(No. 89.)



1879.

TASMANIA.

HOUSE OF ASSEMBLY.

CODLIN MOTH:

REPORT OF SELECT COMMITTEE, WITH EVIDENCE AND APPENDICES.

Brought up by Dr. E. L. Crowther, and ordered by the House to be printed, January 23, 1880.



SELECT COMMITTEE appointed on Thursday, 8th May, 1879, to enquire into the destruction of Fruit by the Codlin Moth (Apocarpus pomonella), with power to call for persons and papers; the Committee to make such recommendations as they may deem necessary in order to limit the action of so formidable a Pest.

MEMBERS OF THE COMMITTEE.

MR. BELBIN. MR. LETTE. MR. RIDDOCH. Mr. Gellibrand. Mr. Clark. Dr. Crowther (Mover).

DAYS OF MEETING.

Friday, 16th January, 1880. Present—Dr. Crowther, Mr. Gellibrand, Mr. Belbin. Wednesday, 21st January, 1880. Present—Dr. Crowther, Mr. Riddoch, Mr. Lette, Mr. Belbin.

WITNESSES EXAMINED.

Mr. Cronly. Mr. John Latham.

REPORT.

Ist. That the time of year is such that, unless immediate action be taken, another whole season will be lost, and the ravages of the pest greatly extended.

2nd. That in the south of the Island, at least, the *Carpocapsa pomonella* is limited in its distribution, and offers a fair chance for its eradication if energetic steps are at once taken.

3rd. That no individual effort, or continuation of the same, will be of any avail unless assisted by Legislative enactment.

4th. That on the 1st February, 1880, your Committee recommend there be appointed an Inspector or Inspectors, whose duty it shall be to see that all diseased fruit is removed from the orchard and destroyed.

5th. That, at the same time, every tree in an infested garden must be carefully bandaged, and periodically examined at intervals of not more than fourteen days, so that any grubs that may have already escaped from the fruit trees be then trapped and destroyed. Later on in the year the trees to be cleared of loose old bark, and lime or other grub-destroying wash applied.

6th. To meet the necessary outlay, your Committee propose that a tax of not exceeding One Penny per bushel per annum be levied upon all apples, pears, and plums, such tax to be paid by the grower upon the net marketable produce.

7th. That if, after being warned, any person refuses to remove and destroy diseased fruit, and take other precautionary measures, it shall be done at the sole cost of the occupier of the land.

8th. That on this Report being approved by Parliament the same be embodied in a Bill.

Committee Room, 23rd January, 1880.

EDWARD L. CROWTHER, Chairman.

EVIDENCE.

FRIDAY, JANUARY 16, 1880.

MR. J. CRONLY examined.

By the Chairman.—1. Mr. Cronly, you have taken great interest in the subject of the Codlin Moth, have you not? I have.

2. What remedies would you suggest for its destruction? That from the 1st of this month all the affected apples should be picked and Genroyed by boiling them; they could then be used for pig food, but not raw, as many of the grubs might then escape.

3. How would you defray the cost of this? By imposing one penny per bushel on all apples, pears, and plums grown, in order to destroy the pest. I think that an Inspector should be appointed to examine gardens supposed to be affected, who should give notice to occupiers or owners to destroy all infected fruit within a certain period, failing which the Inspector shall cause the same to be done at the owner's expense. The Inspector to have power to order bandages to be applied to trees of affected orchards; and if the owners or occupiers neglect such instructions, to cause the same to be done at their expense; all loose bark to be removed, trees scraped and cleaned, and an efficacious wash to be applied, and all bandages to be removed, placed in boiling water or destroyed, once every fortnight.

WEDNESDAY, JANUARY 21, 1880.

MR. JOHN LATHAM, Fruiterer and Exporter, examined.

I have paid considerable attention to the matter of the Codlin Moth. From my own observation I notice it to be spreading rapidly. One garden in the upper part of Liverpool-street, which was not affected last year, is now strongly affected by it. I believe myself, theoretically and practically, the best way to destroy them would be by trapping them with bandages round the trees, which I would examine periodically, destroy and change, also by removing old bark, and cleaning off all covering that the grubs can take shelter in. My objection to removing apparently infected fruit, at this time of the year, is that you are unable to be certain that the grub is in it,—some of the early grubs having perhaps got away. Taken at the earliest part of the year, when the fruit first shows the infected spot, it would be decidedly advantageous to pick off and destroy it. I would suggest the imposition of a tax not exceeding one penny per bushel per annum be levied upon all apples, pears, and plums, such tax to be paid by the grower upon the nett marketable produce,—such money to be expended to secure the services of Inspectors to compulsorily carry out the above. I know of a case where a grower in 1878 had but one bushel of good apples out of eleven on his tree. By removing the old bark and scraping the trees the result was reversed,—9 bushels of good apples and only one bad.

APPENDICES.

DEAR SIR,

Launceston, 7th July, 1879.

HAVING noticed that you were making investigation of the habits of the Codlin Moth, with a view of taking steps towards checking its progress in the South, I beg to submit the result of my experience.

Our gardens here have for years been rendered comparatively valueless by the loss of nearly all apples and pears, the best varieties seeming to suffer most. Under some apple trees I have raspberries growing, and when the apples fall the grubs take shelter in the pith of the old cane stumps. From one of these pieces I have taken a score of the grubs.

In the autumn of 1878 I preserved a number of these canes to observe the result of the insect having thus hidden. They were kept in an open box in an ordinary room till the spring, when I placed them in the greenhouse under a glass shade. About October the moths commenced to emerge from the cocoons and continued to do so for at least two months. They appeared to live about a fortnight, but I did not notice that they deposited any eggs.

The most noticeable feature in the matter is that at the present time the same pieces of cane contain both healthy chrysalis and semi-dormant caterpillars. This shows that even the destruction of all fruit for one year might not get rid of the intruder. My impression is that the most satisfactory and simple way to keep down this pest is to have all infected fruit removed as quickly as possible and destroyed; also to place near the trees suitable harbour for such insects as may have escaped from the fruit, and afterwards burn it; but this should be done by united effort, which can only be secured by resort to legal compulsion.

I send you several pieces of the raspberry canes, which have been kept since last winter, in which you will find the grubs still alive.

I would thank you for any papers bearing on the subject.

Yours truly,

J. G. SHERWIN.

Dr. E. L. CROWTHER, Hobart Tonn.

NOTES ON THE CODLIN MOTH.

By AUGUSTUS SIMSON.

(Read before the Royal Society, Tasmania, 12th August, 1879.)

The Codlin Moth (*Carpocapsa pomonella*) is attracting so much attention at present that I hope I may be excused for making some remarks upon the subject.

This insect belongs to that family of the Lepidoptera called Tortricidæ (in French, "Tordeuses"), on account of the general habit of their larvæ of "twisting" or rolling up the leaves of plants as their abode, usually those leaves enclosing a young shoot or bud. They then devour such leaves, shoots, or buds, to the great detriment of the plant attacked. A few take up their abode in the interior of fruits, especially the apple, pear, and plum.

Professor Westwood, of Oxford, gave a detailed history of the particular species under notice in one of a series of articles on insects most injurious to cultivators in England, in Loudon's *Gardeners' Magazine*, of May, 1838, No. 98. In the same work he gave also, in No. 94, January, 1838, the history of *Ditula angustiorana*, the larva of which does great damage to apricot trees, by tying the young shoots together so firmly that their growth is stopped, and by devouring the young blossom buds. *Tortrix viridana* in certain years strips the oak of its foliage. *Tortrix* vitana does great damage to vines in France.

Dozens of other members of the family might be enumerated, all equally mischievous to certains trees and shrubs; I will, however, only mention one more, *Carpocapsa Woeberiana*, the larvæ of which live beneath the bark of plum trees, where they bore cylindrical galleries and feed upon the sap.

It is highly probable that this insect was brought to Hobart Town in some plums sent from the North. Each species, with very few exceptions, confines itself to a particular plant, or at least to plants of the same genus or order.

It would be interesting to ascertain what the species attacking the plum really is. In a catalogue of European Lepidoptera I possess, the species *Carpocupsa nigricana*, mentioned by Mr. Abbott, is not given. It may be a synonym for the one above alluded to.

The larvæ of all this family are naked fleshy grubs with a horny head, and possess six pectoral (horny and pointed), eight ventral, and two anal (fleshy) feet. Mr. Justice Dobson and Mr. F. Abbott, jun., have so fully detailed the proceedings of the insect in all its stages in their valuable papers read at the Society's meeting in May last, that it is unnecessary for me to make any remark on this point, except to observe that the time of appearance is likely to depend very much upon the season.

The emergence of the moths from the chrysalis state, in which they had remained during the winter, will be hastened by warm weather, and, on the contrary, retarded by a cold spring.

It is most probable that there are two generations in the season. The first originates from the chrysalids which have passed the winter in that stage. These attack the earliest fruit and pass through their transformations in a few weeks, the moths produced therefrom laying their eggs on the later fruit. This second generation only gets as far as the chrysalis stage towards the end of the summer, and remains in that state till the ensuing spring.

As to means of destroying these pests, I would recommend in lieu of the paper suggested by Mr. Dobson, that old bagging, strips of blanket, or some such materials be used. I only recently found quite a multitude of similar larvæ, which had spun their cocoons in some woollen material which was lying on some spars of timber with the bark on. To render any such plan efficient, it would be well to scrape the rough bark off the trees previously to fastening on the material to be used, so as to ensure the caterpillars spinning on or in the substance applied. This should be tied tightly at the upper end, to prevent the grubs from ascending beyond it, but be left tolerably loose and in creases or folds at the lower portion.

For catching the moths, the plan I use for capturing insects might be adopted with advantage. This is to have a wide-mouthed funnel of tin-plate, say 12in. to 15in. across the top, with the tube at the lower end about 1in. in diameter and 3in. long. Stand this in an earthen jar or other vessel, arranged so that there is no outlet except through the funnel. In the jar may be some coarse sawdust or chaff, in which the insects get entangled, or hide themselves. Hang a lantern over the centre of the funnel so that it is partly in the funnel. The moths, attracted by the light, strike the glass and fall through the funnel into the jar, whence they cannot escape. They may be destroyed in the morning by placing the jar before the fire, or in an oven for a short time. With this apparatus, which I occasionally use for capturing nocturnal beetles, I often take great numbers of small moths at the same time.

Scattering old bags or similar things about on the ground under the trees would no doubt lead to the capture of a great many larvæ, especially of those which, lowering themselves, or falling, from the trees at some distance from the trunk, might travel off in some other direction in search of suitable shelter where to spin their cocoons. The ground should previously be cleared of all other rubbish which might afford shelter. The bags should be taken every ten days and be dipped in boiling water, or have some thrown over them; otherwise the pupæ may have had time to become moths, and the trouble will have been in vain.

I will conclude with a few remarks on the report of the Select Committee recently appointed to enquire into the subject.

1. In reply to the query about removing the bark, I would suggest that this be done to all trees with rough bark as soon as it is known that the grubs have entered the chrysalis stage, the bark thus removed to be burnt. Then I would apply the bagging before mentioned, not later than early next spring, when the blossoms begin to appear. By the removal of the bark the grubs will be compelled to spin in or under the bagging and be all the more surely detected.

2. The grub could undoubtedly travel some distance, but is sure to remain at the first suitable shelter it meets with.

3. I do not think it necessary for the fruit to fall. Most of these larvæ can lower themselves by a silken thread.

4. The grub requires a shelter of such kind as to allow of its forming a cavity therein, in which to spin its cocoon, therefore the traps ordinarily used for earwigs would be of no use whatever.

5. The particular insect reported on attacks only apples and pears.

6. This query is already answered above.

For the following reasons it is impossible that any information resulting from the enquiry in Portugal into the natural history of *Phylloxera vastatrix* can be of any use in regard to the best means of destroying the Codlin Moth :—

The Phylloxera belongs to a different order of insects, namely—the Homoptera, family Aphidæ, or Plant-lice, of which the "green fly" on rose trees is a familiar example. They are suctorial insects, destitute of jaws, living upon the juices of plants, which they absorb through their proboscis or sucker.

Their transformations are quite different from those of the Lepidoptera, they being active and resembling the perfect insect in both the larval and pupa stages.

Their mode of propagation is quite abnormal, and different from that of all other orders of insects. As this is highly interesting and probably not generally known, I quote a short extract on the subject from Professor Westwood's Introduction to the Modern Classification of Insects:— "Each family of plant-lice in spring and summer consists of individuals always wingless, and of pupæ; all these, however, are females, which produce living young without a previous union with the other sex; and Bonnet, whose researches have removed all doubts upon the subject, has clearly shown that this power is exercised at least through nine generations, which are produced within the space of three months. Whilst Duvau thus obtained eleven generations in seven months, and Kyber even observed that a colony of *Aphis Dianthi*, brought into a constantly heated room, continued to propagate for four years, with a single impregnation of a female by a male, the young being constantly produced of the female sex. The males, of which some are winged, and others apterous in the same society, are not born until the end of the summer or autumn. They fecundate the last generation, produced by the previously born specimens, consisting of wingless females, which then deposit fecundated eggs, which remain through the winter and produce young in the spring capable of reproduction without fresh impregnation."

It is fortunate for owners of orchards that the Carpocapsa has not the same powers of reproduction as the Aphidæ. Westwood quotes from the *Entomological Magazine* that "troops of Aphides were found in the pips of large sound codlin apples." Hop-growers are, I suspect, the chief sufferers in the Colony from this tribe of insects, and they may probably gain some useful information from the Portugal report when published, though I believe the Aphis Humuli or hopaphis attacks the leaves and young shoots, whereas the Phylloxera attacks the roots, and therefore the method pursued for the destruction of the latter may not be suitable for the former.

Gould's Country, 26th June, 1879.

I shall be much obliged by any one kindly sending me some of the pupze of the Carpocapsa, or of any other similar insects. These I will endeavour to bring to the imago state, and properly mount for the Museum. It will be best to send the small pieces of bark to which they may be attached, or at any rate to send the whole cocoon, which may be placed in a match-box with some cotton wool.

THE Secretary read the following note from Mr. F. Abbott, jun., with the communication to which it refers from the Department of Agriculture, Washington, U.S.:-

"The accompanying communication from the Chamber of Commerce, Washington, relative to the Codlin Moth, I received on Saturday last (9th August). No reference is made to any reports having been made by Commissioners or otherwise on the moth, although I expressly asked for them, should there be any. The information supplied by the Department does not add much to our previous knowledge of this pest, but it confirms the fact of there being two generations in a year, and gives detailed instructions for the suppression of the Moth."

"Department of Agriculture, Washington, 10th June, 1879.

SIR, I HAVE the pleasure of enclosing the information you desire relative to the Codlin Moth, though I fear it will be too late for use this season.

I have the honor, &c.

WM. G. LEDUC, Commissioner of Agriculture.

F. ABBOTT, JUN., Botanic Gardens, Hobart Town, Tasmania."

" Department of Agriculture, Division of Entomology, Washington, D.C., 10th June, 1879.

SIR, IN the absence of the Entomologist, I take the liberty of answering the request of Mr. F. Abbott, jun., of Hobart Town, Tasmania, for information regarding the Codlin Moth (Carpocapsa pomonella).

In the apple-growing regions of the United States the Codlin Moths first appear while the trees are in blossom. The sexes pair, and the females lay their eggs in the flower end of the forming fruit. The worms mature in from thirty to thirty-five days, and leaving the fruit, seek a convenient niche wherein to spin up and transform. In two weeks more the moths appear and lay their eggs, this time usually in the side of the apple. The larvæ winter in their cocoons, transforming to chrysalides the following spring. The universal remedy in this country is by the use of paper or hay-bands around the trunks of the trees, these affording artificial places for the worms to transform. The following rules have been laid down for the use of these bands :---

1st. The bands should be placed around the trees by the 1st of June, and kept on until every apple has been picked.

2nd. They should be examined and all larvæ and chrysalides killed every week, or at the latest every fortnight.

3rd. The trunks of the trees should be kept free from old rough bark so as to give the worms no other place of shelter.

4th. The ground itself should be kept clean from weeds and rubbish. Experience has shown that common straw wrapping paper, folded into a band from 3 in. to 6 in. wide, and tacked around the tree midway between the first fork and the ground, makes as cheap and satisfactory a band as has been found.

In addition to the bands it is advisable to feed all windfalls to the hogs.

Very respectfully,

L. O. HOWARD, Assistant in Entomological Division.

Hon. W. G. LE DUC, Commissioner Agriculture."

THE following communication on the Codlin Moth from the Department of Agriculture, America, was read by Mr. Abbott, who observed, in the first instance, that although little new information as to the moth was brought forward, the paper was valuable as pointing out the great benefit which was likely to accrue from united action being taken to suppress the pest in any given district:—

" Department of Agriculture, Division of Entomology, Washington, D.C., July 8, 1879.

DEAR SIR,

YOUR letter to Commissioner Le Duc, containing questions concerning the Codlin Moth, has been referred to me.

The following is an epitome of the life history of this moth, Carpocapsa pomonella:----

The adult moth appears in early summer and lays its eggs on apples and pears, laying them singly in the blossom end of the fruit.

The larva, when hatched, eats its way to the core, usually causing the fruit to fall prematurely. When full grown, the larva burrows out through the side of the fruit, and undergoes its transformations within a cocoon, under the rough bark of a tree, or in some other protected place. This species is both single and double brooded.

The larvæ winter in their cocoons, transforming to pupæ during early spring.

The remedies are as follows:—Pick up and destroy the infested fruit as soon as it falls, or allow hogs to feed upon it; but by far the most effectual remedy is to trap the larvæ by providing a place for them to spin their cocoons. This may be done in many ways; the most effectual way is to put a band of hay or other material around the trunk of the tree. The trees should be scraped to remove the rough bark before the bands are applied, so that the larvæ will have no other refuge than the bands. The bands should be put upon the trees as soon as the apples begin to fall, and should be examined every two weeks and all the pupæ killed; this process should be repeated until the last apples are harvested in the fall. We use heavy coarse paper for band material, and either tie or tack them around the tree trunks. To have this remedy prove a *perfect* success concerted action is necessary among the neighbouring pomologists, as the moths fly from one orchard to another, more or less. As an instance of what concerted action can do, I will cite the experience of the Peninsula Farmers' Club of Grand Traverse, Mich. This club passed resolutions that all the orchards on the Peninsula should be bandaged. In case the owners would not attend to it, the club bandaged the trees for them. The result was that although before they began seventy-five per cent (75·100) of their fruit was destroyed by the Codlin Moth, after three years' trial only five per cent. (5·100) was lost in that way. I feel quite confident that a similar experiment would succeed with you.

I should add that the orchards should be cleared of rubbish (old boards, &c.) that would afford hiding places for the pupz.

The first remedy spoken of is only partially successful, because about half the larvæ leave the apples before they fall, and crawl down the tree to find a place to make their cocoons.

Yours, &c.

Mr. F. ABBOTT, Botanical Gardens, Tasmania."

J. HENRY COMSTOCK, Entomologist.

With the letter was also sent a copy of the circular referred to. The introductory matter is explained in the above letter. The circular concludes with the following observations:--

1st. The moth belongs to the family *Tortrices*, the worm, the larva of the *Carpocapsa-Pomonella*, or Codlin Moth.

2nd. The egg hatches in our usual spring weather, in from seven to ten days.

3rd. The larva attains its full size in about twenty days, and generally assumes the pupa state before the thirtieth day.

4th. It remains in the pupa state from nine to twelve days.

5th. The moth deposits the egg in the hollow of the blossom and of the fruit (see No. 6), the larva is hatched in a few days, and immediately commences burrowing towards the *Carpellary Ovarium*, or hulls containing the seeds. It then gnaws its way through the pericarp (before or after the premature fall of the fruit) to assume the pupa or chrysalis state.

6th. That the egg is not deposited on the blossom as generally supposed, but after the fruit is well formed.

7th. The first appearance of the moth is generally from 1st to 25th of May.

Sth. The eggs deposited by the early moth become moths and lay eggs for a second generation, and these for a third, which will arrive at perfection by the latter end of August (see 16.)

9th. They generally remain in the caterpillar state throughout the winter, semi-dormant.

10th. The larva is somewhat of a borer, as seen by his preparations for winter quarters, and from refuse in his nest apparently obtains sustenance from the tree.

11th. The larva can be found in trees affected the previous season, under the loose bark, and in some cases in holes bored in the solid bark, and generally on the side of the tree facing the south.

12th. Neither larva nor pupa could be found in the ground around the trees affected last season, nor in the weeds or shrubbery near them (see 15). A careful examination of the body and limbs of those trees, with the aid of a powerful glass, failed to detect any egg deposit.

13th. The larva taken from the apple and pear tree are the same.

14th. The specimens we collected are full grown, and more lively, apparently ready to assume the pupa state as soon as the temperature of the season permits.

15th. In one case a piece of paper was found near a tree, containing a chrysalis or pupa, but cannot say at present if of this family—we think not.

16th. That as each generation of these moths arrive at perfection they deposit their eggs on the fruit throughout the season. Thus late pears and apples are more likely to be destroyed from the rapid increase of the moth than the earlier varieties.

PROBABLE RATE OF INCREASE OF THESE MOTHS.

"Entomologists claim that of the lepidopterous insects, including butterflies and moths, nearly one thousand kinds are known in the United States. That each female lays from 200 to 500 eggs. Taking 200 as the lowest number, twelve female moths in one orchard would produce 2400 caterpillars; if one-half of these were females, they would produce 240,000; in proportion, the third generation would reach twenty-four millions."

From the observations stated, we are led to believe that the destruction of this pest must be consummated while it is in the caterpillar state.

CODLIN MOTH.

(From Mercury.)

The season has arrived when every owner of an orchard should wage war against this growing and spreading devastation, without at the same time losing an opportunity of studying the natural history of the moth, and recording like experiments in its destruction. We published last week an account of one remedy—the use of lime. Carefully applied it can do no harm, but if we rightly understand the result, the present is not the proper season to apply the lime. The grub is in the apple, and whether dead or alive must destroy its keeping qualities. The dead ones certainly cannot propagate the pest, but the present crop has suffered. Whatever, therefore, the properties of the lime, it would appear that it should be applied during the winter season, at any rate before the tree is in leaf. We have the account of another remedy which comes to us all the way from Sacramento, California, United States of America, and it should be satisfactory to D. Edward L. Crowther, Member for Queenborough, to know that his labours in connection reached Messrs. Cooke and Son, Pioneer Box Factory, Sacramento, and these gentlemen having noticed the name of Mr. Joseph Cronly, Sandy Bay, as an indefatigable student of the history of the moth, and one of its most determined exterminators, wrote that gentleman a letter which he has placed at our disposal, and which, after stating how the Tasmanian work had come under their notice, and their reasons for addressing bim, proceeds thus :—" As we are interested in investigations of this pest of the orchards, we take the liberty of writing you personally as we have written the Australazian. Our orchards in Central California have been in many cases nearly destroyed by the peet in 1877, and 1878. We may state to you that we are not fruit growers, but are extensively engaged in the business of box-making, our fruit box sales amounting to 60,000 dollars annually. Our business was threatened with serious damage by the spread of the pest are supplied by nature with a spinnere, by which it can lower itself

The letter speaks for itself. The only regret is that some of the wash was not sent with it. There would have been a saving of a season. We have no doubt that Messrs. Cooke and Son will be as liberal in Tasmania as in Victoria, and that Mr. Cronly will be glad to forward any requests for a trial of the wash.

THE CODLIN MOTH.

TO THE EDITOR OF THE MERCURY.

I HOPE you will allow me space in your widely circulated paper for a few remarks on the codlin moth, which I think might interest many Tasmanian people. This pest is now in the full enjoyment of the destruction of our best fruit. One-third of the apples in many gardens in Sandy Bay at the present time destruction of our best fruit. One-third of the apples in many gardens in Sandy Bay at the present time are only fit for the pig-trough, and should not be allowed to remain on the trees, for by doing so they hasten the destruction of our whole fruit crop. The grubs commenced to leave their winter quarters about the middle of November, in the shape of a small, light-coloured moth. By the middle of December some of those moths were well grown, and they could be seen in hundreds flying about many gardens in Sandy Bay. On the 16th December I saw the first affected apple; it was a well-grown American crow's cgg; and since then there has been dreadful destruction amongst our fruit by the moth. It is to be hoped the Government will take steps to stamp out this pest. I believe it can be done, at all events in the South, as it is as yet only in a nut-shell as it were. Last season I had fruit from several gardens in the neighbourhood of the Brickfields. Lansdowne Crescent, and the top of Macquarie-street : the moth had not reached those of the Brickfields, Lansdowne Crescent, and the top of Macquarie-street; the moth had not reached those places at that time; in fact, it is as yet confined to a part of the city and a part of Sandy Bay. The moth, the grub, and their work of destruction, are as yet unknown to many of our large fruit-growers, and those men should be thankful, yet use every exertion to prevent its spreading, for prevention is better than cure. I do not think the grub has left any of the apples yet, and this is the time to grapple with the evil. I think I shall be able to show from good authority that if the affected apples were carefully gathered and destroyed in Longary. Follower, and March it would go for the varied current this prest altogether. I do not think the grub has left any of the apples yet, and time is the time to graph. think I shall be able to show from good authority that if the affected apples were carefully gathered and destroyed in January, February, and March, it would go far towards stamping out this pest altogether. All authorities agree that the moth is short-lived. M'Intosh, in his book of the garden, says on this subject:—" The codlin moth has been a sad pest to the American orchardists; and by Downing is said to have been introduced to that land of apples from Europe. It appears in the early worm-caten apples and pears in the form of a reddish-white grub, and causes the fruit to fall prematurely from the trees; it is equally destructive in Europe, and is very generally distributed; perhaps there is no garden where its appearance has not been recognised." The following description of it is from Kellar's work on insects, translated from the German by J. and M. Loudon :—" This moth is to be seen in the evening, usually in the beginning of May, on the apple and pear trees, busily depositing its egg. In favourable weather the little grubs are hatched in a few days, so that in May apples and pears are found infested with them. At first the grub is white, a black head and collar, and slanting double dots, which run in four rows from the head to the abdomen ; it afterwards becomes more of a fleshy colour, the head and collar turning brown, the dots gray and indistinct. It is fully grown in three or four weeks, as its food never fails. It now head to the abdomen; it afterwards becomes more of a fleshy colour, the head and collar turning brown, the dots gray and indistinct. It is fully grown in three or four weeks, as its food never fails. It now leaves the fruit, whether it is still hanging on the tree or has fallen off, and selects for itself a secure place on the stem of the tree to spin its cocoon and become a pupa. It usually chooses the rents and seams of the loose bark, hollows itself out a chamber, and spins a white web over itself, intermixing some of the loose bark with it. The little grub becomes a pupa immediately in the web, and in a few days the moth comes out, and shortly afterwards deposits eggs on the fruit. In this way, in July and August, and part of Sentember much sound fruit will argin be piezed and infected with the caterpillar of this moth, which of September, much sound fruit will again be pierced and infected with the caterpillar of this moth, which is then numerous, according to the number of eggs of the first generation which were laid and hatched in May." Again, Sir, Messrs. Cooke and Sons' pamphlet, paragraph No. 8, says:—"The eggs deposited by the early moth become moths, which lay eggs for a second generation, and those for a third, which will arrive at perfection by the middle of August."

All authorities agree that there are two, if not three, generations in one season, and that when each generation has deposited its number of eggs for the new generation it dies, leaving the work of destruction to the new generation, showing that we have but one generation to contend with at one and the same time. They are always open to destruction, and never more so than at the present time. The grub is now in the They are always open to destruction, and never more so than at the present time. The grub is now in the apples on the trees staring us in the face. It may be asked, how are we to come at them? I say by many means. Take the affected apples off and put them in into a tub of water; this will quickly destroy the grub. Then compel every man to keep his affected apples gathered carefully off his trees. If this does not work, let our Government employ labour to do so. I believe twenty boys in this and the next two months would gather every affected apple on this side of the island; I will not attempt to make any calculation for the North. To meet this expense put on, say, one penny per bushel on all fruit coming into market. I believe this would cover the expense twice over. When in the moth state I believe the sparrows will give valuable assistance; I have frequently seen them in numbers amongst the apple and currant trees, and amongst the potatoes, where the moth shelters by day. I have often at dusk killed scores of these moths with a long strip of paling. I have tried naked lights, I believe they are useful, but they require more attention than I could give them.

15th January, 1880.

Yours, &c. J. CRONLY.

CODLIN MOTH.

EXTRACT from DR. PACKARD'S "Report on Insects injuring the Apple," p. 794 of "Report United States Geological Survey, 1875."

THE CODLIN MOTH, Carpocapsa pomonella, Linn. (Plate LXIX, Fig. 9.)—Eating holes in apples, causing them to fall prematurely; a small flesh-coloured worm, transforming into a small grey moth.

This moth, which is such a universal pest in the Eastern States, has for five years past, Mr. Barfort tells me, been injurious to the apples in Salt Lake City. Indeed, it is the only considerable pest of the apple in the Territory, but one that attracts a good deal of attention. Mr. Henry Edwards, of San Francisco, writes me that it has not yet occurred in California.

Sir,

The moth lays usually one egg on the blossom end of the fruit early in summer, and the caterpillar hatches in a few days, burrowing directly into the core of the forming fruit. It attains its full size, becoming fully fed, in about three weeks, when the apple drops to the ground, and the larva transforms in a thin or sometimes quite thick cocoon in crevices in the bark of the tree, &c., and in a few days after another brood of moths appear, though most of them, as I have found in Maine, remain in their cocoons through the winter in the caterpillar state. In this condition I have found them under the loosened bark early in May. Many of the worms, Dr. Le Barm, in his Illinois report, says one-half, instead of waiting for the immature apples to fall, desert the apple and let themselves down by the web or walk down the trunk of the trees. The moth is grey, with numerous darker, transverse lines, and with a curved black line before the ocellated patch on the inner angle, which line is edged with a coppery tint. Plate LXIX, Fig. 9, represents the caterpillar, with the worm-eaten apple, the cocoon (i), and the chrysalis and moth.

Remedies.—This troublesome pest may be partially destroyed by gathering the "windfalls," though the larva often deserts the worm-eaten apples before it falls. The best remedy is that suggested by Dr. Trimble, who binds bands of hay about the trees from July until the middle of September. The larvæ crawl under these bands and there spin their silken coccons, when every fortnight the bands can be removed and the worms destroyed. Dr. Le Barm recommends for Northern Illinois that the bandages be in place a month after the blooming of the trees; that they be examined seven weeks after the falling of the blossoms; that three subsequent examinations be made at intervals of twelve days, and a final one after the leaves of the tree have fallen. In the latitude of Saint Louis, Mr. Riley suggests that the first examination be made not later than six weeks after the falling of the blossoms; and that four subsequent examinations, at intervals of twelve days, be made between it and the final one in the autumn when the apples are gathered.

THE CODLIN MOTH.

EXTRACT from Messrs. COOKE & SON'S pamphlet on the "Natural History and Habits of the Codlin Moth."

"The Codlin Moth is now one of the permanent institutions of the State, and fruit growing, or at least apple and pear growing, have been rendered very unsatisfactory and uncertain."—Sacramento Record Union.

To the Fruit Growers of California and all whom it may concern:

It is unnecessary for our purpose to detail the amount of damage done the apple, pear, and quince crop of central California since 1874, by the insect pest known as the *Codlin* or *Apple Moth*, as unfortunately it is too well known.

In June, 1877, we commenced our investigations to obtain reliable information of the natural history and habits of this pest of the orchard, and respectfully submit the result.

The moth belongs to the family Tortrices, the worm the larva of the Carpocapsa pomonella (the Codlin or Apple Moth). The moth passes the winter in the larva state, and, in some instances in the chrysalis form. The larva can be found under the loose bark, in the crotches or indents or cracks, in the bark of trees affected the previous year. The larva found in apples, pears, and quinces are the same species.

The Codlin or Apple Moth passes the Winter in the larva state generally, but in some cases in the chrysalis form, can be found in nests made on inside of the loose bark, in the crotches or indents or cracks in the bark of apple, pear, and quince trees, which have been affected by this pest the previous season. They apparently prefer the quince and soft-barked apple trees to any other for Winter quarters.

NOTE.-We have found four hundred larvæ on one quince tree, two hundred on one apple tree, and could only find from three to six larvæ on pear trees in the same orchard. The crop of all, we may say, was destroyed the previous season.

If the Spring is warm and favourable, the larvæ are ready to assume the pupa or chrysalis form by the 15th of April. The duration of the pupa or chrysalis state depends on external circumstances. If warm Spring weather, the perfect insect may appear in from fifteen to twenty days, and may be prolonged to twenty or thirty days.

Note.—In an orchard near this city we found a number of chrysalids of this moth on a small smooth-barked apple tree. Nests were close to the ground. The tree was located in a warm spot. They apparently passed the Winter as chrysalids. We found them on the 30th day of March We placed them under glass and applied artificial heat. Transformation in one case took place on April 5th, and in all before April 11th.

FIRST APPEARANCE OF THE MOTH.

The moth generally appears from the 1st to 20th of May; a few in favourable locations by April 25th. The time at which the eggs arrive at maturity apparently coincides with the end or termination of the pupa or chrysalis state, so that the sexes are ready to unite soon after transformation.

The moth deposits the egg generally in the blossom end of the fruit, but sometimes on any part (the latter especially late in the season). The eggs are attached to the fruit by a pasty substance. It is our opinion that at the time the egg is deposited the skin of the fruit is punctured, making easy entrance for the larva. It is rare to find more than one egg on any apple, pear, or quince, or more than one larva.

The larva is hatched in from nine to twelve days, and begins to eat eagerly and burrow towards the *carpellary ovarium*, or core containing the seeds.

The larva when hatched can scarcely be seen with the naked eye; at six days, measures nearly one quarter of an inch in length, about as thick as fine silk thread. (1st), first signs of excrement at burrow; at ten days, three-eighths of an inch, and about as thick as No. 20 wire. It has burrowed by this time about three-fourths of the distance to the seed bag of fruit; at twenty days, nearly full natural size.

When the larva is ready to assume the pupa or chrysalis form, it leaves the fruit by gnawing a hole through the pericarp. Nature has supplied it with a spinneret, the opening apparently in the lower lip, from which issues a viscid fluid in a fine stream, and hardens into silk on contact with the air. By this means it lowers itself to the ground or intervening branches. If it reaches the ground it immediately crawls toward the tree, and on its journey can often be seen. On reaching the tree, it searches for a nesting place under the loose bark in the crotches, or any cavity it can find. If it comes in contact with a branch when leaving fruit, it generally crawls toward the crotches, or until it reaches a hiding place. If under the loose bark it commences building an oval-shaped wall, about one sixteenth of an inch high, composed of the viscid fluid from spinneret, and sometimes mixed with pieces gnawed off the bark; the cover is then put on the nest by using spinneret; the whole completed in twenty-four hours. If in a crevice of the bark the nest is made in different shapes. It is noticeable in the Winter nest the tops and sides are washed with fluid from spinneret, making the nest waterproof to a great extent.

The moth remains in the pupa or chrysalis form from nine to twelve days in our usual May weather. At the proper time the pupa case is burst open and the perfect moth appears.

It may be asked, How does the moth get out of the nest so neatly made, &c.? By some freak of nature about twenty-four hours before transformation the pupa is forced through one end of the nest, so that the perfect insect can easily escape.

The chrysalids of this moth are capable of moving lively at any time, from the time they assume the chrysalis or pupa form until the insect escapes perfect.

PROBABLE RATE OF INCREASE OF THESE MOTHS.

Entomologists claim that of the lepidopterous insects, including butterflies and moths, nearly one thousand kinds are known in the United States. That each female lays from 200 to 500 eggs. Taking 200 as the lowest number, twelve female moths in one orchard would produce 2400 caterpillars; if one half these were females, they would produce 240,000. In proportion the third generation would reach 24,000,000.

From the observations stated we are led to believe that the destruction of this pest must be consummated while it is in the caterpillar state.

A REMEDY FOUND.

With the assistance of David M. Dunne, Esq., of the firm of Messrs. Hutchings & Co., Phœnix Oil Works, San Francisco, a concentrated wash was produced, consisting of whale oil soap, sulphur, &c., which will destroy the larva or chrysalids of this pest. It has been practically tested on an extensive scale. Result easily described. It kills the larva, improves the tree, and the cost is only nominal.

We will mention here that we are under obligation to Mr. John Cox, of Sutterville, and Mr. T. B. Flint, of Riverside, both places in Sacramento County, and also to Mr. George D. Kellogg, of Newcastle, Placer County, for assisting us in every manner they could in making the experiments, which have proved successful.

We will say frankly to fruit growers, where orchards are affected by this pest, to clean your orchards will take time and labour. It will also take the nnited action of all fruit growers in each neighbourhood. No effort should be spared, as each year the pest will be spreading further and become more numerous. You can rest assured, that from the experiments tried by a few, the returns received were equal to five hundred per cent. on the outlay. What better investment could be wished for?

HOW TO PREPARE THE WASH.

Take ten pounds of the concentrated wash and put in a barrel; on this pour two gallons of boiling water, which will form a thick suds; to this add eight gallons of cold water; stir and let stand twelve hours (the longer the better; should be stirred occasionally.) The wash is then ready for use. (One pound of codlin moth mixture to each gallon of water.)

PREPARING THE TREES.

Immediately after the fall of the leaves, provide some small ship scrapers and grind two of the edges in circles so that they will be near to the circles of the trees. Scrapers length of side four inches, will be large enough. Use handles to suit. Procure a cloth made of old sacks or any material convenient, spread on ground around the tree as far as the scrapings are likely to spread; then commence on the tree as far up as there is any rough loose bark, and scrape it carefully off. Also examine and scrape all crevices in the bark or those formed in the crotches of the tree. Continue scraping until you reach the ground. This done, gather the scrapings carefully off the cloth, so that they can be burned or destroyed.

Be careful that you do not neglect gathering carefully the scrapings and destroying them, as on this point depends a great deal of your success.

We have been informed by fruit growers that they have found the larva in store rooms, boxes, &c., in the Winter season. During the last two winters we have made very careful examinations of the fences, shrubbery and packing houses in some orchards, but failed to detect any larva of the Codlin Moth. However, careful search should be made and any suspicious places washed with the above solution.

FURTHER PRECAUTION.

Take a piece of common straw wrapping paper, say twenty-four inches long and ten or twelve inches wide, double it lengthwise (this will be sufficiently long for a tree seven inches in diameter—larger trees will require longer bands, in one or more pieces), and put around the tree a few inches above the ground; fasten it with a piece of wire or narrow strip of tin—either of them is preferable to cord, as they can be pressed into the dents on the surface of the tree. The larva creeping up the tree, makes its nest in the paper. These papers should be examined every eighth day, the larva collected and destroyed. Paper or rags laid on the ground around the tree will answer the same purpose, but may not be so easily examined. We would also recommend that some paper or rags should be placed in the crotches of the tree so as to entrap any larva coming down the branches looking for a nesting place.

We have positive proof that the larvæ will not nest on any part of a tree that has been washed with this solution. Where trees have been washed, they have ascended and nested around the stems of the fruit hanging on tree; therefore the utility of providing traps for them.

The paper bands have been in use for some time by parties in this neighbourhood, and are reported as having done good service in the Eastern States.

ANOTHER PLAN FOR DESTROYING THE PEST.

When Mr. Charles W. Reed, proprietor of Washington Orchard, Yolo County, returned from the East last Spring, it was too late in the season to wash his extensive orchard, and only a small portion of it was done. However, he was determined to make an effort to clear his orchard of the pest. He purchased three hundred hogs and put them in his orchard. He employed men to pick all fruit off his trees showing signs of the larva. The hogs followed the men from tree to tree and picked up the fruit as it was thrown down. This operation was often repeated, so that the early broods were nearly destroyed. Result: Mr. Reed shipped twenty-two car loads of fruit East this year against five last year. This plan is expensive, but it is a first-class remedy.

Some other fruit growers having large orchards had the fruit showing signs of larva picked off and destroyed.

Any means taken to destroy the early broods will prevent the late fruit from being destroyed.

The work of exterminating this pest should be the united action of all fruit growers having orchards affected by this pest. It matters not whether the orchards cover large or small tracts of land—only united action will win the fight. In proof of this, we will mention one instance. We know of an orchard owned by Mr. A. that was properly cleaned this last Spring, and the early crop saved from the ravages of this pest. Adjoining was an orchard owned by Mr. B., neglected in every way, early and late crops destroyed. Mr. A. had in his orchard about four hundred boxes of Winter Nellis pears. During the last twenty days of September three-fourths of them have been destroyed by this pest. Query : Where did they come from ? We will answer, without fear of contradiction, from Mr. B.'s orchard.

To the enterprising and industrious fruit growers of California: Permit us once more to warn you of the danger that threatens the products of your beautiful orchards. Organise a State society; make every effort in your power during the next two months to secure united action in your respective neighbourhoods, for the purpose of exterminating the insect pest known as the Codlin or Apple Moth. If this fails, apply to the Legislature, which meets next January, and get a Bill passed requiring every owner, lessee, renter, or occupant of lands on which there is planted or growing any apple, pear, or quince trees, to uncaterpillar them by picking off and destroying, as prescribed in Bill, all fruit affected or showing signs of larva. Also, attaching penalties, &c.

The above may be considered a harsh recommendation, but what we know of the natural history and habits of this pest makes such a recommendation necessary.

We respectfully refer you to a sentence in the letter of Mr. Cronly to the Tasmanian Committee, which we will repeat: "Now, these are the kind of men the industrious fruit grower seeks protection against."

We are sorry to say, but it is nevertheless a fact, that there are many such men in central California as there referred to by Mr. Cronly. Our experiments have brought us in contact with them. They will freely criticise all experiments made by others, but will be remarkably careful they will not try any themselves; and all the knowledge they claim to possess, their neighbour dare not know it. This class of men should be forced by the strong arm of the law to do their share in work that is a public necessity.

HOW TO EXAMINE THE TREES TO FIND LARVA.

Open the large blade of pocket-knife and take off carefully the pieces of loose bark; examine inside part, and if the larva is there you will find nest. On removing cover off nest it will either contain larva or chrysalis. All crevices and dents in the bark, and crotches, should be examined carefully. Some persons throw the bark away before examining it, thinking the nest is on the tree. This is a mistake.

HOW TO PROCURE SPECIMENS OF THE MOTH.

When you find the larva, if it is not on the loose bark, remove the piece of bark to which it is attached, place it in a small vial, and, if in the summer time, inside of twelve days you will have a genuine specimen of the moth. Fruit growers can get important information concerning the natural history and habits of the insect pests by experiments in this way.

BRIEF MENTION.

The theory that the moth deposited the egg on the fruit blossom, and that it remained there until the fruit was grown to natural size, is a mistake.

Supposing the moth matured from the winter larva on the first day of May, the first brood of the season would reach perfection by the 20th of June, and the second brood by the 12th of August. Those matured after the 20th of August deposit the egg that produces the larva and chrysalids for the next season.

Fruit growers should examine all boxes returned to their orchards. The pest has been spread over the country in return boxes from market, where they have been in contact with boxes containing wormy fruit. We have taken six larva from one bundle of empty boxes at S. V. R. R. depôt, being sent back to the mountain orchards of El Dorado County.

Of pear trees, from 12 to 16 inches diameter, fair height, one man washed 150 per day. One gallon of solution averaged four and one half trees. The Codlin Moth Wash is an excellent fertilizer for the tree, and produces a smooth bark.

The Codlin Moth Wash destroys aphis and all insect life that it reaches, on trees or vines. Grape growers should experiment by washing their young vines twice each year, as we think that it will free them from attacks of insect pests. R. B. Blowers, Esq., of Woodland, Yolo County, indorses this plan for grape vines.

We have received a package of sheep wash from the Standard Soap Company of San Francisco, which we will give a thorough trial and report its effect on the larva of this pest.

It is necessary where an examination is made of an orchard, to examine every tree carefully, of the apple, pear, and quince varieties.

We made an examination of a small orchard containing about 75 apple trees, some of them large trees. On 58 that we examined carefully, we found, all told, three larvæ; on the 59th we found thirty-five in less than fifteen minutes; on the balance we found only a few.

The moth deposits the eggs at night.

Part of the early fruit falls prematurely—when attacked by larva—but little of the late fruit falls before the larva escapes.

NOTE.—Since writing the above we found in a fruit packing room some larva in nests made in a package of paper.

Examine all boxes returned from market before taking into the orchard.

The Codlin Moth Wash can be bought in packages weighing from two pounds to two hundred and fifty pounds.

To be successful use every effort to destroy the spring brood of moths.

Fruit showing signs of larva should not be allowed to remain on the ground around the tree.

We have read statements by fruit growers that they have seen the codlin moth flying in large numbers. In our investigations we have not seen more than two at any one time.

The moth will live in glass seven (7) days.

The female moths deposit their brood of eggs within forty-eight hours.

The egg can be seen plainly by the naked eye.

The best time to see the moths at work is at dawn of day in the months of June and July.

We do not think the female moths can be decoyed from the trees by burning lights at night in orchard until all the eggs in the ovary are deposited.

In our experiments we found the female moths to be about forty per cent. of the number hatched.

Only united action of fruit growers will gain a complete victory over this pest.

Defer not your action—the time arrives as soon as the leaves fall.

AN ENTERPRISING FRUIT GROWER.

Mr. James B. Saul, of the Oak Shade Fruit Company, Davisville, Yolo County, read our pamphlet of January 6th, 1879. He called at our office and examined the larvæ, &c., we had collected. He had not observed any signs of this pest in his orchard. However, he set his men to work and examined every tree carefully, and to his surprise, two larvæ were found in one of his apple trees. Without wasting any time, war was declared against the pest. Washing done, early in the season paper bands were placed on the trees, and throughout the season examined every six days. He also prevailed upon his neighbours to take the same measures to fight the pest. Mr. Saul evidently believes the old proverb, "An ounce of prevention is better than a pound of cure."

JAMES BARNARD,

GOVERNMENT PRINTER, TASMANIA.