upper Madison, and Snake Rivers into that of the Salmon River. On this trip we also collected at various points along the route, besides making numerous inquiries relative to the migratory locusts. Upon our arrival at Salmon City, Idaho, we found that our time which had been allotted for field work had almost expired. After a few days had been spent upon the object of our trip, we returned to the railroad, where we took the train for Ogden. Arriving at Ogden, we found that we still had some time at our disposal; we therefore devoted it to collecting and in visiting the orchards of several of the principal horticulturists, both in the vicinity of Ogden and Salt Lake City. From Ogden we returned to Washington *via* West Point.

I am pleased to be able to report that the leading feature of our notes for the summer's work is the comparative freedom from all insect plagues throughout the entire area traversed by us.

The report you will observe is chiefly in the form of notes as they were taken down from time to time while in the field.

I am, respectfully, yours,

LAWRENCE BRUNER.

Prof. C. V. RILEY,
*United States Entomologist.*

* *Oxytropis lambertii.*

*MIGRATORY LOCUSTS.*

TAOS VALLEY, *June* 2, 1883.

The first locusts of which I could learn came into the Taos Valley from the east during the latter part of May, 1876. They were exceedingly numerous, and during the summer, all through which they remained, they destroyed almost the entire grain crop, leaving a little in only two or three small sections to the south and west of the town of Taos.

In the fall (September) of the year they deposited numerous eggs, which hatched the following spring in great numbers, and much damage resulted during spring and summer (1877). After attaining wings, a few left to the westward, but the majority remained and deposited their eggs, which produced a third brood in the spring of 1878.

In 1877 the crop averaged nearly one-half, and in 1878 a trifle over a half of the usual yield, but this last year many farmers had become discouraged and refused to plant; hence the crop planted was below the average for the valley. During the locust visitation several modes of warfare were tried by a few of the most enterprising citizens, but without any great or decided results. It is related that when the locusts first appeared the storekeepers then in the valley offered the inhabitants as a bounty a pound of coffee for each pound of locusts captured and killed. At first this was not hard on them, but shortly, as the country folk learned how to capture the locusts, the offer was withdrawn, as the coffee went too rapidly and without any apparent diminution in the number of locusts. Methods for the destruction of and protection from the young were various, and in most instances quite similar to those adopted in other portions of the country. Coal oil or kerosene was used in mixtures of various strengths and sprinkled on the crops, which for two or three days after the application was quite effectual in keeping off the young, but gradually, as the scent of the oil disappeared, the wheat also began to disappear before the little 'hoppers. Several tried oil on the surface of the water in the irrigating ditches with some little effect for the time being, but all to no purpose in the end. Another method, and by far the most unique used, was the spreading of wagon sheets on the ground, after which the little hoppers were driven upon them, and then the sides gathered up and several large round stones dropped in and rolled about by keeping the sheet agitated until all the little fellows were killed. I was assured that a very large number of the young were destroyed in this manner.

During the summer of 1878 those locusts that matured left to the westward, and it is claimed that since then none of this species have been seen in the valley.

There is a valley 20 miles south of here in which there were a few in 1879 and also in some isolated spots in 1880, but during neither of these years did they do very great or general injury to the crops over the valley. While in these valleys, in this portion of New Mexico, it is claimed that

their movements were in unison, but not extensive, their flights being very short.

The average elevation of Taos Valley is about 7,000 feet. Not a single specimen, young or old, of this insect was observed from the time of leaving Poudre Cañon to the time of reaching Laramie City on the 10th of July, nor have any been seen or heard of since. While in North Park, Mr. Capern stated that but few had been observed by him since 1879 and 1880, when quite a number had hatched in portions of the park; and it was during these years that they were frequently seen in the air, floating with the wind. From Laramie and Rock Creek, north, we were ever on the lookout for signs of this insect, but failed to see any before reaching Fort McKinney. At this place we succeeded in capturing two fledged specimens and saw but one or two others. We did not ascertain much about their past ravages in this part of the country more than that, in 1877, they had been seen in the air in great numbers; also in 1876, and once or twice previous to this, when they flew in great numbers, and occasionally were noticed piled up in heaps upon the snow on the mountains where they fell as they became numbed while trying to cross the range. Again at Custer's battle-field we saw two or three more among the numerous other species of locusts that abounded among the rich grasses of the bottom lands and coulees, as well as lower hillsides. At Junction, on the Yellowstone River, none of this insect were noticed, though several allied forms were abundant both on the river bottoms and among the sage-brush and bunch-grasses back among the hills and on the bench-lands. At Livingston, where the railroad leaves the Yellowstone Valley, we noticed a great number of locusts, which, when I first saw them from the car windows, jumping about in the grass, I took for this species. Upon going out, the mistake was quickly observed. While there did not appear to be any *C. spretus* among the hosts of locusts, there were quite a large number of *Camnula atrox*, or *pellucida*. I also observed several of this species here in the vicinity of Bozeman (August 3). I have not, however, been able to learn of any damage having been committed by them in this valley the present season. Since leaving Bozeman, and while crossing the country along the Yellowstone River, we did not observe a single specimen of *C. spretus*, either old or young, in the air or on the ground. During past years, however, they were reared in great numbers throughout the National Park and Upper Snake River valleys when, at times, they were numerous enough to "almost obscure the sun"; at least I was so informed by a Mr. Livermore, who has a ranche at Henry's Lake.

As to dates and particulars of flights, &c., he was not certain; therefore I can give none of these. As we proceed down the valley of Henry's Fork toward the Snake River there is a great tract of country crossed that at times has been the originating center for the great swarms that came into Cache Valley and other portions of northern

Utah and southern Idaho; it is also quite impossible for me to give any of the particulars as to dates, &c. Thus far (August 23) we have not met with a single *C. spretus* in Idaho, nor have we heard of their presence in any portion of the Territory. But as there is no accurate account extant of the locust history for the region of Salmon River Valley and adjacent country, it may be well to give it in brief here. The first reliable account that I could obtain in reference to locust swarms dates back to the summer of 1869, when they came in from the Snake River by way of Birch Creek and Wood River, and followed northward down both the Lemhi and the main branch of the Salmon to about Salmon City. These deposited eggs, thereby giving young locusts for 1870. Again, in 1871, locusts appeared in the vicinity of Lemhi Agency and Salmon City. From this time on till the summer of 1875 I was unable to learn of their appearance or presence in this portion of the Territory, but during this year (1875) they again appeared in great numbers, coming as before from the southeast and south, following down the valleys of the two rivers heretofore named. This summer, as well as during the three following, they deposited great numbers of eggs and proved exceedingly injurious to the few crops of grain and vegetables that were planted in the country (valleys). Since 1879, however, they have entirely disappeared from these regions. The time of their appearing in the valley of the Salmon, I am told, varies from the middle of June to the first of August, after which latter date, if none have already come, the farmers consider themselves entirely safe as far as locust swarms are concerned. From what I could learn, there are no exceptions to the northward movement of swarms of *C. spretus* in this particular portion of Idaho, and judging from the surface configuration of the lower Salmon River country, I would imagine that all swarms leaving must cross over the range to the headwaters of the Bitterroot and Big-Hole Rivers, which streams they follow down, and thereby divide and reach different portions of the Territory of Montana. As far as my inquiries went, no data were obtained of methods having been adopted for their destruction in the various stages of their growth, which differed in any way from those used in other portions of the West, and already described in former reports. The parasites, too, do not appear to have varied from those in other sections of the locust area.

### CAMNULA ATROX.

In connection with the migratory locust this insect deserves separate notice, as it has been observed at various points along our route from Fort McKinney to Beaver Cañon, Idaho. At some of the points where seen it was quite numerous and threatened mischief, while at others there were but a few isolated specimens observed.

We observed them at the following localities: Bozeman, Trail Creek, Gibbon River, Lower Fire-Hole Basin, Henry's Lake, and on Camas Creek. Their habits, of course, are already known, and need no further

mention in this connection. However numerous this insect has thus far become in the mountain districts of Idaho, Montana, and Wyoming, I have failed to learn as yet of any depredations having been caused by it in these Territories, though I am unable to predict what they will do in the future, but my opinion is that they need not be feared. This, of course, is only an opinion based upon no facts. From observations made during the period of three years in this portion of the country they appear to be on the increase, and at other points not seen by me heretofore were quite common this summer. Whether they have migrated into these new sections recently or whether they already occurred there during previous seasons and were overlooked I am unable to say. None have been noticed in the act of migration thus far this season, though at Livingston, on the 2d of August, they were seen by far the most numerous, and were very restless and kept up a continual hopping and flitting about as if desirous of doing something besides being quiet and inactive. One thing we can be pretty sure of in connection with this insect, viz., that it will never leave the mountains and higher altitudes for the agricultural districts of Dakota and Nebraska, which lie to the east and southeast of here, because they are not capable of such long continued flights as are other species.

*C. spretus.*

Again, in the valleys of the Great Salt Lake Basin a few specimens of this insect were observed, which were, as a rule, confined to meadows and low, wet localities, away from fields of grain and garden patches, and I do not think they will ever become numerous enough here to do great damage to the products of the farm.

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### "NATIVE LOCUSTS."

There were but three or, at the most, four species of locusts which had attained wings to be found near Albuquerque, N. Mex., viz., two *Œdipodæ* and one *Psoloessa*. They all frequent comparatively dry localities where the grass is beginning to show a little green. They are quite active, are easily disturbed, and fly rather far at each start. Among the young not yet matured but two species were discerned, viz., one *Œdipoda* and a *Caloptenus* or *Pezotettix*. These latter were only met with in fields of alfalfa, along irrigating ditches, and then only occasionally.

At Santa Fé we saw several specimens of the *Psoloessa*, and also two or three specimens of some species of *Arphia*. In passing along the road from Santa Fé to Espanola, as we approached the sandy flat, and also as we crossed it to the south of Santa Cruz, quite a number of a large, yellow-winged *Œdipoda* (*Hippiscus haldermannii*), were seen. It was the same as the largest one taken at Albuquerque.

At Espanola we observed a few of the same three species mentioned above as having been taken at Albuquerque. Again, at Embudo, we

collected a few of these locusts, and, in addition, several specimens of the *Arphia* mentioned as having been seen at Santa Fé. It was found to be partial to the high, rocky mesas, about 1,000 feet above the Rio Grande. Here we also took several pupæ of some Tettigidean, which frequents low, wet places near the river. Going into the Taos Valley we found about the same species heretofore mentioned, with the addition of the larvæ of several others, but in no case could any of these be referred to *Caloptenus spretus*, although there appear to be some representatives of the genus *Caloptenus* found there.

Two species of *Chimarocephala* were met with in the rank vegetation (willows and cottonwoods) at Red River, and some larvæ and pupæ of one or two species of *Pezotettix* were taken. These were found among the sedges along the river.

At Fort Garland, *Arphia* and *Chimarocephala* are represented along the valley of Ute Creek in fair numbers, and as one walks along among the trees numerous males of these species are to be seen in the air.

After leaving Fort Garland, I did not notice any locusts until we reached a point below Laveta, where the train stopped for something, and I heard the rattling noise made by some species of *Gomphocerus*, and after searching a while succeeded in capturing a male specimen. A few immature specimens of several other species were also observed, but not captured. Between there and here (Fort Collins) no stop was made, and consequently no specimens taken or no locusts of any kind noticed. Here, in the mouth of Poudre Cañon, 12 miles to the northwest of Fort Collins, since the numerous heavy rains, there is a great variety of locusts, mostly young, of which we have taken large series. These are, however, all "natives." Almost all of them are such species as are partial to certain plants, or else to particular kinds of surface configuration. These peculiarities can, however, be better set forth in a work entirely devoted to the history of North American locusts.

There do not appear to be any species of migratory locusts here at present; none have been noticed in the air or on the ground. Specimens of *Caloptenus minor*, with both blue and red tibiæ, are quite common here; in fact this is the only species of fledged *Calopteni* that I have thus far observed in this portion of Colorado this spring, though the young of several species are occasionally met with. I have also taken a few specimens of what to me now, without comparison with description, appear to be the *Pezotettix dodgei* of Thomas. *P.* (*Dactylotum*) *pictus* is just now commencing to hatch, while some of the *Stenobothri* and *Œdipodæ* have reached the pupa state.

At various points along the route we observed a few species of "native locusts" in various stages of development, though none were taken except at a point on Laramie Plains, until we came to the Laramie River. These were a species of *Gomphocerus* that was found about 10 miles from Tie Siding, and its peculiarity consisted in the close re-

semblance of the noise made by the males to the rattling of a rattlesnake.

At Laramie River, where some little time was occupied in collecting, we obtained, in addition to such forms as were taken in the vicinity of Fort Collins, a few specimens of a greenish-white *Psoloessa* that was only observed to feed upon the "sweet" or mountain sage. In the North Park no additional species were taken or noticed, while all forms appeared to be rather scarce and wild. The genus *Arphia*, however, seemed to be the best represented in forms. A few specimens of *Caloptenus minor* were noticed among the dense vegetation along boggy and damp places. After coming out of the park and entering the Laramie Plains on the west side of Laramie River, a few locusts, though nothing new, were taken. On the 18th of July a few specimens of a light greenish *Gomphocerus* were taken at Aurora, where they were found to be partial to the common sage-brush (*Artemisia tridentata*). *Stenobothrus occipitalis*, a species with light gray antennæ, was also taken.

Between Rock Creek and Fort McKinney but very few locusts of any kind were noticed, and none were taken. At Fort McKinney we captured a large number of various species of locusts, among which were several of interest, on account of their rarity in collections as well as in their peculiar habits. During the summer we observed that quite a number of locusts are partial to certain food-plants; and, as a rule, in all such cases they imitate in color, to a certain degree, very closely the plant or plants upon which they feed.

*Pezotettix albus*, Dodge, feeds upon a white Artemisia. *Pezotettix borckii*, which is only to be met with in the mountains of Montana, Idaho, and Wyoming, appears to abound only where two or three particular plants are met with, one of which is a species of geranium. Again, *Caloptenus turnbullii*, which is found in the vicinity of Custer's battlefield, only feeds upon two species of plants, as nearly as I could ascertain by observation, viz., the "pig-weed" and a small greenish-white plant of a similar nature. Those found on the pig-weed are somewhat glaucous yellow, while those feeding on the other plant are more of a whitish color, mingled with greenish blue instead of greenish yellow. In like manner two species of *Caloptenus*, perhaps the *Melanoplus devastator* and the *M. cinereus* of Scudder, feed upon the sage brush (*Artemisia borealis* ?, and *A. tridentata*). The latter is grayish in color, and when at rest, both in the preparatory and the imago stages, is difficult to detect, so nearly does its color coincide with that of the plant upon which it is resting. Other locusts are not partial to certain food-plants, but appear to be so to certain soils and surroundings. For example, all those species of *Œdipodinæ* which would naturally fall under Mr. Scudder's genus *Circotettix*, love barren and rocky slopes and hillsides, the different species living at different altitudes and on differently colored soils. The species all love bright and warm sunshine, and during such times are very active and remarkably noisy, being almost incessantly in the air, where

they keep their wings clattering and rattling to such an extent that one would suppose they were rattling into pieces. We did some collecting at Custer's battle-field, where we took a large variety of species, as well as in most cases a large series of specimens. Here we also observed to a great extent the partiality which certain species exhibited in the selection of special food-plants. Again, at Junction City, Mont., we made some collections, adding a few to the list of species taken. Here, for the first time, we took several specimens of a species of *Œdipodinæ* belonging in the genus *Mestobregma*, and which almost exactly imitates in color a species of *Psoloessa* which we took on the Laramie River, south of Laramie City. While these two insects so closely resemble each other in color they are quite distinct, and as Scudder has subdivided the genus *Œdipoda* they fall into distinct genera. The two species in question, however, are both partial to the same food-plant, viz., the white or sweet sage, and thus far I have found neither away from where this plant abounds.

We again collected at a point on the Yellowstone River about midway from Trail Creek to the National Park, at the Mammoth Hot Springs, and at Henry's Lake. It was at the former of these localities that we found the *Mestobregma* most abundant.

While passing along the road near Gardiner, a new town, which is to be the terminus of the Park branch of the Northern Pacific Railway, we captured a few specimens of the same species of light-blue-winged *Trimerotropis* that I took last year at Fort Benton, thereby extending its range at least to the southern border of Montana. It appeared to be quite rare even in its special haunts, viz., a light, almost bare, whitish, alkaline soil destitute of rocks. It was also taken in the Lemhi Valley of Idaho. At this same locality several other species of closely allied locusts were taken. After crossing the main Rocky range to the west side a change in the comparative abundance of some species and in the total absence or replacement of other species was observed.

While on the eastern slope we found *Circotettix carlingianus* quite abundant and *C. undulatus* rather rare, on the western side of the divide we found just the reverse.

The large, red-winged *Hippiscus* which on the east side is everywhere so abundant, and in fact all the red-winged forms, have thus far been exceedingly rare, only four specimens having been seen during the five days that have passed since crossing the summit. A species which, on the eastern side, was met with but occasionally has become quite plentiful. It is perhaps what Mr. Scudder has called *Psinidia wallula*.

Thus far we have found locusts to be most numerous in species at an elevation varying from 2,500 to 6,000 feet above sea-level, and on the bench-lands in preference to either bottom or mountain lands. While most of the *Caloptenus* and *Pezotettix* were partial to moist localities where vegetation was rankest, the *Œdipodinæ* and *Stenobothrini*, &c.,

were most common on partially bare and dryer grounds where the vegetation is less rank. Color of wings and tibiæ does not necessarily indicate specific differences.

## DESCRIPTION OF SURFACE.

The Taos Valley extends from the Arroyo Hondo, or deep ravine, of the Rio Hondo, or deep river, on the north, and from the cañon of the Rio Grande on the west to the foot of the Taos range of mountains on the east. It slopes to the southwest from the mouth of the Rio Hondo cañon, which has an elevation of 7,800 feet, to the edge of the Rio Grande cañon, which is about 6,400. The greater portion of the country is of a drift deposit, and consequently is mixed with bowlders and fragments of rock from the bordering mountains. It also is very rich when irrigated, which can be done over almost every portion by some one of the various beautiful mountain torrents that traverse the valley towards the Rio Grande. At present all or nearly all the farming is confined to the upper portion of the valley bordering the mountains, but I am satisfied that the lower portions, which are at present occupied by sage-brush, will be equally productive with the aid of water.

The surrounding mountains are rich in minerals, and only await the approach of railroad communication to be developed. With this, farming will also necessarily increase and the region become one of the richest in this section of New Mexico. Stock-raising is confined chiefly to goats, a few sheep, burros, hogs (which are picketed out), and a few cows. An abundance of chickens, too, is also raised in some parts of the valley. (Eggs and wood always one price, the former 25 cents for 16, and the latter same per load.) In passing north from Taos we enter the valley of the Rio Hondo. This latter is a stream of almost double the size of any of those passing through the Taos Valley, but differs from them by running in the center of a deep, narrow, cañon-like valley; most of this, however, is farmed, as is the high mesa on the south side of the valley, which latter slopes toward the Taos Valley. The upper end of this mesa, at the base of the mountains, is about 8,000 feet above sea-level, and descends toward the Rio Grande at the rate of about 100 feet to the mile. After leaving the Rio Hondo a low spur of the mountains, or high, irregular mesa, partly of volcanic rocks and covered with piñon pines and cedars, is crossed. This, at the highest point, reaches an elevation of 8,215 feet at a distance of between 2 and 3 miles from the mountains, which at the general slope of the country would be about 8,500 at the base of them. From this point the descent toward the Red River is quite rapid, this latter being about 7,400 feet where it leaves the mountains, and about 100 less where it enters the cañon at the foot of the valley, and preparatory to entering the Rio Grande. This valley, like that of the Rio Hondo, is comparatively narrow, and pretty well occupied by farms.

On the north edge of this valley begins what is known as San Luis

Valley, a plateau-like area of land about 140 miles in length and varying from 20 to 30 miles in width, or perhaps a little more, if we include that lying to the west of the Rio Grande. The general elevation of this valley along its eastern border is about 8,000 feet, sloping gradually toward the Rio Grande on the west. It is bounded all along the east by high, snow-covered mountains, and on the west by a series of volcanic cones and basaltic ridges. Some of these also, at isolated points, are to be seen protruding from the valley itself. All the way from Albuquerque, N. Mex., to this point (Fort Garland) the Rio Grande appears to be the dividing line between the basaltic and the other rocks, the basalt only appearing at isolated points near the river on the east side. The general surface of this entire valley is somewhat sandy, and the soil is interspersed with bowlders and pebbles from the mountains. It is covered with sage-brush, interspersed with short grasses, chiefly *Bouteloua*. At various points small streams cross it, and it is along these that all the efforts at farming have been made.

North of Alamosa and west of the Sierra Sangre de Christo range the valley appears to be richer in natural grasses, and is dotted here and there by small, shallow lakes. Immediately to the north of Fort Garland are situated Sierra Blanca and Mount Baldy, two of the highest peaks in Colorado, and at their base runs Ute Creek, the valley of which contains some fine grazing lands and a few good ranches, where at times the locusts have bred in great numbers.

After leaving Fort Garland we followed up the valley of Trinchara Creek to Veta Pass, where we crossed over the range into the valley of the Apaches and Santa Clara—a magnificent farming and grazing section.

At La Veta the elevation is between 6,000 and 7,000 feet, but descends quite rapidly towards the Arkansas, where the country expands into a wide, somewhat rolling country, dotted here and there with rocky ridges and coal fields. This country lies north of the Spanish Peaks and south and east of the Rainy range of mountains. This entire area, with the exception of a few small patches, is quite suitable for the propagation of locust swarms, and at times undoubtedly has been the seat of great swarms, although I failed to obtain any data concerning this insect for this particular locality. At the time of passing through here (June 10) the vegetation was quite green and the country looked well, although around Ojo, in the head of the valley, the oaks had not yet leafed out. On the summit in Veta Pass, where the elevation is about 10,400 feet, there was about 6 inches of snow.

Of course these extensive plains, that are so admirably fitted for the development of large locust swarms, sometimes have their drawbacks in the shape of seasons of great drought, as well as cold, wet, and backward springs following open winters, and in such cases the locusts suffer decrease here as elsewhere. From here we passed through such country as has already been often described—that lying between Pueblo and Den-

ver and between Denver and Fort Collins. At this latter place there is, as at Golden, a series of low mountains lying in front of the main range and separating the open country from a series of fertile valleys and park-like areas that lie back among the foot-hills and low mountains. These valleys and park-like openings among the foot-hills and low mountains are richly clothed with nutritious grasses, and are mostly well watered, thereby affording good footing for the breeding of locusts during years of their presence in this section of the country, and being every year the home of scores of species of "natives." It is in such localities as these that the greatest variety of locusts of all sorts is to be found in Colorado.

What is known as the Livermore country, on the North Fork of the Cache la Poudre, is a widening out of the valleys and park-like tracts into quite a large area of good farming land and a better grazing region. This Livermore country continues to stretch out to the west and northwest until it is lost among the park-like openings on the summit of the Laramie Range, south of Sherman; and from here is joined to the Laramie Plains on the west slope by valleys sloping that way. The Laramie Plains require no description here, while the numerous small parks lying to the south of the Laramie River, and between it and North Park, can be described as being merely openings in the timber, varying from 7,500 to 8,500 feet above the sea, and they at times form splendid retreats to the locusts and excellent grazing areas at all times to cattle and the large herds of game that frequent these parts of Colorado. During the summer and fall of 1880, a greater portion of this country, lying between the Laramie River and the North Park, was overrun by fires, during the progress of which, without any doubt, great numbers of both migratory and native locusts must have perished from heat and smoke. North Park is a vast grassy tract surrounded on all sides by high ranges of mountains, and shows plainly by its leading features that it was at one time the bed of a vast lake. Its lower end is about 7,600 feet in altitude, while all the other portions are higher. It is well watered and grassed, thus rendering it one of the most reliable grazing regions in northern Colorado. While its altitude is too great for safe adventure in general farming, it will nevertheless produce excellent crops of vegetables and small grain. Its entire surface could be burned over with some result in locust years.

## PRELIMINARY REPORT OF OBSERVATIONS UPON INSECTS INJURIOUS TO COTTON, ORANGE, AND SUGAR CANE IN BRAZIL.*

By John C. Branner.

Sir: On the 20th of November, 1882, I was, upon your recommendation, and under your direction, commissioned by the Commissioner of Agriculture to visit Brazil for the purpose of investigating the subject of insects injurious to cotton, cane, and oranges; and to collect such other information as would be useful to you in your capacity of United States Entomologist.

On the 30th of the same month I left Washington, D. C., accompanied by one assistant, Mr. Albert Koebele, and left Newport News, Va., on the 2d of December, on board the British steamer Borghese. Landing at St. Thomas, in the West Indies, on the 9th of December, we took advantage of the few hours' delay of the steamer in that port to examine what cotton and other industrial plants we could find for injurious insects. We collected some scale insects on the "sapadilla" tree and sent them to the Department. We found no injurious insects on the few cotton plants examined.

We left St. Thomas on the same day and reached Para on the 18th of December. Here we improved the opportunity to examine orange trees for scale insects, and in the few hours we were able to spend on shore we made a small collection of insects from these trees. Fortunately we were able to visit the Natural History Museum of this province, which we did in hope of finding something interesting in the way of insects injurious to vegetation, especially of those attacking cotton, cane, and orange plants. No such insects, however, were found in the collection.

I made inquiries of the officers of the Brazilian navy station at the marine arsenal at Para concerning the winds prevailing along the northern coast of Brazil, and along the Amazon Valley. I made similar inquiries of the commanders of the steamers plying on the Amazon and

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* The principal objects of Mr. Branner's trip to Brazil, as detailed in his letter of instructions, were as follows:

1. The gathering of historical information upon the culture of cotton in Brazil, including the determination of the species of insects known to affect the crop there, and the collecting of facts relating to their habits.

2. To ascertain whether or not *Aletia xylina* is found in the vicinity of Bahia, and to collect specimens in all stages of this and allied insects.

3. To obtain as complete memoranda as possible of the prevailing course of winds at different seasons of the year.

4. To obtain specimens and information relative to the insect enemies of the orange and the cultivation of the crop.

5. To obtain specimens in all stages of the destructive locusts of Brazil, together with publications on the subject.

its tributaries, and especially of those who have run on the river for a number of years.

We left Para December 19, and on the 22d arrived at Maranhão. At this place the delay of the steamer was too short to allow of any investigations, however short, in the field. I had time though, to call upon his Excellency, the President of the Province of Maranhão, and to solicit his support in carrying on the investigations intrusted to me. He cheerfully promised to aid me in every way in his power, and furnished me with the names of such planters in the interior as would be able to answer any inquiries in regard to the diseases common to cotton and cane, and the methods of cultivation employed in this country. I am indebted also to Snr. Themistocles Aranha, the editor of the *Paiz*, the leading newspaper of the Province of Maranhão, for valuable historical information upon the subject of cotton culture in this part of Brazil.

On the 27th of December we landed at Pernambuco. My original instructions had been to proceed to Bahia to carry on my investigations, but sufficient liberty of action was allowed me to enable me to stop at some other point, should I find it better adapted to the purposes of my work.

Taking into consideration the importance of the province of Pernambuco as a cotton-growing district, as compared with the province of Bahia, the nearness of the cotton district to the coast, and its consequent accessibility, its geographical position in relation to the southern United States, and its proximity to the Bahia district, I concluded that it would be best for us to go into the interior from this place.

Before leaving Washington, we had, at your request, been furnished letters from his Excellency the Brazilian Minister at Washington, Snr. Lopes Netto, to various officials in Brazil. One of these letters was directed to the President of the Province of Pernambuco. On the day following our landing, I called upon his Excellency the President. He gave me a set of the reports of the Presidents for several years previous, from which I could collect information concerning the production of cotton and cane, and directed that letters should be given us to the local authorities in the places we might visit in the cotton-growing district. I called also upon Dr. Portella, for many years the president of the Pernambuco Society of Agriculture, to obtain information in regard to the localities most favorable for our work, and to learn also what had been done by the Society or by the Government in the way of investigating insects and diseases common to cane and to cotton in this province. He gave me some publications made by the Society, and presented me to other gentlemen who gave me valuable information in regard to insect pests, cotton culture, &c.

The cotton region, through this part of Brazil, lies just inland from the cane-growing lands, which form a belt along the coast from 35 to 50 miles wide. Toward the south of the province Garanhuns is the center of the cotton-producing area. Further inland the production is smaller,

owing to the increased cost of transportation, while along the coast cane is supposed to be more profitable and better adapted to the climate and soil. Distance inland, however, is not an insurmountable obstacle in the way of cotton culture here, for some of the places most noted for the amount and quality of cotton sent into the market are situated on the northern confines of the province, or even in the province of Parahyba, or in Ceará. It is no uncommon thing for cotton to be carried 400 miles on horseback. In the northern part of the province some of the principal cotton-yielding regions are about Brejo, and in the province of Parahyba about Campina Grande and Independencia, while to the westward Riancó, in Parahyba, is a good cotton-growing district, as well as Pesqueira, Alagôa de Baixo, and Ingazeira in Pernambuco.

Although I conversed with many intelligent persons in the city of Pernambuco, several of them members of the Agricultural Society, upon the subject, I was unable to find out certainly whether such a thing was known as a caterpillar that devoured the leaves of the cotton plant. Dr. Portella informed me that many years ago—perhaps forty—some kind of a plague attacked the cotton so seriously that its cultivation was very largely abandoned by the planters. He knew nothing, however, of the nature of this plague. The only evidence I could find of the existence of such caterpillars in this part of the country was a verse of a popular song, formerly sung by the poorer classes hereabout. My attention was called to it by Snr. José de Vasconcellos, the editor of the *Jornal do Recife*. Aside from this, the only insect I could learn of as being injurious to cotton in any way was the locust, which, as I was told, sometimes ate the leaves.

After consulting with those most capable of advising me in such a matter, I decided that Bonito, in the province of Pernambuco, would be the best place for our work. The President of the Province and Dr. Portella furnished us with all necessary letters of introduction to the local authorities, and to such persons as would be able to aid us in the vicinity of Bonito, and on the 4th day of January, 1883, we left Pernambuco for that place. We took the São Francisco railway as far as Palmares, and there hired horses to carry us and our baggage to Bonito, about a day's ride to the north.

Remaining over night at Palmares, I met and conversed with some of the engineers in charge of the extension of the São Francisco railway.

In making inquiries in regard to the prevailing winds, I learned that a series of meteorological observations had been made by the engineer corps at this place, extending over a period of six years. I availed myself of the opportunity to copy the record, and consider myself fortunate in having this, the only carefully made series of observations that I am aware have been made so far from the coast in this part of Brazil. They cover the six years from 1877 to 1882, inclusive.

On the day following our arrival at Palmares we took horses for Bonito, and arrived at our destination in the evening of the same day.

The village of Bonito is a small one, on the southeastern border of the cotton-growing district. There being no hotel in the place, and it being impossible to arrange any other way to live and carry on our work, it was necessary to hire a house for these purposes. With considerable difficulty one was obtained, and preparation made for a short stay in the place.

Arriving at Bonito on the 6th of January, it was my expectation that we would be able to leave for the provinces further south, in which much cotton is grown, within a couple of weeks at the most. It was found later, however, that in order to carry out our investigations satisfactorily it would be necessary to remain at Bonito much longer than I originally proposed. The fact that we had arrived so early in the season, as far as insects were concerned, also made it necessary to remain here longer than would have been necessary had we come later, say in April or May, when insects are more active.

Once in the cotton-producing country, there was no difficulty in learning of the existence of caterpillars that destroy the plants. On the day following our arrival we visited some fields of cotton near Bonito, but, though we found various interesting insects injuring the plants, we were not able to find any indication of the existence of caterpillars. The people assured me that it was too early in the season, and that the weather was not of the kind favorable to these insects. The next day, however, Mr. Koebele found both larvæ and eggs, and, although they never appeared in large numbers during our stay at Bonito, from that time forth we found a few every day. In order to obtain as good a collection as possible of these insects in every stage of development, and of their parasites, we arranged to breed all we could find until our collections and observations were complete. At the same time especial efforts were made to find and raise caterpillars that feed upon other species of malvaceous plants. We had about a hundred breeding cases in our house for the different kinds of insects, parasites, &c.

We made observations on and collections of insects injurious to other industrial plants, such as oranges, coffee, corn, beans, tobacco, &c., and also of useful insects, such as bees.

Sugar cane is not grown at Bonito in sufficient quantity to allow of our doing much in regard to the sugar-cane disease, or insects affecting it. At the city of Pernambuco I learned that the Imperial Government had appointed a committee to investigate the causes and report upon remedies for the cane disease that has been doing great damage in this country for several years, but I was unable to find that anything had been made public in regard to what the committee had accomplished. The Pernambuco Agricultural Society had sent specimens of diseased cane to Germany for examination, and a short report from the gentleman to whom they were sent was given me. This report says that a

species of fungus was found in the specimen sent for examination, but that it is impossible to say whether the disease is caused by the fungus.

We made observations on and inquiries in regard to the direction of winds, the ravages of locusts, and insects injurious and beneficial to agriculture. Mr. Koebele captured a large number of moths at night upon the flowers of a species of *Cleome* that grew abundantly about our house. Among the noctuids were a very few cotton moths. The collection we made of these insects was obtained almost entirely by breeding them from the larvæ. The moths first bred from larvæ feeding on cotton were unlike those so injurious to the cotton plant in the United States, but later we found another kind, though not in such numbers, which is identical with that of the Southern States. The planters informed me that it was the latter and somewhat larger of these two larvæ that does the greatest damage to cotton in Brazil. Up to the time of our departure from Bonito there were but few of these caterpillars to be found.

Having completed the work at Bonito as nearly as possible in the time at our disposal, we left that place on the 7th of February for Pernambuco, on our way to Bahia, taking with us a collection of insects, which we estimated at about 10,000 specimens.

Between the time of our arrival in the city of Pernambuco and our departure, our time was occupied in arranging our collection for shipment to Washington, and in making preparation for further field work in the province of Bahia.

We arrived at the city of Bahia March 11. As was to be expected, we learned that the cotton-growing part of the province of Bahia was far inland, and that though this port formerly exported large quantities of cotton, there is no export at present, and even the few cotton factories in the province are obliged to import their raw material from Pernambuco, Alagôas and Sergipe.

The Baron of Guahy, President of the Commercial Association, kindly furnished me with the official statistics of the exports of cotton from Bahia since 1862. These statistics show that the exports of cotton from Bahia fell from 7,000,000 kilograms in 1868 to nothing in 1880.

In the commercial reports of one of the leading daily papers of Bahia I noticed the following in regard to cotton, the paper bearing the date of March 14, 1883:

IMPORTS: Cotton, 863 bales from Alagôas and Pernambuco, principally on account of different cotton factories.

Under the head of exports it is remarked:

Cotton: No exports from this province.

Taking such facts into account, the great distance from Bahia to that part of the province in which a little cotton is grown for domestic purposes, the dearness of transportation to such places, and the shortness of the time at our disposal, I thought it best to abandon all thoughts of a trip into the interior. My decision was also strengthened by the

fact that I found that Dr. Antonio de Lacerda, a Brazilian gentleman living at Bahia, and one already well known for his intelligent interest in, and contributions to, entomology, informed me that he had bred a moth from a larva found by himself upon cotton in the suburbs of Bahia. Dr. Lacerda gave me this specimen. It is the same as the larger cotton moth found by us at Bonito, and the same as the one common in the United States.

I hoped, however, that we might be able to find the other moth in the immediate vicinity of the city. With this object in view, we examined all the cotton plants we could find growing about the houses in the suburbs, and were fortunate enough to obtain a number, both of larvæ and of eggs, which being bred, gave us both species of moth found at Bonito. We considered this sufficient evidence of the existence of both species of cotton moth at Bahia, and made arrangements to stop field-work and leave Bahia at once.

In order to obtain all available publications upon entomology, historical facts and statistics of production and exportation from the whole empire, and also to obtain the indorsement of his Excellency the Minister of Agriculture for the circular I proposed sending out asking for information, I found it necessary to continue my voyage to the capital, at Rio de Janeiro. Arriving in that city on the 29th of March, I prepared at once a circular containing fifty-two questions asking information in regard to the history of cotton culture in the country, the kinds planted, the methods of working and harvesting, the climate and soil found most favorable to it, the diseases and insects that attack it, and the remedies used for such evils; and also concerning oranges, varieties, methods of propagation and cultivation, and the insects and plants injurious to the trees. This circular included inquiries concerning the destructive locusts and concerning the direction of the winds. It was submitted to the Minister of Agriculture for his approval, and he cheerfully indorsed it, and urged those who might receive it to give it their careful attention. Five hundred copies of this circular were printed and sent out through the empire, more especially through those parts of the country where cotton is or has been grown most extensively. The presidents of the provinces of Pernambuco and Maranhão aided me in directing these circulars to planters and other persons who were able to give me intelligent and trustworthy answers.

During my stay in Rio de Janeiro I got together all the information and special reports to be had in the Portuguese language upon entomology. These consisted of a few valuable articles by Fritz Müller, published in the *Archivos* of the National Museum, and a few miscellaneous contributions to be found scattered through old periodicals in the National Library. These latter articles, however, are rather curious than valuable, and could only be had by copying from the books. Through the kindness of Mr. W. T. Gepp I obtained access to the reports and statistics of Brazilian commerce kept by the Commercial Association in Rio de Janeiro, and

was thus enabled to make as complete a table of the exports of cotton from the whole empire as it is possible to obtain. I have arranged these tables so as to show the exports both by years and by provinces, and have reduced the weights, which were originally given in arrobas and kilograms, to pounds. Anything like a complete report of exports can only be had as far back as 1851–'52. From other sources I found that cotton had been exported from Brazil as early as 1760, when 20,833 pounds were shipped from Maranhão. From 1851–'52 to 1875–'76 the total exports from all the provinces reached 1,532,272,075 pounds.

I gathered some trustworthy information in regard to the ravages of the cotton insects in the province of São Paulo, which is the most southerly province in which cotton has been grown successfully, and with it an idea of the percentage of loss caused by these insects in that part of the country.

From the works of M. Mouchez, formerly a lieutenant in the Brazilian navy, and a good authority on the subject, I have obtained a series of charts showing the direction of winds along the northern coast of Brazil for each month in the year. From Maury's data, as furnished me by the United States Hydrographic Office, I have also constructed charts for each month of the year, showing the same thing.

In addition to the reports on winds, already mentioned as having been obtained at Palmares, in the province of Pernambuco, I received from Dr. Draennert, the director of the Imperial Agricultural School at Bahia, a report on the direction of winds at that place, the observations having been made by him, and covering a period of six years. This report includes information in regard to the force of the winds.

Having obtained all the historical and statistical information to be had in Rio de Janeiro upon the subjects which I was directed by you to investigate, and having sent out the circular questions asking for further information on these subjects, I embarked at Rio de Janeiro for New York on the 18th of April, and reached Washington on the 16th of May of the present year.

I have already received a number of valuable replies to the circular and shall doubtless receive others before the report upon my work will have been finished.

I have the honor to be, sir, your obedient servant,

JOHN C. BRANNER,
*Special Agent.*

Prof. C. V. RILEY,
*U. S. Entomologist.*

## REPORT ON THE EFFECTS OF COLD UPON THE SCALE INSECTS OF THE ORANGE IN FLORIDA.

By Joseph Voyle.

Gainesville, Fla., *December* 10, 1883.

Sir: I have the honor to present the following report of experiments made with cold temperatures on scale insects injurious to orange trees. These experiments were made for the purpose of obtaining some information as to the extent of relief given by frost to infested trees, there being a very general belief that any damages to the tree by frost are fully compensated for by the destruction of injurious insects. Several successive winters with cold of such severity as to, in some cases, seriously damage orange trees, having been followed by heavy swarms of destructive scale insects, gave reason for doubting the truth of the accepted theory. During the past winter, 1882–'83, by some special observations, positive evidence was obtained that often very little damage was done to scale insects by cold that killed the tender orange shoots. On the morning of December 16, 1882, the thermometer was reported at various figures, from 19° to 25° F. My own lowest reading was 25°. On this morning I cut orange branches incrusted with scale insects and found young migratory larvæ of *Mytilaspis* running about quite lively.

By your direction I entered upon a series of experiments that should as nearly as practicable solve the question of "What temperature is fatal to the larvæ and to the eggs of these scale insects?" The laboratory of the East Florida Seminary, with its apparatus, was placed at my service for this work, but fire destroyed the building and contents before the work was begun. It was therefore necessary to devise some inexpensive means of accomplishing the work. The final result of experiments for this purpose was a freezer composed of three tin cylinders of 10 inches, 6 inches, and 2 inches diameter, respectively. The 6 inch was placed within the 10-inch, and by means of a collar both were fastened together and the space between them filled with dry feathers; another collar then fitted on, and all soldered tight. A suitable collar being fitted to both ends of the 2-inch cylinder (which was only 10 inches in length, the others being 14), it was placed within the 6-inch, equidistant from the ends, and soldered tight, thus leaving room for a head 2 inches thick and 6 inches diameter at each end, the heads being packed with dry feathers. Thus was obtained a central chamber within an empty annular chamber, surrounded by another annular chamber filled with a good non-conductor; the central chamber for the speci-

mens and thermometer, the empty annular chamber for the freezing mixture, filled through a short 1¾-inch tube.

Method of using: The specimens and registering maximum and minimum thermometer were placed in the central chamber, the freezing mixture placed in the empty chamber, and the temperature allowed to gradually sink to the desired point, the indices of the thermometer then set to the mercury, and all closed by the heads for the desired time. On opening, the thermometer readings were at once taken and the temperature allowed to rise gradually to that of the atmosphere. The freezing mixture found to be most satisfactory was ice and salt, varied in proportion as required in each case. As will be seen by the table, the larvæ were killed at a temperature above 32° F., and eggs hatched after being subjected to 25° F.

In experiments where, as in these, there is no previous experience to guide the examiner, it is necessary to make various experiments for instruction as to the value of appearances. Sometimes larvæ retain for several days an apparently natural appearance, leaving it doubtful whether their final death is the result of the temperature or want of food. If a small beam of the sun's rays be brought to a focus on the stage of the microscope, the larvæ placed on a slide, the living larva on being brought into the focus of the rays always moves quickly, draws up its sucking tubes, and otherwise shows signs of life, the dead larva showing no motion under the same influence.

The motion of the one is not attributable to heat on inert matter, but to sensibility indicating life, and affords a method of examination before the question of starvation can arise. At moderate temperatures, 30°–32° F., some eggs turn brown and collapse, whilst others, even in the same scale, retain their form and color. This was for a long time unaccountable; at length the brown was found to characterize eggs very near hatching. In experiment No. 10, where some eggs hatched after a temperature of 25° F., out of a large number only three hatched, and of these three only one had strength sufficient to slowly leave the position of the eggs; the others showed life by motion of their legs and antennæ. As a temperature of 19° F. was reported here last winter without clearing off the coccids, a lower temperature was supposed to be necessary, and the first experiments were at 16° F.; then, as results were ascertained, higher and higher until at 24° F. it appeared that the limit was reached. The eggs of *Parlatoria pergandii* and *Mytilaspis citricola* appeared to require a lower temperature for destruction of their vitality than the eggs of *M. gloverii*. Special experiments for this purpose showed that there was only a delay of the changes of appearance, no eggs hatching after a temperature of 24° F. To be practically serviceable, artificial conditions in experiments must approach some form of the natural condition of which information is required. In these experiments the nearest practical approach to nature was taking the insects at the greatest exposure in a still atmosphere. If, then, the temperature

reported, 19° F., be correct, scale insects with only moderate protection should have been killed, and all their eggs with them; but such was not the case. Both thermometers and readings are often questionable. Unreliability of graduation of common instruments, particularly below the temperate figures, and readings made by parties unaccustomed to accuracy, may be taken as a reasonable explanation of wide discrepancies.

There are conditions practically unattainable artificially, where the coccids are protected from the effects of such temperature as under favorable conditions would be fatal to them. The leaves of the tree, the warm current rising from the ground around the trunk of the tree, and the initial heat of the tree itself perform an important part in modifying temperature for these insects. In a still atmosphere this might become a perfect protection against a temperature much lower than would prove fatal in other conditions. Again, a cold, moist breeze following a rain might lower this protection to a fatal point. Casual observation warrants the supposition that these conditions do occur with the results as supposed. Valuable information could be obtained by using registering thermometers within the protection of the head of the tree, and, on the outer branches; a comparison of records would indicate the amount of protection, and give data for ascertaining approximately the amount of cold required to reduce the temperature all over a tree to a point absolutely fatal to coccids: probably a temperature fatal to the tree also.

The table has been arranged from the notes so as to present results without unnecessary details. The experiments were repeated for verification, and also whenever any results were doubtful.

The table may be regarded as an accurate exponent of the effect of low temperature on orange coccids.

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*Table showing results obtained by exposing orange scale insects to various degrees of cold.*

| No. of experiment. | Minimum temperature. | Maximum temperature. | Time of exposure. | Result to larvæ. | Result to eggs. | Time from exposure to final result in eggs. | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | *Hours.* | | | *Days.* | |
| 1 | 16 | 24 | 5 | Dead | Dead | 31 | |
| 2 | 19 | 32 | 10 | do | do | 12 | |
| 3 | 20 | 25 | 10 | do | do | 4 | |
| 4 | 22 | 22 | 5 | do | do | 7 | |
| 5 | 22 | 22 | 3 | do | do | 12 | |
| 6 | 22 | 22 | 1 | do | do | 14 | |
| 7 | 23 | 23 | 1 | do | do | 14 | |
| 8 | 25 | 34 | 10 | do | do | 20 | |
| 9 | 25 | 25 | 5 | do | do | 12 | |
| 10 | 25 | 34 | 16 | do | Hatch | 8 | 3 eggs only out of a large number. |

*Results obtained by exposing orange scale insects, &c.*—Continued.

| No. of experiment. | Minimum temperature. | Maximum temperature. | Time of exposure. | Result to larvæ. | Result to eggs. | Time from exposure to final collapse of larvæ. | Remarks. |
|---|---|---|---|---|---|---|---|
| | | | *Hours.* | | | *Days.* | |
| 11 | 29 | 29 | 1 | Dead | Hatch | 5 | |
| 12 | 29 | 32 | 1½ | do | do | 5 | |
| 13 | 29 | 34 | 2 | do | do | 6 | |
| 14 | 30 | 32 | 16 | do | do | 5 | |
| 15 | 30 | 32 | 10 | do | do | 10 | |
| 16 | 32 | 32 | 12 | do | do | 10 | |
| 17 | 32 | 32 | 5 | do | do | 5 | |
| 18 | 32 | 34 | 1¼ | do | do | 6 | |
| 19 | 34 | 34 | 11 | do | do | 3 | |
| 20 | 34 | 34 | 3 | do | do | 3 | |
| 21 | 34 | 34 | 2 | do | do | 6 | |
| 22 | 36 | 36 | 2 | do | do | 8 | |

DECEMBER 26, 1883.

During my recent absence from home there was a short period of cold weather, which on my return I found had produced naturally nearly all of the conditions that in my experiments were produced artificially.

Although I was only 10 miles directly south of here, at the place where I was the effects were very slight, and near by there were no traces of frost, tomatoes and bell peppers out of doors being unhurt.

Had I known in time the extent of the damage elsewhere I could have made some valuable observations.

The thermometer is reported at various figures, ranging from 21° F. to 30° F. The effects show as wide a difference.

In the same neighborhood I find young orange trees killed to the collar at the ground, and orange and lemon trees that are unhurt, and these are sometimes within a few yards of each other.

Six days after the frost, examination showed that the defoliated branches infested by insects were dead, whilst others not so exposed were living, and that where the small twigs were not killed there were some living eggs.

I also find the same appearances as in the experiments, eggs dead and living in the same scale.

The stated probable effects of the initial heat of the tree, &c., are realized and very distinctly marked. I inclose a twig showing this. The outer portion is dead, and the eggs are also dead. The basal portion cut from near the body of the tree is living, and there are also there at this writing some eggs that are clear and pink.

This cold term was calm, the greatest cold of short duration, not more than an hour. The conditions were as nearly a reproduction of those of the experiments, probably, as ever occurs naturally, and the results are so similar as to give greater value to the information artificially obtained.

Respectfully,

JOS. VOYLE.

Prof. C. V. RILEY, *U. S. Entomologist.*

## EXTRACTS FROM CORRESPONDENCE.

### Water-proof Insecticides.

For years I have been investigating the habits of insects injurious to fruit and vegetables. I find that all insects are more or less susceptible to smells, and their depredations can be largely prevented by the use of some pungent odor. The curculio (*Conotrachelus nenuphar*), for example, can be almost entirely driven from plum-trees by the oil of penny-royal mixed with lard and rubbed on the branches, or cotton wool saturated with the same and suspended in muslin bags throughout the tree as soon as the first blossoms begin to open. I have never known this to fail, if done in season and thoroughly and at once renewed in case of rain. I have also used to advantage a strong decoction of quassia against the rose-bugs (*Macrodactylus subspinosus*). I have made various successful experiments in this line. I think I have made a faithful test of all the well-known insecticides, and am fully satisfied that when decoctions, tinctures, or emulsions are used, or when the poison can be temporarily held in suspension, the finer the spray the more efficacious appears the remedy. I think there can be no question on this point. A single trial of the tincture of pyrethrum will be sufficient to prove this statement. How far pyrethrum can take the place of Paris green or London purple may still be an open question, or whether refined coal-oil mixed with milk or other ingredients will supply the use of these poisons and be equally effectual without the consequent danger.

In the use of the various liquid insecticides in my experiments I found that their effects were often entirely nullified by exposure to the air, or the material itself was washed off by the first rain. This led me to experiment how to avoid this trouble. An addition of glue and bichromate of potash proved the best remedy. I use from one to two ounces of glue and one-quarter ounce of the bichromate to a gallon of the liquid. The glue should be soaked twenty-four hours in cold water; then dissolved in hot water. The two are to be thoroughly mixed with the liquid insecticide. The application should in every case be made in the form of a minute spray. After the evaporation of the moisture, which takes place in a few minutes, there remains an almost water-proof residuum retaining all its virtues. I believe I have given these experiments a most thorough trial, and that the result has been all that could be desired. There are other chemicals which will produce similar results, but, as far as my experience goes, the above has proved the best.

I think there is hardly any limit to the application of a water-proof insecticide when applied with a proper apparatus.—[WILLIAM PLUMER, *Lexington, Mass., January* 22, 1883.

[We were very glad indeed to receive the full account of Mr. Plumer's experiments with water-proof insecticides. For a number of years past we have been at work at the same point, especially with reference to the Southern cotton-worm, and the latest and most satisfactory results in preventing the washing off of insecticides by rain have been obtained by the perfecting of machinery for spraying the under-sides of the leaves. A long series of experiments with adhesives, such as dextrine, mucilage, gum-arabic, and molasses show that such substances can be used to some considerable advantage, but that this advantage is soon limited by the closing of the stomata of the leaves, thus injuring the plant, and by the interference which they offer to the use of a very fine spray. With Mr. Plumer's particular formula we have not experimented, but we will see that careful trial of it is made next season. His experiments, as given in his letter of the 22d instant, are interesting, but we are rather skeptical as to the use of pennyroyal for the curculio, as we have always found that this insect was very slightly affected by malodorants, and it is so easy to mistake a natural disappearance for the result of a remedy.]

## DESTRUCTION OF SCALE INSECTS BY COLD.

* * * I mail you with this a piece of orange branch covered with *Mytilaspis* that has been submitted to a temperature lower than usually, if ever, occurs in this State. It was first placed in the chamber of the glacier at atmospheric temperature 82° F., and the temperature gradually lowered to 42° during one hour; then the cooling was forced, and left for four hours, when the reading was 24°. The indices were then brought to contact, the chamber closed, the cooling forced, and then left for twelve hours. At the end of that time the chamber was opened, and the maximum immediately read, being 30°. The minimum index read 16°. Therefore, after cooling for five hours, the coccids were subjected for twelve hours to a temperature commencing with 24° F., descending to 16°, and not rising above 30°. A microscopic examination was immediately made. No sign of life was found in the larvæ examined. The eggs appeared natural. After drying in the atmosphere the forms of many of the larvæ appeared shrunken; some eggs had collapsed, leaving white forms; others retain, after twenty-four hours, their usual form. They will be examined from day to day, to see if any of them can bear the treatment, and hatch, so as to be a guide for the next freezing. * * * —[JOS. VOYLE, *Gainesville, Fla., May* 15, 1883.

[A careful examination of the scales received failed to show any live eggs.]

## A Pine Saw-fly from Arkansas.

I send you specimens of the pine worm of which you have received mention. They are fast disappearing, but a great many of the largest trees are completely stripped of their foliage, and the sign of their ravages is visible on every tree and bush. I have never noticed but one instance where they had eaten any other tree than the pine, and that was a small ash on which a few had lodged in falling from a tree after defoliating it. The leaves of the ash had been eaten to a slight extent. They never touch the new growth, but confine themselves entirely to the growth of last year. * * * —[W. A. Moseley, *Camden, Ark.*, *May* 4, 1883.

[The pine worm proved to be the undescribed larva of a saw fly of the genus *Lophyrus*. These insects undergo their transformation to pupæ in silken cocoons on the surface of the ground, among the leaves and other rubbish; hence burning over the surface of the ground in winter, where it is possible, will be a good remedy. Ornamental trees can be preserved from their attacks by syringing them with hellebore water or Paris green water.]

## Saw-fly Larvæ on Wheat Heads.

I have as fine a field of wheat as I have seen this season. This morning, in looking over it, I find upon the heads quite a number of such worms as are here inclosed. They take a portion of the grains out of the heads they attack. They are not very numerous, perhaps three or four in a rod square. I am at a loss to know what they are, or whether they will materially injure our wheat. My neighbors also have them. Will you please inspect them?—[J. C. Hostetter, *Minerva, Ohio*, *June* 16, 1883.

Your favor of 21st instant is at hand; also mailing box and stamps.

I have just returned from a walk around a twenty-acre field of wheat. My object was to pick off a dozen or more of those worms to send you. To my utter surprise (though making diligent search) I found but three, one of which I lost on my way to the house. Only a week ago I could have found any number of them in the same field. They are now gone, having either dropped off, or been taken by the birds, or both. Please pardon me, therefore, for sending only those two discoveries for inspection. If I find more I will send again. I think these are full size, or nearly. I found them on small heads of wheat, the same inclosed. You are evidently clearly right in saying we need not apprehend much damage from them. Their time is of short duration and seems to be confined to the period soon after the wheat is in head. I don't think they affect the kernels when fully formed.—[J. C. Hostetter, *Minerva, Ohio*, *June* 25, 1883.

The larva above mentioned was that of a species of saw-fly (family *Tenthredinidæ*). We sent for a number of additional specimens in order to endeavor to obtain the mature insect, for we did not recall any record of injury to wheat by a *Tenthredinid* in this country. Curtis gives an account of one in Europe, the description of which agrees very closely with this larva, but from his account it would seem to have come from some neighboring woods and not to have been naturally feeding on wheat. As many of the saw-fly larvæ, when abundant, have a habit of wandering from their original food-plants, such may have been the case in this instance. We endeavored to get positive evidence of its wheat-feeding habits, but failed, and the larvæ received from Mr. Hostetter died before transforming, so that the species was not even ascertained. The same larva was reported by W. S. Chamberlain, Secretary of the State Board of Agriculture, as occurring on wheat at Columbus, Ohio.]

## Tineid Moths in Dried Fungi.

Please allow me the privilege of sending you a specimen of my collection of fungi and their foe, and, if not too much trouble, please tell me the name of the insect. These fungi were put in a strong paper box and tightly wrapped in three folds of paper and tied with twine to prevent the moths from depositing on them their eggs. It seems that the larvæ bored through paper and box and gained access to them. Corrosive sublimate, &c., does not appear to protect them unless *saturated*. The only way I have succeeded in saving specimens is to put them in tight boxes with a sponge saturated with chloroform.

I sent you specimens once before. You wrote me you thought them new. Your final answer is given in *American Entomologist*, vol. 3, p. 297—*Cis fuscipes* Mell. Evidently a mistake has in some way happened.—[J. J. Brown, M. D., *Sheboygan, Wis., May* 15, 1883.

[The moth proved to be *Scardia cloacella*, Haw., allied to the common grain moth. There was no mistake about *Cis fuscipes*. Both species were received, and both infest the fungi.]

## The Apple Maggot.

* * * In regard to the apple maggot, I can say that with us it is a pest equal if not exceeding the Codlin moth (or its larva). It attacks both early and winter fruit, greenings and Baldwins seeming to be its choice, sometimes, yes often, completely honey-combing the fruit. We have fed out quantities of apples infested with this maggot.—[S. E. Frisbie, *Milford, Conn., March* 15, 1883.

Your very obliging letter, acknowledging receipt of the Dynastes pupa, should have been noticed sooner, but I wanted to find some memoran-

dum of what I now suppose was a rare opportunity to have studied this beetle. None is to be found. I am ashamed to own it, and to offer my memory of what occurred years ago. In fact, at the time, I noticed such things merely for my passing pleasure, without the least notion of interesting the world. It was as I mentioned: In March of 1868, a large post-oak tree I had cut for rails, posts, and wood, was found hollow at the top; the cavity some 10 feet long, and branching into the larger limbs, by 12 inches in diameter. I do not recollect seeing any large opening into the cavity. There were small holes, such as might have been made by woodpeckers and squirrels. Within, the trunk contained no nests of birds or other animals, but some decaying acorn hulls, sticks, and leaves. The lower half contained a black, damp mass of decaying vegetable matter, rotten wood and fungi. In this rotten and decaying mass were numbers of grubs, evidently grubs of beetles, and in size from 1 inch to 4 in length; at the top, in looser, drier matter, were several pupæ, and amongst the old sticks and leaves numbers of perfect beetles, most of them dead and in pieces, but a few still alive. * * *

I send you a small tin box containing the nest of a sand bee of some kind. There were four cells originally, as plowed up in a cotton field 6 miles northeast of Selma, but the curiosity of a companion destroyed two of them before I was aware. A more curious thing, also, in the box—unless you have seen the same before—is a large tick laying her eggs. On the 10th of March the tick was found, full of blood, at the foot of a bank, where a cow had recently rubbed it off after carrying it all winter. I placed it in a box, with loose cotton on top. Two weeks later, looking at it, I found it had shrunken to half its original size, and the first mass of eggs was extruded. It should have been sent you then, but I was busy about other things and it was overlooked. Now, after eighteen days, it has continued to lay, and another mass is hanging to it, whilst the skin seems shrunken very much.—[LAWRENCE C. JOHNSON, *Selma, Ala., April* 20, 1883.

[The nest of the "sand bee" was that of a species of *Osmia*, and the tick was the common *Ixodes bovis.*]

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## TEE SCREW WORM.

Permit me to call your attention to the Texas "Screw Worm," which was very troublesome to stock in Kansas last year. I am medically informed it is the *Sarcophaga georgina.* I send you a larval specimen. It kills a great many animals and some people. Neglected babies, children, and adults with nasal catarrh are sometimes afflicted and killed by it. We are told that it flies into the nose of a man the same as the bot-fly in the nostrils of a sheep, and lays its eggs or young. In animals a wound or blood attracts it. Calomel, chloroform, and carbolic

acid kill it. I shall blow dry calomel up a patient's nose or ear that is attacked when I treat it. It is said to prefer the dog and sheep for victims.

Hope we may see some facts published in next Agricultural Report about it, and oblige 10,000 Kansas farmers and stockmen, &c.—[W. S. NEWLON, *Oswego, Kans., March* 30, 1883.

[The larva was that of *Lucilia macellaria.*]

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## JUNE BUGS AND PEAR-LEAF MITES.

The "West Town Farm and Garden Club," at its meeting last Saturday evening, had two items before it, among others, which it wishes to refer to you for information.

The first regards a swarm of bugs that in large numbers at night are eating the foliage of the fruit trees on one or two neighboring farms. They are evidently a species of June bug, or May beetle, as some of the latter were found on the tree the smaller ones were taken from, one of which is inclosed with the smaller bugs.

The other item may not come in your department. If not, please have it put in the right hands.

A member brought in a branch of a pear tree, a twig of which is inclosed. The tree appeared perfectly healthy up to the time of its attack, when in twenty-four hours the leaves were all affected more or less as the sample inclosed. The club would like to know the nature of the disease, and the remedy, if any, for it; whether it is likely to be fatal, or contagious to neighboring trees.—[JAS. B. FISHER, *President, West Town, Orange County, N. Y., May* 21, 1883.

[The "June bug" eating the foliage of the fruit trees was *Lachnosterna tristis.* The best remedy will be found in attracting them at night by a light suspended over a tub of water on which is a thin scum of kerosene.

The diseased appearance of the pear leaves sent was caused by one of the gall mites—probably *Typhlodromus pyri.* We advised that the tree be sprayed with one of the kerosene emulsions spoken of in the Annual Report of this Department for 1881–2, pp. 115 and 116.]

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## THE GRAPE-VINE COLASPIS.

I send you some bugs in a vial. Please tell me what they are, and if there is any way to kill them or prevent them from eating up grape-vines and young grapes. Three years ago I planted out 75 acres in grapes, mostly Scuppernong variety, but some of all kinds. Last year these

bugs made their appearance in countless numbers, but I caught them in a cloth; but this year the vines are too large, and I tried several remedies and none will move them. Please inform me as soon as possible if you know of anything, and greatly benefit, yours, respectfully.—[JOSEPH A. HARPER, *Blackshear, Ga., May* 10, 1883.

[The beetle injuring the grape-vines proved to be the Grape-vine Colaspis (*Colaspis brunnea* Fabr.), treated in our Third Missouri Report, p. 81. The larvæ feed on the roots of plants, and often do considerable damage to strawberry plants. The best remedies found are in jarring them into sheets saturated with kerosene, and in spraying the vines with a Paris green or London purple solution in the proportion of 2 ounces of the poison to 10 gallons of water, thoroughly stirred.]

I have a vineyard of about 800 plants, of twenty or twenty-five different home varieties. It is in its fourth year on the ground, and up to the 12th ultimo looked perfectly beautiful and of a luxuriant growth, whilst the vines were almost all loaded with fruit of excellent form and size. An insect has since made its appearance in myriads and myriads, and perforated the leaves in such a way as to cause their becoming dry and falling. It attacked almost all varieties, less in some way the Concord, although the leaves are fearfully damaged. The grapes, thus far, lost none of their vigor, owing perhaps to wet weather, which, unfortunately, troubles us for all other crops very much.

In a separate parcel I send you some insects of the above. Please examine them, and let me know their history, and if there is any chance of a remedy for their destruction before they destroy our crop. Last year, too, we were troubled by the same pests, but to a smaller degree. If my statement is any way obscure, please call it to my attention that I may furnish you with further information. Our Scuppernongs are not damaged, but many weeds with large leaves, such as docks, are perfectly perforated, the same as our grape-vines.—[C. MENELAS, *Brookhaven, Miss., July* 6, 1883.

[This was same insect and the same advice was sent.]

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### STRAWBERRY FRUIT BEETLES.

Inclosed you will find some insects which have proved very destructive to my strawberries. I have only 400 plants in my garden, and last year should have been their best bearing year; but the crop was entirely destroyed by these insects. They came as the berries commenced turning, and we had very few to ripen, as they ate small holes in them, and then the whole berry became soft. I salted the vines when they were done bearing last year, thinking it might kill the bugs for this year. And I thought I had succeeded, as we gathered a splendid crop

of berries before the bugs came; but the last week of bearing the crop was again destroyed by the same insect.

Is it a new plague, or has it been known before, and can you tell me what it is, and what will prevent its ravages in the future?—[Mrs. GEO. SCHALL, *North Wales, Montgomery County, Pennsylvania, July* 4, 1883.

[The insect accompanying this letter, and which was said to injure strawberries, was a common beetle known as *Stelidota strigosa*, Schön. It has never been recorded as doing any appreciable damage to any crop before. It feeds ordinarily upon fallen fruit, in which the female also lays her eggs. The larva attains its full growth in a short time, and the beetle issues in late summer and hibernates in this state. With regard to remedies, it will be difficult to advise. Feeding on the fruit as it does, the ordinary poisons cannot be used. The insects and their breeding habits should be carefully studied on the spot; in this way a remedy can doubtless be found.]

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GREEN SOLDIER-BUG (RAPHIGASTER HILARIS) ON ORANGE TREES.

* * * You also request observations on the Green Soldier-bug. I forward by same mail twigs of the orange tree injured by the bug. The insects are coupling now. The females will soon lay the eggs in a cluster on a leaf, straddling over them while laying. The young appear in the latter part of February or the first part of March. As observed by the eye the young are black, with white spots, which color they retain until nearly full grown, when they acquire wings and change to a bright green. How this is done I do not know. They mature very quickly, and increase with surprising rapidity, continuing to breed until November. In the spring and early summer they confine their attacks principally to garden vegetables and succulent weeds. They are particularly abundant on tomato-vines, egg-plants, turnip-tops, and mustard, seldom doing much damage to orange trees at this season. When pea-vines are well grown, about or a little before the time of blossoming, they abandon nearly everything for the pea-vines. Last year they totally destroyed my garden. Not one tomato came to perfection. Where the insect had inserted its sucking-tube a reddish-yellow spot appeared. When cut the fruit was full of lumps and totally devoid of flavor. The tomato-vines grew so enormous a crop that the ground was almost covered by the fallen fruit. Last year I had 35 acres planted in cow-pea vines, which bore an enormous crop of peas; but not enough sound peas could be gathered to plant 5 acres additional land. Later it was impossible to find a sound pea. I attempted to turn under the vines, but so luxuriant was the growth that it could not be done. Towards the end of August the pea-vines were dead or dying, when the bugs swarmed to the orange tree, killing nearly all the

new growth. Immense numbers were killed by keeping men constantly going over the grove, shaking the trees, and killing all that fell on the ground. The wingless individuals were readily killed, but the larger number of the mature insects saved themselves by flight. This method of destruction was kept up until the middle of December, by which time very few were found. On very cold days the winged insects were nearly dormant and could not fly. I have the trees frequently searched now, but rarely find the bug. The number of the insects is incredible. When thoroughly shaken, the ground under the trees would be alive with the fallen insects, and two days later just as many would be found. I despaired of getting rid of them until the cold weather commenced, when I found the number rapidly decrease until their nearly total extinction.

As to the damage. The bug first attacks the latest growth, which wilts and droops while the bug is sucking; in a few days the shoot is dead; the same eye soon sends out another shoot which shares the fate of its predecessor, and so on until the eye has the appearance of a large bunch, as you will see on twigs sent. After all the tender growth has been destroyed the bug inserts his sharp sucking tube in the previous growth which has nearly hardened. Here I can only give you the facts and my theory; it is a fact that the insect sucks such wood, but the damage does not follow so quickly; but very soon after, on such wood known to be sucked, numerous bumps appear, which crack and exude a sticky sap, white at first, but soon a rusty red, and hard. Later on the insects suck the juice from fully-matured wood (an inch or more in diameter); on this wood the bumps do not appear, but the same kind of sticky sap exudes in tears, which soon harden and redden and are what I understand by "red rust." That the cause and effect are strictly true I can only surmise, but this much I and my men have seen: the insects sucking the sap as stated and the branches where sucked having the appearance described. In the winter months I have found clusters of the bugs on the stocks of the buds, two inches in diameter, and always an exudation of sap at these places, which I have never observed to redden as in the instances stated above. Why this is so, and why the insect leaves the more tender bud above to suck the sap from harder wood nearer the roots, I can offer no suggestion. At first I was strongly inclined to think that red rust was caused by soil-poisoning, but if so, why is it that trees have grown for many years on the same soil and never had this disease until the introduction of the Green Bug? To illustrate: When I bought this place ten years ago there was a field of five acres which had been in partial cultivation several years, and on which grew spontaneously the tomato and mustard plant, the two plants on which the insects thrive the best. (At present I can only find the insect on the mustard.) Since my purchase I have kept this field constantly growing pea-vines, as well as the forty other acres which I have in orange trees, thus giving every encouragement to the in-

crease of the pest. Adjoining this old field was a wild orange grove in a dense forest. Many of the sour stumps had large sweet buds, neither the buds nor sour trees giving any signs of the red rust until the winter following the clearing, and after a crop of pea-vines had been grown among the trees. Now the trees in this wild grove are just as much damaged as in the old field adjoining. Another case I will mention, and not trespass further on your patience. Five miles distant is the grove of L. Merritt, a wild grove budded. The buds are six years old and ought to be bearing heavy crops, but an occasional bloom is all. The trees have been in an unhealthy and "die back" condition for several years. When visiting his grove in the fall of 1881, I told him I had some trees in the same condition and was inclined to think the Green Bug was the cause. Since that time he has persistently hunted the bug, whipping it out of the large trees with poles, and killing wherever found; also he stopped planting peas. I have just visited his grove and found but two twigs damaged, and could not find a specimen of the bug. The trees have changed so remarkably in this grove that it was past recognition. Instead of a dense crop of dead twigs all over his grove, as at a previous visit, the trees had nearly doubled in size, and had a very large, healthy growth of branches in place of the dead twigs. I hear his trees are now in profuse bloom. I do not think that washes will do much damage to the bug. Very strong whale-oil soap rarely kills. Whale-oil soap, 1 pound; kerosene oil, 1 pint; water, 12 pints; sometimes kills when sprayed over them, nearly always when immersed. Pure kerosene kills, but not always instantly.

The Green Bug has a parasite. I do not know what, but I frequently find their shells with the inside devoured. Last winter I buried a number to see if plowing under would kill them. In ten days none were dead; in three weeks 20 per cent. were dead, nothing remaining but the shells; in six weeks all but one were dead, empty shells remaining. The living insect I put in a bottle with a little earth over it, hoping to find the parasite, but unfortunately in about ten days the bottle was broken, the Green Bug was dead, the empty shell as in the other instances.

At present the insect is very rare here; if found at all, generally on the mustard plant or a weed locally known as nightshade. Yesterday, while showing a lemon tree to some visitors, I found some of the twigs drooping and remarked it looked like the work of the Green Bug. One was found under a leaf close to his work. I send you one of the shoots. If at any time you may consider the subject of sufficient importance to send a trained observer in the field, I will be happy to see him here and place every facility at his disposal.

With apologies for the length of my letter.—[JAMES FRANKLIN, *West Apopka, Fla., January* 31, 1883.

### The Apple Tree Plant-louse.

Could you make it convenient to tell me the name of the inclosed Aphides? This is fruit year for the apples of Monmouth County, New Jersey, and the trees are almost black on the flower buds with these lice. The farmers are filled with apprehensions. Last night was a black frost, and it bids fair to be so to-night. But I find that, though numb on the trees to-day, they became quite lively when brought into the house. What do you think about them? Is it usual so early? Any information will be gratefully received.

P. S.—Just after making up the package my son brought me some buds of Bartlett pears similarly attacked. I opened the package and put them in. They are inclosed in tinfoil, thus separating them from the others.—[Samuel Lockwood, *Freehold, N. J., April* 25, 1883.

[The louse was the common *Aphis mali*, and it is not at all unusual to find them in such numbers thus early in the season. As a remedy we advised trying a very dilute kerosene emulsion, as described in our last Report for 1881–2, pages 112–116.]

### Oak Bark-lice.

With this note I send you portions of an oak twig (*Quercus aquatica*) which are incrusted with scales or galls, or whatever you may term them. The branch looks barnacled.

I do not remember ever having seen them before. The oak from which they came is growing on the roadside, and is about 15 feet high. The twig or young branch seems to have been twisted by some driver who wanted a switch, but who did not succeed in wringing it off. It is (as you will see from the young leaves) still growing, and upon this twig *only* were found the insect scales. Nowhere else on the tree are they to be seen—only on this hanging and twisted branch.—[J. H. Mellichamp, *Bluffton, S. C., April* 23, 1883.

[The bark-lice belonged to an undescribed species of the true genus *Lecanium*. The fact that they were found on the broken twig is of great interest, as bearing on the preference which all bark-lice seem to have for enfeebled trees and portions of trees.]

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### Cattle Tick on Human Body.

This tick was removed by a friend of mine—a physician—from the border of the arm-pit of a young lady. The tick had penetrated so deeply that it was removed with some difficulty without breaking it in

pieces. As far as I can ascertain by consulting Packard's Guide, I guess it may be a species of *Ixodes*. Is it a common pest?—[H. C. BEARDSLEE, *Painesville, Ohio, July* 1, 1883.

[The tick was a variety of *Ixodes bovis*.]

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### ORANGE RUST MITE, MEALY BUG, AND TAP-ROOT DISEASE.

Having business near Orange Lake during the past week, I visited several orange groves. I found all of the Florida varieties of scale-insects in abundance. Oranges are already rusty, and the rust mite in many places, on both leaves and fruit, in such large numbers as to give a distinct coloration, distinguishable at a distance of ten feet.

But the most destructive insect, at present absorbing all the attention of the orange-growers there, is the mealy bug, *Dactylopius destructor*. This insect causes the fruit to rot under the colonies. A favorite place of lodgment is at the stem, under the calyx; the result is, the fruit drops.

I staid there three days to examine methods used and experiment in their destruction.

The cottony armor repels all watery solutions.

The methods used are: spraying each separate colony with pure kerosene by means of bellows atomizers; and mechanical action—rubbing or pinching each separate colony (by colony I mean the little clusters consisting of from ten to several hundred individuals); this is done by the fingers.

I examined the trees that had been treated with the kerosene spray and found both the leaves and fruit spotted yellow. I was also informed that fruit saved in this way two years ago was useless, having absorbed the odor of kerosene. The effective progress made by the means used is trifling, in consideration of the work to be done. I tried experiments with solutions of murvite, sprayed on, but with no good result; then tried kerosene butter, using thick, milky solution of murvite, which combines in exactly the same way as with cow's milk, and found that an effective emulsion could thus be made.

After using and watching the action of this for some time, I saw that the interior insects of a dense mass were protected by the exterior ones; further experiments were made to meet this difficulty. By watching the men at work I saw that nearly every infested orange was handled to turn all of its sides to the eye; that wherever a large colony found lodgment in a fork of twigs or in a depression of the bark they were handled, also that the bunches of Spanish moss (*Tillandsia*) formed formidable breeding places. All of these require force for their dislodgment.

A strong stream of water was tried and proved effective, but laborious, and the insects falling to the ground were not killed.

Experiments with solution of murvite, made under a microscope, showed that in all cases where the solution came into actual contact with the skin of the insect the bug was instantly killed. Acting upon this and the knowledge gained by previous observation and experiment, I tried the effect of a fine, solid stream issuing under pressure, using a solution of murvite, one part, to water two hundred and fifty parts. The results were excellent; the solution being forced into the colonies broke them up, and coming into contact with the insects killed them, the method of working being one man at the pump, another to guide the stream. The apparatus improvised being badly adapted to the purpose is very awkward. The work, although about four times as fast as with the bellows atomizer, is not adequate to the economical requirements. This method has the merit of no loss by damage to fruit or leaves by the material used; the waste, falling on the leaves and branches, will exterminate both scale insects and rust mites, these being plentiful, but neglected in the presence of the more pressing necessity of saving the growing crop from destruction by the mealy bug.

Business required my presence at home, so I was obliged to leave. As I can do so, I will try to fit up an apparatus adapted to this work. Having none of the insects here, or, as far as I know, nearer than the ake, twenty miles distant, I cannot make any experiments at home as I would like to do.

At Micanopy I found several large trees dying slowly from some unseen cause. Some time ago I induced one person to dig under the lateral roots and examine the tap root of a tree in a similar condition; result, bark of tap root not all rotten. I was not present to examine it. The tree being large and yielding well, the owners generally prefer to take the chance of recovery to any act that may expose the roots and increase the damage; but the matter is important and statements are confused; some say that a white worm causes it; others, white ants; others, wood lice. I have found trees damaged by each of them, but they differ from the causes at Micanopy. I have heard of its being serious at other places.

Can you advise me of the best means of proceeding, what to look for, and how to look for it, so that if I have opportunity I may intelligently search into the matter?—[JOS. VOYLE, *Gainesville, Fla., June* 12, 1883.

[This disease of the larger trees is supposed by Mr. Hubbard and others to be caused by the tap-root reaching water and decaying in consequence.]

## Miscellaneous Observations.

The larva of the *Papilio cresphontes* has, to me, a new enemy. So few enemies has it, from its smell, no doubt, that no birds attack it, though often exposed. The shrike, that is almost omnivorous, will not touch it, nor will the bee martin, nor the mocking bird. The Tachina fly is only occasionally a parasite. The Mutilla (cow ant) this year has nearly cleared my trees of the *cresphontes*: it snips out a piece from the abdominal ring, takes a sip of the fluid, and then the "sugar-ants" finish the work. By the way, these "sugar-ants"—small, yellow fellows—are pests invading the cupboard, getting into meat, sugar, &c. I find their nests in rotten wood, in roofs, logs, &c. They are nearly as bad as the cockroach, and this last ought to be named "*Omnivora periplaneta*." Pyrethrum has but little effect on the roach here.

I made a "grand round" lately to see the effect of my experiments with kerosene last year.

In Bulletin No. 1, pp. 17, 18, Professor Hubbard states that a five per cent. kerosene emulsion did not prove satisfactory, and that by next spring Dr. Neal would have considerably modified his conclusion. Of course, if the facts proved me wrong, I would, but they do not.

Experiment 1. Made at Judge J. F. McDonell's, 5 miles south of me—trees 12–32 years old, badly affected. June 1, 1883; trees growing well and clear of the old scale. The most of the leaves dropped, but a new growth soon took their place.

3. Two miles southeast of Archer. Examined in October and November: no scale on the new growth of leaves; none June 1, except when trees affected had been set in proximity.

10. Five miles south. The owner reports, "trees in good order; no scale on the trees you worked on."

From what I have seen, I can see no reason to modify the conclusion on p. 34, though I believe it most economical of time and money to buy and use "Bonnetheau's" emulsion, made at Jacksonville. Then a compound of kerosene, petroleum, tobacco, potash, &c., is cheap and easily used. Two two and one-half per cent. applications, one in March and one in June, do good work. Dr. Todd, of Lawtey, Fla., has used "crude petroleum," made up a la kerosene 5 per cent. emulsion, and likes it better than kerosene or creosote.

Who has tried "oil of tansy"? A few experiments I have made indicate that in most cases it is a grand insecticide, and added to kerosene emulsion doubles its efficacy. The proportion I have not yet determined. It could be very easily obtained, as probably an infusion would answer.

There is a general abeyance of insects this year: very few of the Heliothis in corn or tomato; no cotton worms yet found, and no Dysdercus reported. Even the Plusia and Agrotis are not plentiful. Result of the warm February? * * * [J. C. Neal, M. D., *Archer, Fla., July* 3, 1883.

### Another East Indian Cotton Worm Remedy.

With regard to sending to your Department specimens of insects which injure the cotton crop in Burma, I regret I cannot do it at once, as most of the cotton fields in Burma have been left waste for the last two or three years, on account of disturbances between the king of Burma and Shan chiefs. At such times the cultivators are not safe, being every now and then attacked by the enemy and looted, but I will keep in mind, and will endeavor as soon as an opportunity is offered to procure the specimens of injurious insects which attack the cotton and forward the same to you as desired.

I will send you shortly another remedy for injurious insects; it is the bark of a tree that natives soak in a jar of water for twenty-four hours, after which the water is sprinkled on the plants. I am told that by such process insects are killed, and the smell of the water on the plants prevents them going near to the plants any further. I shall send the seed also with the bark, that on trial of the experiment, if successful, you may try the seed for growing the tree.—[C. Lucas, *Rangoon, Burma, January* 29, 1883.

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### Possible northern Food-plant of Aletia.

Referring to mine of 17th ultimo, and in reply to yours of 13th instant, I regret to state that the larva unknown described to you as feeding on *Hibiscus trionum*, disappeared during the night of the 23d ultimo, before which time I had discovered two similar, save a black dorsal line, each upon flower spike of *Lupinus pilosus*. A drawing was sent to the Entomological Society of Ontario, and a description. I have to state that larvæ similar in size and color to Figs. 4 and 5 of Plates V and VI, page 348, Agricultural Report for 1879, were seen by me in my garden at Riverside in August of 1879—supposition, from eggs attached to botanical débris obtained near Washington, perhaps leaves and fruit of *Callirrhoë pedata* obtained from back of Mr. Gray's, 204 Seventh street southwest—crawling upon and imbedded in plants of *Gnaphalium uliginosum* L. (Marsh Cudweed), a common weed in this district, *i. e.*, Riverside. I sent you a specimen of the plant from my garden.—[Alfred H. Moore, *Toronto, Ont., October* 19, 1883.

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### Paria aterrima Injuring Strawberries.

I sent you some larvæ of the strawberry crown-borer in a potato this morning. I have a few more now and will send them the same way, except that I will inclose some damp soil with them. I think they do not eat now, for I find them in a little cavity in the earth, not far from the surface. I have been acquainted with this pest for ten years, and I re-

ceive plants from all parts of the country that have been injured by it. The injury it does by boring into the crown is as nothing compared with what it does to the roots, eating off the bark and fine roots. Soon after the roots are injured the leaves get rusty and finally die. The inner leaves lose their glossy and healthy appearance. Where they are plenty they will injure the roots of young runners almost as fast as new plants are formed. It is common to find a runner with four or five plants, the oldest of which will have its roots ruined, the next two more or less damaged, and the youngest uninjured. Plants set in spring to be grown in hills wil flourish till July, or August, then send out weak, slender runners, commence to rust, and almost die. These larvæ never bore down the center of the crown, but down and part way around the outside and some times horizontally into the center. I am not sure it is the crown-borer at all. A few years ago I received plants from Dimondale, Mich., where Professor Cook first saw the strawberry-root worm. If this is it I have had it ten years in this town. The plants I speak of were greatly injured the first season, so that I had to remove them. As soon as I see a bed where this pest is at work I can tell by the rusty, sickly appearance of the foliage.

There is another worm that damages my plants to a great extent, but it is not confined to the strawberry. It eats potatoes, carrots, or any roots, and is very fond of celery. When it works on strawberries the foliage is apt to lose its dark glossy green look, and become almost variegated, yellow and green. The leaves do not attain their full size, and have a warped appearance, like a thin piece of steel made red hot and thrown into water. These worms are about three-fourths of an inch in length, not thicker than a pin, brown color, with many legs, and almost as hard as wire. Early in the spring I find many without legs, almost white, and less lively than the ones I describe.

Many of my plants are perforated by a little bug or beetle about one-fourth of an inch long, in shape resembling a striped cucumber bug, and of a dull yellowish color. I saw plenty of them two months ago, making holes in the tenderest leaves, and now I see many of their holes. Is it the crown-borer?

I would like to know where the eggs of these larvæ are laid. I have found that young plants taken up in July and washed clean and planted in a new bed are sometimes badly injured the same fall, but cannot tell whether the eggs were attached to them or not.—[M. CRAWFORD, *Cuyahoga Falls, Ohio, October* 9, 1883.

[The larvæ were not those of the Strawberry Crown-borer (*Analcis fragariæ*), but belonged to a little beetle known as *Paria aterrima*, the same species mentioned by Professor Cook in his address before the Ingham County Horticultural Society, and described in the *American Entomologist* for October, 1880. The other worm mentioned and which was not confined to strawberries, was the common *Iulus multistriatus*, one of the commonest of the "thousand-legged worms."]

### The Elm-leaf Beetle.

*Galeruca xanthomelæna* came in great force in June, and defoliated all our beautiful elms, to the great injury of our village. In the third week of July the trees all put forth a new crop of leaves, about one-third the size of the first crop. In the fourth week of July the second brood of *Galeruca* came, and devoured the new leaves. We are all anxious to see whether the trees will stand this treatment next spring. I fear our fine elms here are all doomed.—[Rev. Samuel Lockwood, *Freehold, N. J., August* 6, 1883.

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### Grape Pest—Codling Moth.

I send you to-day a beetle which you will confer a favor by determining at your earliest convenience. You will remember I sent you a *Blapstinus* said to be destroying foliage of grape-vines. Now here is another Tenebrionid that in one case has destroyed 35 acres of grape-vine. (Further particulars soon.) I also send you a codling moth I raised from a pear four years ago. I found quite a number last year. Is this a different species from *Carpocapsa pomonella*, or only a variety? The specimen is in vial.—[Matthew Cooke, *Sacramento, Cal., July* 23, 1883.

[The Tenebrionid sent was *Eleodes quadricollis* Lec.; a very numerous species in the more northern part of California. The species of that genus, so numerous and abundant in the region west of the Rocky Mountains, are all known to feed upon decaying vegetable matter, and none have hitherto been reported as doing damage to cultivated plants. In fact, this communication, if correct, would indicate a change of habit hitherto unprecedented in the history of economic entomology, and, unless further proof be brought forth, we can hardly believe that the species referred to is the real author of the damage to grape-vines. The only species of the large family *Tenebrionidæ* which can be considered as injurious are those feeding on stored produce, *e. g.*, *Tenebrio molitor*, *T. obscurus*, *Tribolium ferrugineum*, *Gnathocerus cornutus*, and a few others.

The codling moth was an interesting variety of *Carpocapsa pomonella*, with obsolete maculation.]

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### The Wheat Midge.

I find that I have fallen into the error of using a name for the wheat pest that is in erroneous use here (*weevil*). The one I mean is called in Ontario the midge. It comes out in the fly state in July, and deposits its eggs near the kernels when the wheat is in its early stage. The yellow grubs live upon the wheat in its milky state and leave it shriveled and worthless. When we get a very early season, as this is, the wheat

sown before the 1st of May matures earlier and escapes to a great extent. Last year the wheat sown on the 16th of June got very well clear, but that sown from the 5th to last of May was severely handled by the midge. I shall be glad if you can give me any information as to the best means of getting rid of the pest. I have no doubt you are well acquainted with its habits and have often referred to it in your reports.

If you wish I will collect and forward samples of eggs in season.—[WM. HEARD, *The Cedars, Prince Edward's Island, April* 23, 1883.

[The insect spoken of in this letter was, without doubt, the Wheat Midge (*Diplosis tritici*, Kirby). It has done but little damage in the United States for the last twenty years, and we have not had occasion to study it particularly, nor have there been any articles of importance published about it since Dr. Fitch's lengthy summary in the Transactions of the New York State Agricultural Society for 1860. This is the best account of the midge ever published. Another excellent account is found in Harris's Insects Injurious to Vegetation. We sent for further specimens and received the following reply:]

In accordance with the request contained in your favor of 28th April last, I now forward by mail some specimens of wheat midge, which are in good condition for investigation. This year we would have had a magnificent return but for the depredations of this insect. In some districts the loss is total. Late-sown wheat has so far escaped. Perhaps this may be found the only safe plan, but the risk of bad weather in September for harvest induces many to run the risk of early sowing.

* * * [WM. HEARD, *The Cedars, Prince Edward's Island, August* 22, 1883.

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### MAMESTRA PICTA EATING PEA VINES.

A little worm is eating our pea vines. Not having noticed it before, I thought I would send you a few specimens for determination. I send them in a small box by this mail. If not too much trouble, please tell me the name, and if it is common. Have found it on only one or two plants, but these plants were covered and entirely destroyed.—[F. H. HORSFORD, *Charlotte, Vt., June* 30, 1883.

[These specimens were in poor condition and unrecognizable, and more were sent for, which were received together with the following letter:]

Yours of the 5th is at hand. I inclose in a vial, by this mail, a few of the live worms which I sent some time since. They have grown so much that I would hardly recognize them if I did not find them on the pea vines. They seem to do much damage, but are not yet very numerous. The first plant that I discovered was completely covered with the little worms like what I sent you first.—[F. H. HORSFORD, *July* 8, 1883.

[These were perfectly satisfactory, and were easily recognizable as the Zebra caterpillar (*Mamestra picta*, Harris), figured and described in Harris's Insects Injurious to Vegetation, in the second report on the Insects of Missouri, and in the report of the Entomologist of the Department for 1883. From its conspicuous appearance, and from the fact that the caterpillars are gregarious when young, it is easily destroyed by hand picking.]

## Locusts in Yucatan.

Referring to my dispatch No. 70, dated November 27, 1882, and to Department instructions No. 65 and 75, dated, respectively, January 3, 1883, and June 20, 1883, I have now the honor to report as follows:

The flights of locusts reported by me in my No. 70 increased in size and numbers, and invested the whole country, where they have bred with astonishing prolificacy. The situation of affairs here is exceedingly grave.

The whole country is now swarming with this insect in both the "'hopper" state and as the perfect insect. Nothing escapes their voracity. For a time hopes were entertained that the henequen plant* would be free, but now everything is being destroyed. Lamentable stories are brought in daily of the utter destruction of promising corn, bean, and henequen fields of vast extent. The peculiar conformation of the country renders any systematic and efficient warfare against them extremely difficult, if, indeed, practicable. Added to this is the natural "laisser aller" and indifference of the ordinary Mexican. Sporadic outbursts of energy are seen here and there, but very little is thus accomplished. The State legislature some time ago passed a decree calling on every male inhabitant of the State to give one day's work in each week towards killing locusts, or in lieu thereof 50 cents per week.

The decree is good, but, so far as I can learn, it has not yet been put into effect.

The results are already deplorable; cattle and horses are dying for want of food; the Indian who lives only on corn can no longer depend on the home crop, but must buy imported corn at the rate in city of Merida of $3.25 per "carga" of 94 pounds, say 3½ cents per pound wholesale, but by the time it reaches the Indian it costs him nearly 6 cents a pound. He can earn 25 cents a day. Part of this goes toward extinguishing his ever increasing debt to his employer, the remainder to provide for his great, hungry family.

In 1881 there were imported into this State 549,626 bushels of corn; this year three times this quantity will be needed, and unless this plague be abated, Yucatan will very shortly have no henequen fiber to send

* *Agave sisalana.*

about in exchange for corn. Money is exceedingly tight; exchange at an extravagant figure, and in general the prospects of Yucatan are exceedingly gloomy.

I shall be pleased to furnish any details the Department may desire, or to answer any questions that may be put.—[LOUIS H. AYMÉ, *United States Consul, Merida, Yucatan, August* 25, 1883.

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## SUPPOSED IMPORTATION OF PHYLLOXERA.

The following correspondence having been the subject of several Associated Press dispatches last April, we print it in full:

TREASURY DEPARTMENT, *April* 17, 1883.

SIR: I transmit herewith a report from the collector of customs at New York, dated the 13th instant, in regard to the importation at that port of vine-cuttings, which it is suspected may be infected with phylloxera. The report of the examiner who made the examination is not conclusive on the question at issue, but even if it were I know of no law that authorizes this Department to prevent their delivery. Dr. Battershall, of the appraiser's office at New York, suggested that the clippings be submitted for examination to Professor Riley of your Department, and they are accordingly transmitted for such examination.

Please return the paper with such comments as you may deem proper.

Yours, very respectfully,

H. F. FRENCH,
*Acting Secretary.*

HON. GEO. B. LORING,
*Commissioner of Agriculture.*

CUSTOM-HOUSE, NEW YORK,
*Collector's Office, April* 13, 1883.

SIR: I herewith transmit a communication from the United States consul at Funchal, inclosing invoice of vine-cuttings. The communication of the consul was referred to the appraisers immediately on receipt, and that officer's report thereon is herewith inclosed. I also forward the vine sample alluded to in the appraiser's report.

Being unable to find any provision of law authorizing the collector to seize or otherwise interfere with importations of this character, even though the vines are affected as surmised, I respectfully refer the matter to the Department, with the request that instructions be given as to any action to be taken by me in the premises.

Very respectfully,

W. H. ROBERTSON,
*Collector.*

HON. CHAS. J. FOLGER,
*Secretary of the Treasury.*

PORT OF NEW YORK, APPRAISER'S OFFICE,
*April* 10, 1883.

SIR: Respectfully referring to the inclosed communication, directing that a microscopic examination be made of a sample of certain vine clippings recently imported from the island of Madeira, I have the honor to report as follows: I have submitted the above sample to a microscopic examination, and, while I have as yet been unable to detect certain positive indications of the presence of phylloxera, I am of the opinion, after comparing the clippings with others of known freedom from disease, that they present appearances which are at least suspicious. Considering the importance of this matter, I would respectfully suggest that the clippings under consideration be submitted for examination to Prof. C. V. Riley, who I believe is at present the entomologist of the United States Department of Agriculture, and who has devoted more attention to this special subject than any other American scientist.

An investigation would require experience of a peculiar nature, and would involve a more complete acquaintance with the physical appearance of the healthy and diseased vine than I can make claim to.

Respectfully,

J. B. BATTERSHALL.

The Hon. A. G. KETCHUM.

WASHINGTON, *April* 18, 1883.

SIR: In reply to the letter of the Assistant Secretary of the Treasury, with inclosures from the New York Custom-House, respecting an invoice of vine-cuttings from Madeira suspected of "phylloxera disease," I would submit the following:

The samples submitted, upon examination, furnish no sign whatever of Phylloxera, and it is extremely doubtful whether any trace of Phylloxera could be discovered upon any of the cuttings: 1st, because Phylloxera is not known to be destructive in Madeira; and, 2d, because it could only be found in winter egg, which, even in countries where Phylloxera abounds, is extremely rare. Hence the chances of the introduction of the pest upon these cuttings are so very remote as not to be worth considering. But, even if the cuttings came from a country badly infested with Phylloxera, the danger of the introduction of the pest upon them would be very slight, the reasons for which conclusion I have already discussed in the *American Naturalist* for March, 1881, and I beg leave to inclose a copy of said article, which gives in addition a succinct statement of the life habits of the insect.

Even were it possible to introduce the insect with these cuttings, no harm could result so long as they were sent to any part of the United States east of the Rocky Mountains, since the Phyllóxera is indigenous here. On the same supposition that the cuttings were badly infested, prudence would dictate that they should not be sent to the Pacific coast, or those portions of it where the Phylloxera does not yet exist; but

for the reasons first given I do not hesitate to say that there can be no danger in sending them even there, and as it seems that there is no law to warrant their detention they may certainly be forwarded without fear of injury.

Respectfully,

C. V. RILEY,
*Entomologist.*

Hon. GEO. B. LORING,
*Commissioner of Agriculture.*

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## FURTHER REPORTS ON THE GROWTH OF PYRETHRUM.

CALIFORNIA. San Bernardino, August 12, 1883.—JAMES S. BROOKS.

I have a few plants of pyrethrum now in flower, raised from seed that I sent East for last year, but as I do not know how to prepare the powder for the purpose of destroying insects I shall let the seed ripen and plant again next season, hoping that I will succeed better, as but very few plants came up.

CANADA. Dundas, Ont., June 22, 1882.—JOHN A. FISHER.

I have much pleasure in inclosing you three flowers raised by me from the pyrethrum seed which you so kindly sent me a little over a year ago. The plants that I have are in a perfect mass of bloom.

CANADA. Riverside, Toronto, September 9, 1883.—ALFRED H. MOORE.

A plant of the 1881 seedlings of pyrethrum rose bloomed last May (1883) so gloriously as to elicit a notice in the *Evening Telegram* of this city. Had in bloom, nearly at same time, twenty-seven heads, but no fecundated fruit. Are the flowers all entomophilous, and so abortive?

ILLINOIS. Champaign, July 12, 1882.—S. A. FORBES.

Concerning the pyrethrum seed sent me, I believe that I have not reported that I succeeded in raising a few plants last year, although most failed because of the severe drought. Those that grew survived the winter, blossomed this summer, and matured their seed about three weeks ago. This was *Pyrethrum roseum*. The seed of both species has come up sparingly this spring, injured this time by the extremely wet weather.

IOWA. Garrison, June 10, 1882.—JAMES H. DICKSON.

I received a package of pyrethrum seed (insect-powder plant) in the spring of 1881 from Professor Riley, and sowed seed in a shallow box and placed it in a hot-bed. The seed nearly all grew, and were transplanted to the garden the latter part of April. They grew fast and had a few blooms the latter part of September, but not enough to pay for the gathering. Before hard-freezing weather set in I gave the bed a

light covering of leaves, at the same time lifting a few plants and potting them, thinking if I lost those in the open ground that I would still have a start; but those in the open ground started with a vigorous growth, and to-day (the 10th of June) gathered a handful of blooms from a space 5 feet square. The blooms of those kept in the house are inferior to the others. The seed received of you this spring I gave the same treatment, with almost an entire failure; have several plants of each kind. We were well pleased with our former success, and expect to gather blooms enough this season to make powder, so that we can try its virtues on all kinds of insects that infest house plants.

KANSAS. Manhattan, May 2, 1883.—S. C. WELLS.

I gave away a part of the pyrethrum seed you sent me last spring, and planted the rest; some of them came up, but our dry winds or something else destroyed all but one plant. That one is now growing and looking well.

MASSACHUSETTS. Franklin, June 18, 1882.—RUTH H. SMITH.

The seeds of the *Pyrethrum roseum* received from you early in April, 1881, were planted according to direction. They came up, but did not seem to thrive well during the year. However, a few plants survived the severe hail-storm of July 4, and wintered well without any covering. They bloomed first about three weeks ago.

MICHIGAN. Burnside, October 22, 1883.—MICHAEL J. KIRWVEN.

According to your request I write to inform you of my success in raising the pyrethrum. I sowed the seed in a dark, sandy loam spot in my garden on the 23d of May. Of the *P. carneum* but one plant grew; *P. roseum*, five; *P. cinerariæfolium* from Austria, none; *P. cinerariæfolium* from California, about thirty-five plants grew. None of them have come to maturity. Will the *P. roseum* stand the winter without protection?

MISSISSIPPI. Oxford, April 28, 1883.—R. W. JONES.

The pyrethrum plants, which I mentioned in my report of January 11, 1883, are now blooming beautifully. I send you specimens of the blooms and leaves. They are (1) *Pyrethrum roseum*, (2) *Pyrethrum cinerariæfolium*. I think the only difficulty here in growing the plant is in getting it started. From my experience thus far I am led to the conclusion that in Mississippi the best time for sowing the seed is in October; seeds sown in the spring do not do so well, though I succeeded in raising some plants from seed sown in the spring. The hot, dry summer of this latitude is a severer trial to the plants when young than our winters are. In the spring, too, the rains are too heavy and too often repeated for the young plants to thrive. It is very interesting to watch insects that are attracted by the brightness of the colors of *P. roseum*, as they fly to the bloom and suddenly leave. I note that some

small insects, of which I send you specimens, and the bumblebee seem to use the blooms without hurt.

[The insect mentioned is *Cerotoma caminea*, Fabr.]

NEW YORK. Rochester, June 11, 1882.—M. ALDEN.

The seeds of *Pyrethrum roseum* sent to me fifteen months ago were divided into two parts and planted: 1st, in a gravelly loam—these did not live: 2d, in a flower bed partially shaded in summer, having a southern exposure, and composed of leaf-mold, one-half; well-rotted cow manure, one-fourth; clay, one-fourth. Liberal additions of waste coffee-grounds have been thrown on this bed from time to time. The pyrethrum planted there is in fine condition, and is now in bud; the plants are about 18 inches high. They did not flower last summer, and the roots were left out all winter, protected by three inches of leaves and manure.

PENNSYLVANIA. New Bloomfield, October 2, 1883.—E. W. CLAYPOLE.

In the spring of 1881 you sent me some seed of the Persian insect-plant, *P. roseum*. I sowed some of it and it came up well. It grew through the summer in a box and was left out through the winter. The roots being much exposed by the sides of the box were liable to be killed by frost. Yet it lived. I was away from home during the cold part of the winter, which came before Christmas, but at my return the plants were alive and continued so, at least some of them, until they began to grow in the spring, when, unfortunately, they were forgotten and exposed to a cold rain and sudden hard frost in March, which killed them in the growing state. In the spring of 1882 I sowed again some of the same seed, which I had kept over, and also some of the Dalmatian species, *P. cinerariæfolium*. Both came up well. The seed leaves of the latter were less spatulate than those of the former, and the later leaves came more freely. Altogether, the latter is the more freely growing plant. They flourish well through the summer, and though the winter was a very cold one (in Pennsylvania), yet with very little shelter (such as that of an open shed or an unwarmed room) they survived it, and in the spring began to grow very early. May add that the Dalmatian species was evergreen, retaining its leaves all the winter. The other was not. In the spring I planted them in an open border, where they grew well and flowered, especially the Persian plant, the flowers being crimson, magenta, and white. The other species did not bloom as freely. I do not know how they will bear the winter in the ground, but the probability is in their favor. Judging from appearances the seed of neither species was matured.

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